Bovine respiratory disease (BRD) is the most common and costly syndrome afflicting beef cattle after weaning. A basic understanding of the disease syndrome is important to design a treatment and prevention program. Many bacterial pathogens associated with BRD are normal flora that can be isolated from the upper respiratory tract of healthy cattle. Other disease syndromes relevant to the cow-calf farm including reproductive pathogens, may also be found in animals without clinical signs. Contributing factors such as animal immune status, pathogen load, organism virulence, and environmental conditions influence disease severity. Managing for a single disease causing agent or risk factor will not eliminate disease from the population. The complete animal management program must be evaluated to maintain hope of diminishing disease impact.

BRD diagnosis
Timely identification of clinically ill animals is critical because the best treatment protocol is ineffective if severe damage occurred prior to treatment. Recognition of disease is an art, not a science. The keys are systematic pen and animal appraisal, and diagnosis evaluation. Differentiation of specific diseases often depends on the epidemiology of the case presentation in the affected population.

Typical signs of respiratory disease include; anorexia, depression, animal isolation, increased respiratory rates, nasal discharge, coughing and diarrhea. A consistent method for evaluating pens and individuals within the group is important for accurate, timely identification of disease. Cattle are herd animals and considered prey in the predator-prey relationship of wild animals. In nature, predators feeding on the herd will pick out the weakest animals that may be easier to catch; therefore, the instinct for a sick calf is to blend in with the herd and not be found. Domesticated cattle have this instinct and try to avoid appearance of illness when possible.

A study of feedlot steers revealed that although only 35% of the animals were treated, 72% had pulmonary lesions present at slaughter. (Wittum, Woollen et al. 1996) The pulmonary lesions were directly associated with a significant reduction in ADG during the feeding period. One of the most remarkable findings of the study was that 68% of the untreated steers had pulmonary lesions. This indicates that visual evaluation was inadequate to prevent significant production losses attributable to respiratory tract disease. We should evaluate pens with these facts in mind. Walking or riding into the middle of the pen and trying to identify a sick animal is often fruitless unless the animals are very ill.

BRD prevention
Immunizations at arrival are commonly used for prevention of BRD. Products utilized often include viral antigens and may also include bacterial antigens. Research has illustrated differing levels of efficacy among specific antigens, and the veterinarian should have a realistic expectation of the risk reduction associated with vaccination at feedyard arrival.

Population-level BRD treatment and prevention strategies may most efficiently be employed soon after cattle arrive to the stocker or feeder operation; however, utilization of these tools is based on an accurate estimation of the population risk for BRD. Immediately prior to and after feeding is a good time to evaluate a pen for clinical illness. Animals exhibiting anorexia can be identified and animal movement toward the bunk can be used to assess locomotion or potential signs of lameness. All individuals within the pen should be viewed to assess for potential signs of illness.

BRD Risk profiling
Individual pens need to be managed differently based on cattle type and length of time they have been on the farm. Appropriate labor should be allocated to ensure adequate evaluation of cattle in the highest risk category and time frame. Risk categories are based on several factors that influence overall risk for morbidity and mortality including: distance traveled, age, weight, gender, and previous vaccination status of the cattle. Cattle that arrived in the last 2-3 weeks are at highest disease risk and these cattle may need more frequent observations. Treatment records and necropsy results also dictate pens needing a concentrated effort.

Summary
Operations differ significantly in management techniques and health programs. Critical control points should be identified for each farm and used to ascertain the biggest areas for potential improvement to allow proper allocation of resources. A customized wellness program couples medicine and management to minimize the negative impact of disease.

References / Suggested reading
Clinical diagnosis is one of the most common and important tasks completed daily by veterinarians. Adding value to client herds through diagnostic tests is common, and test results should be interpreted considering expected disease prevalence and economic consequences. The value of adding new diagnostic methods to the existing system is dependent on the characteristics of the current diagnostic test as well as the expected change in specificity and sensitivity with the addition of the new assessment methodology.

