

# Pre-weaning pneumonia in cow-calf herds: Field investigations

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## Abstract

The risk factors associated with outbreaks of pneumonia in pre-weaned beef calves are not as well characterized as those associated with bovine respiratory disease in post-weaned calves. Therefore, the expertise of veterinarians is often called upon to investigate these outbreaks with the goal of identifying pertinent risk factors that may be avoided in subsequent years.

Field investigations of pre-weaning beef calf pneumonia cases should begin with a review of the facts surrounding the operation, their animals, and their management. Veterinarians should attempt to describe the outbreak in terms of the animals, their locations, and timing. Among the most critical items to determine are a workable case definition that differentiates an affected calf from a non-affected calf, and dates of illness onset.

When a good understanding of the various risk factors present in the outbreak is obtained, the calves and their environment should be examined to further add to the information set. Antemortem diagnostics should be considered only when there is a clear understanding of how the results will be used. In many cases, however, testing for the presence of bovine viral diarrhea virus persistently infected animals may be a worthy consideration. Significant risk factors for the herd's pre-weaning beef calf pneumonia problems may be determined simply from review of the information gained from the history and examination. Otherwise, simple calculations of incidence rates between calves in different risk factor categories, as well as risk ratios and construction of histograms, may be useful to help determine significant risk factors for the herd.

**Key words:** cow-calf, beef, pneumonia, risk factors

## Résumé

Les facteurs de risque associés aux flambées de pneumonie chez les veaux de boucherie présevrés ne sont pas aussi bien établis que ceux associés aux maladies respiratoires chez les veaux après le sevrage. Par conséquent, on fait donc souvent appel à l'expertise des vétérinaires pour examiner ces flambées dans le but d'identifier les facteurs de risque pertinents qui pourraient être prévenus les années suivantes.

Les études sur le terrain de la pneumonie chez les veaux présevrés devraient commencer par la revue des faits concernant l'entreprise, ses animaux et sa régie. Les vétérinaires devraient tenter de décrire la flambée sur une base individuelle tant au point de vue de la localisation des animaux que du moment. Parmi les éléments clés, il est important d'avoir une définition pratique qui permettra de différencier les veaux atteints des veaux non-atteints et d'établir la date du début de la maladie.

Lorsque les facteurs de risque présents lors de la flambée sont bien connus, il faut examiner les veaux et leur environnement afin d'ajouter aux connaissances. Un diagnostic ante-mortem ne devrait être considéré que dans les cas où l'utilisation des résultats est clair. Dans plusieurs cas, toutefois, il peut être souhaitable de tester pour la présence du virus de la diarrhée virale bovine chez les individus immunotolérants. Les facteurs de risque impliqués au niveau des problèmes de pneumonie chez les veaux présevrés d'un troupeau peuvent être simplement déterminés en considérant l'information recueillie lors de l'enquête et de l'examen. Autrement, le calcul de taux d'incidence pour les veaux dans différentes catégories de risque de même que des rapports de cote et des histogrammes peuvent être utiles pour déterminer les facteurs de risque qui sont importants dans le troupeau.

## Introduction

Cases of respiratory disease in pre-weaned beef calves raise many questions for veterinarians and their clients. While post-weaning pneumonia has been fairly well-characterized over the years, much less is known about risk factors contributing to respiratory disease in beef calves not yet weaned. As such, the expertise of veterinarians is often called upon to evaluate the factors that may contribute to such outbreaks. Field investigations of pre-weaned beef calf pneumonia can be valuable exercises in evaluating factors specific to a particular farm's outbreak.

## Putting out the Fire

In many instances, the veterinarian's first chance to become involved in cases of calf pneumonia is when

he or she is called upon to immediately intervene in the midst of an outbreak. Emphasis is placed upon identifying and treating sick calves. While important and necessary, the identification of the outbreak's causative factors usually takes a back seat to the more urgent matter of stopping the outbreak.

If attempts are not made to identify pertinent risk factors that contributed to the outbreak, it is possible that similar problems will occur in the future. But identification of those risk factors—especially for a condition as uncharacterized as pre-weaning calf pneumonia—takes patience, time, and effort on the part of the veterinarian and the cow-calf producer.

Despite this, practitioners should not miss the opportunity to perform field investigations for herds that have experienced pre-weaned beef calf pneumonia, with the eventual goal being formulation of recommendations to prevent outbreaks from occurring in the future.

This type of field investigation can be considered an epidemiologic investigation. Epidemiology has been defined as “the study of the distribution and determinants of disease in populations and the application of this information in the control of health problems.”<sup>2</sup> Descriptive epidemiology, then, deals with describing this distribution: “organizing and summarizing health-related data according to time, place, and person (or in this case, animals).”<sup>1</sup> In considering the approach to the field investigation of pre-weaning beef calf pneumonia, this definition is a good place to start.