**Clinical decision process**

The clinical decision process often utilizes diagnostic tests as a method to generate information for determining treatment and management plans. Diagnostic tests are often evaluated in terms of sensitivity and specificity which is a useful starting place, but clinical decisions based on test results should also be influenced by expected positive and negative predictive value of the test. The positive and negative predictive values of a diagnostic test are influenced by test sensitivity, test specificity, and prevalence of the disease (or predicted probability that an individual animal or herd has the disease). The positive predictive value provides a probability that the positive test is truly positive, and conversely the negative predictive value provides a likelihood that a negative test animal is truly negative. Often the practitioner may choose to believe one side of the test (example: a test with high positive predictive value that is positive is likely true; while the same test with a low negative predictive value that is negative may not be accurate). Using the negative and positive predictive values allows veterinarians to incorporate clinical judgement in the test evaluation process and quantify the effect that changes in disease prevalence could have on test or case outcome.

Additionally, the economic consequences of misdiagnosis (false positive or false negative) is often not equally distributed and the optimal solution may be influenced by the expected economic consequences. The economic consequences of misdiagnosis may even vary by the expected prevalence (as this drives the overall rate of misdiagnosis in each category). Thus, the decision to retest or further evaluate test positive/negative animals is based on the expected consequences of an incorrect classification (false positive / false negative) vs. the expected cost of accurate diagnosis (true positive / true negative). Several online and decision tools are available for practitioners to calculated the expected positive and negative predictive values as well as the expected economic consequences of disease.

**Summary**

Clinical diagnosis is a key daily task for veterinary practitioners and using specific criteria for evaluating test results in differing situations can provide increased overall clinical diagnostic accuracy. Decisions often need to be made with imperfect information, but a framework can be developed to guide the process by including the known characteristics of the diagnostic modality, the expected prevalence (or predicted probability) of disease, and the economic consequences of misdiagnosis (false positive and false negative). Using this framework, clinical decisions can be augmented and improved over time as new information is collected.

**References**


Key points

- Monitoring reproductive success is an important service to cow-calf clients and visualizing the reproductive history of the herd can be a useful methodology to monitor progress.
- Graphing the calf birth rate by 21-day period over the calving season provides valuable information when diagnosing reproductive problems, evaluating herd economic performance, and optimizing breeding program success.

Evaluation of reproductive success in the cow-calf herd

Reproductive success is a key component of the successful cow-calf herd. Reproductive parameters should be evaluated in light of the herd’s production constraints and overall goals. To identify areas for improvement, veterinarians can compare numbers from the herd of interest to standard production targets. The goal is to create a reproductive profile of the herd which contains information regarding the breeding season, maintenance of pregnancy, calving patterns, and the weaning percentages. A key statistic to evaluate is the number (or percent) of calves weaned per female exposed to the bull in the previous breeding season. Our common target for this number is approximately 85-88%. If the herd is below this number, then further investigations should be initiated to determine potential causes of reproductive loss.

Our goal for pregnancy rate after a 60 day breeding season is 95% or greater; while, we may not recommend an intervention or actions unless the pregnancy rate drops below 85%. It is important to realize that pregnancy rates will fluctuate some on an annual basis and may vary based on the age of the cow herd and the current nutritional status. If pregnancy rates are lower than expected, this indicates potential reproductive problems; however, this value does not indicate where the problem is occurring. Typically reproductive problems can be divided into three major areas: female problems (cows not cycling, cows in poor body condition), male problems (bulls with traumatic injuries, bull infertility), or infectious reproductive diseases (viral or bacterial). To assist the herd in overcoming reproductive issues, it is important to utilize the herd reproductive profile to narrow down the potential issues for evaluation.

Front end loading is important to maintain a 365-day calving interval with the majority of the cow herd. By managing average herd age, body condition score, and calving time frame, a producer can keep cows calving on a 365-day or less calving interval. This enhances lifetime productivity of the cow herd and increases economic results to the producer. While the average length of post-partum anestrus is around 60 d, this is variable among herds and in individual cows within the herd. The 90th percentile for length of post-partum anestrus (or number of days at which 90% of the herd would be expected to be cycling) is almost 80 days (or near the maximum days so that a cow can breed back and calve every 365 days. Any problems can cause cows to experience longer post-partum anestrus periods.

Evaluation of the length of the breeding season and distribution of calves born within the calving season can be a valuable diagnostic tool for the cow-calf practitioner. Ideally, we will have 60-65% of cows calve in the first 21 days of the calving season. Another 25% will calve in the second 21-day period followed by 10% of the herd calving in the last 21 day period. This leaves 5% open at the end of a 60 day breeding season. Some breeding seasons may be longer, but a rule of thumb is that in cycling females, we’d expect about 2/3 (66%) of eligible females to conceive during each 21 day period.

Modifications to this ideal calving pattern (either increases in length or changes in distribution) may result from changes in management or disease problems. These patterns may be indicative of specific problems and are useful to narrow the differential list into more discrete categories (e.g. failure to conceive, male problems, pregnancy loss). Using the pregnancy histogram as a diagnostic tool provides the practitioner a cost efficient method of generating a prioritized differential diagnosis list.

Summary

Reproductive success is critical to the beef cow-calf herd and the veterinarian plays an important role in identifying problems in this area. Using the histograms describing the calving pattern can be useful to help herds optimize production as well as diagnosing potential problems when reproductive rates are less than ideal.

References

Adding value to client operations is a key component of many veterinary practices. Practitioners strive to provide the best information to clients in a timely fashion. Often data are collected in the field and require some interpretation to provide useful information to clients. Several tools exist to help in this process. Each client also has somewhat unique situations or restrictions which may limit their ability to control disease: online portals are available to assist veterinarians in providing decision support and customized recommendations for their clients. Veterinarians have several opportunities to add value to client herds by using online tools and providing additional information.

**Mobile apps**
Mobile applications allow field data collection and interpretation for practitioners. The advantage of having the data present on phone or portable tablet is that immediate feedback can be provided to the client. Several mobile apps exist that can be useful for practitioners including a pregnancy analysis app.

Optimal pre-weaning calf health starts with the planned breeding season. Creating a well-defined, relatively short calving season leads to groups of calves that are more manageable from a health standpoint because they are at similar age / immunological states. The risk of disease changes with calf age and in a herd with a prolonged calving season managing these risks becomes problematic. A short calving season allows more efficient of grouping calves by age to manage risk status. Tightly grouping calves by age also allows the ability to apply interventions, such as vaccinations, at an appropriate time period to the greatest number of calves. In this case, the production goal of a tight calving season with most calves born early in the season, aligns well with the health management goal of preventing disease in pre-weaned calves. The timing of the breeding season should be planned to match resource availability allowing cows to breed back in a reasonable period and maintain annual calving.

**Online CONSULTs**
The CONSULT (Collaborative, Online, Novel, Science-based, User-friendly, Learning Tools) system has created several modules to help practitioners work through recommendations with their clients. Each tool is built using expertise combined with published literature to generate a series of recommendations for specific diseases and different situations. The CONSULTs model a phone call between a producer and an expert on the specific disease or syndrome: the CONSULT provides a recommendation and the producer can select if they can follow the recommendation or not. The selection by the producer then influences subsequent recommendations. Final results include a customized series of recommendations for each farm.

Initial consults have been created for Trichomoniasis and Bovine Viral Diarrhea:

- [http://www.trichconsult.org/](http://www.trichconsult.org/)

Working through the CONSULTs with clients can facilitate communication on effective disease control measures for specific syndromes on each operation.

**Summary**
Several mobile apps and online tools are present to help practitioners add value to client herds through decision process. Practitioners can apply these tools using field data collection and provide immediate feedback to enhance client communication.
In many situations, the infrastructure of the beef industry limits the ability to prevent BRD before it occurs and health care providers must work on managing BRD cases to limit potential outbreaks. Optimal BRD management is based on accurate diagnosis and timely application of appropriate therapy. The BRD management plan can be evaluated based on case outcomes, but these outcomes need to be evaluated over time to determine potential changes in treatment protocols.