### Kitchen Table Analysis

It is second nature for a veterinarian, in conducting a field investigation visit, to first want to dive head-on into the problem as defined by the client. Jumping out of the truck and starting to examine the affected animals is very tempting, and is oftentimes what the client expects. This approach, however, has the potential to lead the investigation in directions that may not be fruitful, especially when the veterinarian has an incomplete understanding of the animals involved, the timing of the illness, or the locations in which the illnesses occurred.

Therefore, the first place visited by the practitioner in a successful field pre-weaning calf pneumonia investigation should be the producer's kitchen table or his or her office. The practitioner should make written notes during this visit. Even when a long-standing veterinary-client-patient relationship exists, the veterinarian should not make assumptions about aspects of the outbreak. One should always strive for a complete understanding of the various attributes of the operation and the outbreak. Considering our first goal of describing the outbreak's epidemiology in terms of animal, place, and time, the following items should be discussed and recorded:

#### 1. The animals

- **Case definition.** On what basis is a sick calf identified as a sick calf? Oftentimes, this is determined by the cow-calf producer on the basis of clinical signs. The veterinarian should attempt to refine the definition of what constitutes a case of pre-weaning calf pneumonia in the herd in question. Typical clinical signs related to pneumonia in pre-weaned calves include increased respiratory rates, dyspnea, and cough, but can also include lethargy and droopy ears. A case definition that includes at least one of these signs should be developed and adhered to. In most situations it is impractical to make case definitions on the basis of individual calf examinations or rectal temperatures from each animal.

Because the goal of the investigation is to elucidate factors specific to pre-weaning beef calf pneumonia, calves that exclusively have signs of other diseases such as pinkeye or polyarthritis should be excluded from the list of affected calves. The risk factors associated with these conditions may not be the same as those associated with calves truly affected with pneumonia.

- **Number of affected animals and their locations.** Once a case definition has been agreed upon, the number of affected as well as non-affected calves should be recorded for each location in the operation. In a perfect world, the veterinarian would have complete treatment records for all affected calves in order to facilitate this. However, the investigator should understand that these records are unfortunately not always generated in field situations.
- **Animal data.** Pertinent information about the calves in the herd should be obtained as completely as possible. At a minimum, calf birth date and date of the onset of clinical signs should be recorded. Cow-calf operations typically have records of individual calf birth dates. In some cases, other calf-level information may be available, such as gender, age/parity of dam, whether calf had to be assisted during delivery, group ID (if animals are managed in distinct management groups), and dates of processing. If available, these should be recorded by the investigator as well. Incidence of other diseases such as calf scours may be of value in determining whether failure of passive transfer may be present in the group. A more extensive list of calf-level risk factors is presented in Appendix A.

## 2. Place

- **Physical layout of animal locations.** A map should be drawn and labeled identifying the locations of the pastures and pens that housed affected as well as unaffected animals. The number and location of physical structures (sheds, calf shelters, creep areas) should also be recorded. It may also be useful to chart the location of gathering areas such as water tanks, feeding areas, chutes or working areas. Animal populations adjacent to the animals of interest, such as cattle owned by neighbors or feedlot animals, should also be identified.

## 3. Time

- **Date of disease onset.** The most critical piece of temporal data to obtain is the date of onset of clinical signs of pneumonia for each affected calf. Many outbreaks of pre-weaning beef calf pneumonia begin as 1 or 2 ill calves that are identified and treated, and the producer may record or remember these first individual cases. However, as the outbreak expands, time constraints often preclude the producers' recording of calf identification and dates. To the extent possible, veterinarians should encourage producers to record the identification number of animals treated.
- **Other dates.** Dates for pertinent activities related to herd management and the outbreak should be determined and recorded. This includes dates for calving, group movements, processing, vaccinations, gathering for heat synchronization, artificial insemination, and so forth. Dates of introduction of other animals (cow/calf pairs, bred cows, replacement heifers, bulls, foster calves) should be recorded, along with the numbers and types of the new animals. Other events that may be pertinent include extraordinary weather events such as storms, blizzards, heavy rainfall, or heat spells. Such events may force animals to bunch or seek shelter in structures for prolonged periods of time.

Obtaining this information before any observation, while potentially tedious, is critical to the process of identifying risk factors. At this point of the investigation, a cursory observation of the information obtained may reveal associations of illness with events or certain locations that were not obvious to either producer or veterinarian at the outset.

## Boots on the Ground Observations

Next, the calves and their environments should be physically examined. Ideally, this examination should take place as soon as possible, in order to more closely match conditions present at the time of the outbreak. Once again, the evaluation can be broken into components of animal, place, and time.