**Diagnosis of BRD**

Therapeutic response is influenced by the timing and accuracy of BRD diagnosis. The most common method for diagnosis is based on visual appraisal of animal clinical signs, and this method has been shown to have relatively low diagnostic accuracy. Cattle illustrate behavioral changes associated with illness, but some of these behavioral changes may be difficult to identify early in the disease process. Finding diseased cattle early in the process is an important aspect of applying appropriate therapeutic regime.

Making sure that cattle initially identified as ill are truly diseased is also an important part of the diagnostic process. Research has shown that improving the specificity of BRD diagnosis is economically viable in the feedyard setting. BRD diagnostic specificity can be improved by applying multiple tests in series and modifying the case definition as appropriate. Commonly measured parameters, such as rectal temperature, may provide some information, but the ability to predict case outcome is limited. However, incorporating additional information regarding the case (clinical illness score, case history, etc) may be useful in generating more accurate predictions of case outcomes. Care should be taken to create a consistent case definition to allow appropriate application of therapeutic products and evaluate case outcomes.

**Population therapeutics**

Population-level BRD treatment and prevention strategies may most efficiently be employed soon after cattle arrive to the stocker or feeder operation; however, utilization of these tools is based on an accurate estimation of the population risk for BRD. The population risk for BRD can be estimated based on a combination of subjective and objective variables including: historical records, previous history of vaccinations or preconditioning, implementation of management procedures such as castration, arrival weight of calves, the distance traveled to the feedyard. However, this baseline data may not predict the exact risk of the population, but can serve as a guideline of when to implement treatment at arrival.

Metaphylaxis has been shown to decrease the overall morbidity risk compared to negative controls, and the rule of thumb estimate is to expect a 50% reduction in morbidity and mortality compared to non-treated controls. However, research has illustrated that the impact of metaphylaxis varies by the type of protocol selected and the specific outcome of interest. Several factors should be evaluated to determine the appropriate situations to apply metaphylaxis to incoming cattle.

**Summary**

Bovine respiratory disease is the major illness encountered by calves in the post-weaning production phase and appropriate therapy is dependent on accurate diagnosis. A case definition with accompanying management strategy should be designed for each situation. Evaluation of case outcomes can be used modify and improve the diagnostic and therapeutic strategies in specific situations.

**References / Suggested reading**


Key points
- Calf wellness prior to weaning requires a systematic approach to reducing disease challenge and building calf immunity.
- The herd calving pattern influences the ability to prevent and control pre-weaning disease.
- Some diseases (e.g. calf scours) are best controlled by managing pathogen exposure.
- Building and managing immunity is important for controlling some syndromes (e.g. bovine respiratory disease).
- Combining knowledge of disease and management factors can facilitate building complete preventative health plan.

Introduction
Pre-weaning disease in beef calves can cause significant problems in cow-calf herds. Several diseases are relatively common (e.g. calf scours and bovine respiratory disease, BRD), but these syndromes do not impact all herds equally. While some disease may be present at a low level in many herds, other herds may deal with outbreaks of disease in pre-weaning calves. The objective of this presentation is to describe best practices for preparing a preventative health program with the goal of optimizing calf health prior to weaning.

Optimizing health management includes managing both the disease challenge and the level of immunity in pre-weaned calves. The specific disease syndrome and epidemiology of risk factors influence where focus should be placed for the preventative health management program. The herd health program can be customized to individual operations to decrease the disease presence in the herd.

Calving management
Optimal pre-weaning calf health starts with the planned breeding season. The calving season in the current year is highly influenced by the previous calving season as post-partum interval influences potential rebreeding times. In other words, herds have reproductive momentum and the calving pattern and length of season tends to be similar year to year unless actions are taken to modify this pattern. Herds can have a negative or positive momentum and this can influence the risk of disease.

Creating a well-defined, relatively short calving season leads to groups of calves that are more manageable from a health standpoint because they are at similar age / immunological states. The risk of disease changes with calf age and in a herd with a prolonged calving season managing these risks becomes problematic. A short calving season allows more efficient of grouping calves by age to manage risk status. Tightly grouping calves by age also allows the ability to apply interventions, such as vaccinations, at an appropriate time period to the greatest number of calves.