### 1. The animals

The affected calves, as well as non-affected calves and other animals present in the operation, should be observed. It is often the case that there are no affected calves on the premises—having recovered from the outbreak—at the time of the visit. If sick calves are still on the premises, some of them should be examined by the practitioner to confirm the diagnosis of respiratory disease (through clinical signs, auscultation, or rectal temperatures). Calves that have recently died should be subjected to a necropsy examination. The necropsy examination should include an evaluation of all the organ systems of the calf rather than just the respiratory tract, in order to look for other causes of death.

Antemortem diagnostic samples from calves involved in outbreaks of pre-weaning respiratory disease do not always yield useful results. As with cattle affected with post-weaning respiratory disease, pneumonia-causing pathogens can be found in the respiratory tracts of normal animals.<sup>1</sup> A certain percentage of nasal swab samples from affected as well as non-affected calves can be expected to harbor potential pathogens such as *Mannheimia haemolytica*, *Histophilus somni*, *Pasteurella multocida*, and *Mycoplasma bovis*.

Pathogens obtained from deeper in the respiratory tract may be more representative of disease processes at the lung level. Techniques such as deep pharyngeal swabs, bronchoalveolar lavage, and transtracheal washes are technically more difficult to perform, but will normally yield results more relevant to lung pathology.<sup>3</sup>

Bovine viral diarrhea virus (BVDV) has the potential to suppress the immune system in infected animals. This immunosuppression can result in unexpected outbreaks of illnesses such as diarrhea and pneumonia in pre-weaned calves. Persistently infected (PI) calves are considered the reservoir for BVDV, and strategies to identify and remove PI calves should be considered in

herds that have experienced pre-weaning calf respiratory disease. These methods have been described elsewhere.<sup>4</sup> Importantly, cow-calf producers and veterinarians should understand that any test strategy short of detecting all potential PI animals in the population is at best a waste of time and resources, and at worst, a source of false security if PI animals remain in the herd following testing.

If antemortem diagnostics are to be pursued as a part of a field investigation, certain rules should be followed:

*Have a diagnostic plan in place.* Practitioners contemplating antemortem diagnostics in outbreaks of pre-weaning beef calf pneumonia should first ask themselves how the results of such testing will be used. If management and preventive programs will not change because of the results, the decision to undertake diagnostics is a questionable one. If the decision is made to proceed, veterinarians should consult with their diagnostic laboratory prior to taking samples to determine the specific procedures to request and sampling and shipping recommendations.

*Sample affected as well as non-affected calves.* This will allow a more likely attribution of the pathogen to the respiratory outbreak if it is primarily identified in affected calves rather than non-affected calves. Sampling more than 1 unaffected (“control”) calf per affected calf will usually result in a more favorable statistical outcome.

*Sample enough calves.* In most cases, veterinarians are left with “taking what they can get” when it comes to sampling calves. In other instances, sample size calculators (e.g. EpiTools, <http://epitools.ausvet.com.au>) may be consulted.

## 2. Place

Some specific aspects of the calf environment to examine include:

*Location and description of adjacent groups of cattle.* Where do pre-weaned calves have potential contact with cows and calves owned by neighbors? Is there a possibility of fenceline contact with weaned feeder or stocker calves, whether owned by this operator or by neighbors?

*Type and condition of structures accessible to pre-weaned calves and cows.* This includes calf shelters, open front or enclosed sheds, and windbreaks. Calf shelters designed to provide calves an area protected from winds and precipitation may also provide an opportunity for increased calf density and transmission of respiratory pathogens between animals, especially if they are shut up very tightly without adequate ventilation.

*Types, number, and condition of “gathering” spots such as feeding areas, water tanks, and stock ponds.*

## Making Sense of Your Findings

An investigation of pre-weaning beef calf pneumonia can potentially yield a large amount of data. A good first step in analyzing this data is to calculate some simple incidence rates of affected calves revolving around a single risk factor. Any risk factor, such as age of calf at illness onset, pasture group, incidence of dystocia at birth, and so forth, could be used. As an example, one could examine the influence of dam age on the incidence of pneumonia in their calves by calculating the incidence of sick calves in each dam age group. For example:

- 35 total calves were born to first-calf heifers, of which 10 calves became sick:  $10/35 = 29\%$
- 125 total calves were born to non-primiparous cows, 24 of which became sick:  $24/125 = 19\%$

Based on these calculations, calves born to heifers were more likely to become ill than calves from older dams. This is a risk factor that makes biological sense to be considered, because first-calf heifers would be expected to supply lower levels of colostral antibodies to their calves compared to older dams.