In this case, the production goal of a tight calving season with most calves born early in the season, aligns well with the health management goal of preventing disease in pre-weaned calves. The timing of the breeding season should be planned to match resource availability allowing cows to breed back in a reasonable period and maintain annual calving.

Managing calf scours
Calf scours is a common pre-weaning disease and this syndrome can be caused by a variety of pathogens. Most of the etiologic agents are transmitted by fecal-oral transmission and disease results when the pathogen burden on the environment is greater than the calf’s ability to immunologically clear the pathogen. Calves born early in the season may be exposed to a relatively small pathogen burden, but when calves become sick they shed large amounts of pathogen into the environment. Thus, on a herd level, most outbreaks of calf scours occur after sufficient calves have been infected to create an environment where pathogen levels are high. One of the mainstays of calf scours control is managing cattle movement and environment in a manner to decrease potential pathogen exposure when calves are in a high risk period.

Pre-weaning bovine respiratory disease (BRD)
Bovine respiratory disease (BRD) prior to weaning can cause significant problems in cow-calf herds. Most herds have few problems with this syndrome; however, some herds have outbreaks of disease resulting in significant losses. Several research projects have identified common risk factors associated with potential pathogen exposure (e.g. contact with calves new to the herd or stocker calves during the pre-weaning phase). Decreasing maternal immunity as calves age may also play a role in outbreak development as most cases occur between days 80-120 of age.

Producers have the opportunity to immunize calves early in life and this may help decrease the incidence of disease. Research on both viral and bacterial immunizations have illustrated the benefits of these vaccines at decreasing the level of respiratory disease in the herd. However, most research has been performed on cattle at high risk for BRD when entering the feedyard. Managing both the environment and calf immunity are keys to preventing problems with pre-weaning BRD.
Summary
Pre-weaning health management is an important aspect of the cow-calf production system. Creating a systematic plan that includes calving season management, decreasing disease exposure, and increasing immunity is key to optimizing pre-weaning calf health.

References and further reading
Suite of Reproductive Tools for Cow-Calf Clients
Brad White, DVM, MS
Kansas State University
Manhattan, KS

Reproductive success and optimal performance in cow-calf herds is influenced by disease prevention, replacement heifer, and bull management. Disease prevention is based on managing both the disease challenge and building an appropriate level of immunity. Bull management is also an important part of the reproductive equation by performing breeding soundness exams and selecting the appropriate number of bulls for the herd. Overall success of the replacement heifer program is based on preparing the heifers for the initial breeding season, selecting the subset of heifers with the greatest chance of reproductive success and managing the breeding program. Combined, these decisions influence overall reproductive productivity of the herd.

Preventing productive loss
Optimizing reproductive success in cow-calf herds relies on combining appropriate immunization and biosecurity practices with the current production system management techniques in the herd. The goal of the immunization program is to match herd immunity to the risks faced. Modifications to the immunization program include not only selection of appropriate antigens, but also matching the timing of immunizations to the time of greatest disease challenge in the environment.

Importing cattle into a cow-calf operation represents a potential source of disease exposure to the resident herd. This risk can be limited through diagnostic testing and an effective quarantine program. The diagnostic tests selected for the operation depend on goals of management, current on-farm disease status, and other state/federal regulations. Prior to implementing any test as a part of import procedures, the veterinarian and owner should decide how test results will impact future decisions (if tests are positive, what will be done with the animals?) Using diagnostic tests as a screening tool to reduce risk of disease introduction from new imports is most effective in diseases with a carrier state.

Risk of disease transfer from imported cattle to the resident herd can also be reduced by implementing a quarantine period at arrival. This technique is most helpful for pathogens that result in a transient infectious state. The length of the quarantine period is based on the estimated length of the infection, and as a rule of thumb, new arrivals are typically housed separately from the resident herd for 21-35 days.

Bull management
Breeding soundness examinations are commonly performed in yearling bulls. Research at Kansas State has evaluated risk factors associated with failing the initial breeding soundness exam and also the potential to predict if the bull will eventually pass the exam. Selecting the appropriate number of bulls for the herd is critical, and even in multi-sire pastures, the distribution of pregnancies is not evenly dispersed among all bulls. After bulls have entered the breeding herd, an in season evaluation can help identify problems early enough to intervene prior to the end of the breeding season.

Replacement heifer: Preparation for initial breeding season
Preparing heifers to breed early in the breeding season is critical as the timing of calving at the first calving influences the overall lifetime productivity of the replacement heifer. Calving early in the calving season increases calf weaning weight due to age and increases the heifer’s chances of re-breeding. The post-partum interval in heifers is the time required from calving to potential rebreeding. The post-partum interval or anestrus period in heifers can range from 80-120 days; therefore, heifers that calve early in their first calving season have more time to return to estrus and become pregnant earlier in the subsequent breeding season. Calving early has been shown to increase longevity in the herd and increase overall lifetime productivity.

Preparing for the initial breeding season begins with adequate record keeping when the heifers are born and continues through the initial breeding. Heifers that were born earlier in the calving season have a greater chance of attaining puberty in a production system designed to have heifers calve at approximately 24 months of age. Recording heifer birthdates may be useful to identify heifers born early in the calving season. At weaning, weight of the heifers can be evaluated to determine the optimal nutrition program to be sure heifers attain the ideal target weight by pre-breeding.

The goal is to have the heifers reach puberty before the initiation of the breeding season. The onset of puberty is influenced by weight, age, and breed. Age and breed are typically threshold parameters and once a minimum age for a specific breed is attained, greater age is not valuable. Heifer weight is one of the primary drivers of puberty onset and heifers from most breeds reach puberty at 55-65% of mature body weight. The heifers should be managed so that the majority of heifers are pubertal at the start of the breeding season.

Examination of heifers prior to initiation of the breeding season can provide information on the pubertal status of the group and identify potential problems that should be removed from the group. This examination is typically done when heifers are yearling age and near enough the breeding season to provide an accurate prediction of the breeding status of the heifers. The pre-breeding exam
may occur anywhere 2 to 6 weeks prior to breeding. Performing the pre-breeding soundness exam 6 weeks prior to breeding allows time for management changes (nutrition/ration changes) to be implemented; however, the greater time from the actual breeding means potentially less accurate depiction of the reproductive status of the group. Performing the pre-breeding soundness exam 2 weeks prior to breeding provides an accurate depiction of replacement heifer status, but does not allow time to initiate any management changes.

The pre-breeding heifer soundness exam typically consists of several assessments of each heifer combined to make an overall determination of the cohort status as well as identify individual problem heifers. Collected information typically includes body weight, body condition score, age (if known), a reproductive tract score, and a pelvic measurement. These data can be combined in a variety of manners, and we have found using the Ready, Intermediate, Problem (RIP) categorization system as a useful tool.

The RIP categorization allows placing heifers into discrete categories based on the combination of measurements assessed at pre-breeding. Heifers in the RIP category have BCS > 4, are at 55-67% of mature body weight, are cycling and have normal pelvic shape with > 130 sq. cm of pelvic area. Heifers in the intermediate category have BCS > 4, are at 50-60% of mature body weight, are non-cycling, and have normal pelvic shape with > 130 sq cm pelvic area. Heifers in the problem category may have immature or problem reproductive tract (pregnancy or free martin), or abnormal shaped or very small pelvic area. Heifers in the Ready category are deemed as ready to breed immediately, Problems should be culled, and Intermediate may eventually be good breeding stock, but are not currently ready.

In herds close to breeding (within 2 weeks), the target is to have 85-90% of heifers in the Ready category. For heifers farther from breeding (6 weeks), the target is to have 65% in the Ready category with the assumption of a homogenous group that the Intermediate heifers will begin cycling by the start of breeding. Problem heifers should be a minimal component of the group and should be culled.

**Summary**

Replacement heifer management is key to long term beef cow-calf reproductive success, and the metric for a successful program is the percent of heifers that have their second calf in the first 21 days of the primiparous calving season. A successful reproductive program includes replacement heifer management, a disease prevention program, and appropriate bull management.

**References / Suggested reading**