One could take this calculation further by calculating a risk ratio to determine the strength of the association.<sup>5</sup> To calculate a risk ratio, a 2x2 table can be constructed as follows (Table 1):

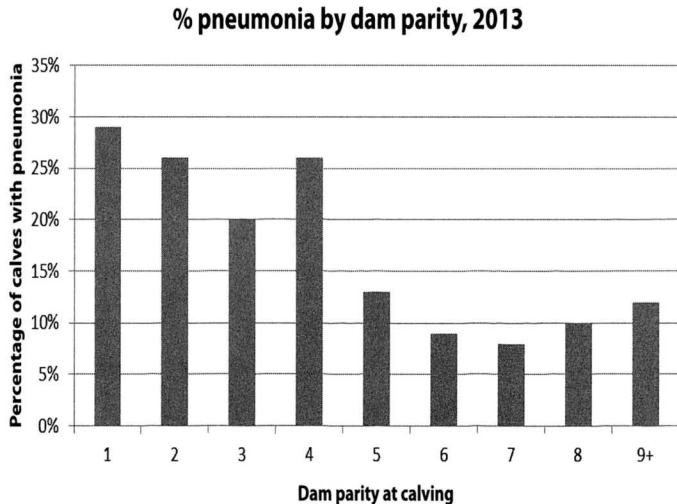
**Table 1.** 2x2 table for calculating risk ratio.

		Affected by pneumonia?		Totals
		Yes	No	
Calf's dam is a first-calf heifer?	Yes	10	25	35
	No	24	101	125
		34	126	160

The risk ratio is calculated as the rate of disease in the population exposed to the risk factor of interest (in this case the calves born to first-calf heifers) divided by the rate of disease in the population not exposed to the risk factor of interest. In this example, the relative risk is  $(10/35) \div (24/125) = .286 \div .192 = 1.49$ . Since the risk ratio is greater than 1.0, we conclude that the calves born to first-calf heifers were at a higher risk for becoming ill than calves from older dams. Furthermore, the strength of the association with the risk factor can be determined from this calculation: calves from first-calf heifers were about 1.5 times more likely to become sick. This may be a piece of information the producer can use in managing the herd in subsequent years to avoid outbreaks of pre-weaning beef calf pneumonia.

All of the other risk factors recorded can be analyzed in this fashion. Statistical significance of this association can be calculated with statistical software.<sup>5</sup> Of course, the usefulness of these calculations depends upon the quality of the data obtained in the field investigation.

In addition to these calculations, practitioners may find it useful to construct histograms that chart the number or percentage of animals across different levels of a risk factor. For example, a histogram that details the level of illness for each dam age group can be constructed (Figure 1). These may be extremely useful for visualizing the effect of certain risk factors.



**Figure 1.** Example of a histogram showing percentage of ill calves for each dam parity group.

## Conclusion

Pre-weaning beef calf respiratory disease is a condition that has not been well-characterized, presumably because of the many contributing factors. As such, field investigations by practitioners are extremely important in determining the risk factors important in the occurrence of this illness. Identification of these factors is critical in preventing future outbreaks as well as helping our profession gain a clearer overall understanding of the factors that contribute to this syndrome.

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## Appendix A. Potential risk factors to consider in field investigations of pre-weaning beef calf pneumonia outbreaks

### 1. Calf-level

- Birth date
- Birth weight (if available)
- Gender
- Breed
- Dam parity
- Dystocia encountered at birth?
- Colostrum consumption/absorption – fresh vs. frozen, use of colostrum replacers or supplements
- Date of diagnosis/treatment for respiratory disease
- Date of diagnosis/treatment for other disease
- Age of calf at onset of respiratory disease
- Group ID (if the operation manages different subgroups of cattle)
- Number of calves in the subgroup or total group
  - Is this calf's subgroup an age-segregated subgroup?

### 2. Herd-level

- Herd size
- Cow age profile - % heifers, etc.
- Calf vaccination program/timing
- Cow vaccination program/timing: pre-calving, pre-breeding
- Separation/gathering events
  - Estrus synchronization
  - Artificial insemination
  - Branding/castrating/other processing
  - Pasture moves, co-mingling events
- New herd introductions prior to outbreak (e.g., bulls, new cow-calf pairs): types, numbers, dates of entry
- Presence of feedlot/stocker animals in operation prior to outbreak
- Fenceline contact with weaned cattle
- Fenceline contact with neighboring herds

### 3. Environmental

- Calving area – pasture, calving lot, calving barn?
- Presence of calf shelters or sheds with calf access
- Precipitation events – amounts and timing
- Temperature – number and timing of extreme temperature events (heat, cold)
- Storms, other weather events