Optimizing Health and Welfare in the Pre-weaned Calf: Housing and Management Practices

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Take Home Messages

- Calves reared in group or paired housing during the pre-weaning period have improved social development, which can have lifelong benefits.
- Group or pair-housed calves don't have to have increased disease or cross sucking, if the environment and colostrum program are well-managed.
- Deep bedding with long straw both helps calves stay warm in the winter and reduces risk of respiratory disease.
- If housing calves indoors, a positive-pressure ventilation system supplemented with natural ventilation can ensure adequate air exchange without drafts.
- Calf vaccine programs are important for health, but can't overcome poor environmental management, and should be designed in consultation with your herd veterinarian.
- Disbudding should be done well ahead of weaning, and at a time when pre-weaned calves are healthy and vigorous.
- Regardless of method, disbudding pain control should include both a local anesthetic and an NSAID analgesic.

Housing

Cattle are naturally social animals, and several studies have shown that calves reared in isolation have trouble adapting to new situations and may be more fearful or avoid new objects or feeds, compared with those reared with at least one other calf (Costa et al., 2016). Group or pair housing improves social development and can decrease the stresses associated with weaning. Weaning is often accompanied by other stressors such as changes in pen, group size, and feed type and feed access. Calves reared in group or paired housing pre-weaning have been shown to adapt better to these changes (Van Os et al., 2021) which can mean lower risk of disease and improved growth and development, leading to improved milk production (Costa et al., 2016). Challenges of group housing include potential increase in disease risk, and abnormal behaviours such as cross sucking. However, these can be limited or eliminated with careful management around colostrum, bedding, nutrition, and disease monitoring (Van Os et al., 2021).

Ideally, stable groups (not continually adding or removing calves from a group) using 'all-in-all-out' can benefit calves by not exposing younger calves to older calves who may carry disease causing agents, and because the pen can be cleaned and left to dry between groups, breaking the cycle of infectious agents (Nordlund and Halbach, 2019). However, this is often difficult to accomplish on the average Canadian farm based on the number of calves born per week. With a continual flow system, calves can still achieve excellent health and growth when other aspects of management (e.g., nutrition, bedding, ventilation) are optimized.

For group housed calves, smaller (ten or less) and more stable groups (not continually adding or removing calves from a group) have less disease than larger groups with continuous flow of calves in and out (Van

Os et al., 2021b). However, larger groups of up to 20 can likely be managed well if other aspects of housing, like stocking density, appropriate meal size and daily allowance, are well managed (Nordlund and Halbach, 2019). It is generally recognized that there is a higher risk of disease as group size increases. For smaller farms, or those unable to accommodate group housing, pair housing is an alternative that can provide social benefits without the challenges associated with groups of varying age. Besides having individual group pens, farms can modify outdoor housing by connecting the outdoor space around two individual calf hutches with wire or corral panels. Alternatively, as calves will prefer to lay together in the same hutch, group or super hutches can be used that provide more square footage, but care must be taken in the winter as the opening is larger (Van Os et al., 2021a). Super hutches generally provide 60 square feet of bedded space, appropriate for two calves (Van Os et al., 2021a). Ideally, pairs should be started earlier in life; one study found that calves paired at six days of age outperformed calves not paired until 43 days of age (Costa et al., 2015). Indoor paired housing can be created by removing the divider between two pens (Figure 1).

Figure 1: Pulling dividers is an easy way to accommodate pair housing in a calf barn.

For indoor housing, stocking density has an enormous impact on air quality and subsequently, on calf health. Based on studies focusing on airborne bacterial loads, industry experts recommend a minimum of 35 square feet of bedded area per calf (Nordlund and Halbach, 2019). Total airspace should also be considered, with a goal of at least 600 cubic feet per calf.

▪ Bedding

Air quality is important to assess at the calf level. Although the air quality might be good in the middle of an alley, depending on the barn's ventilation, air quality at the calf level might be quite different. Calves spend the majority of their time laying down, so air quality at the level of the bedding can have a big impact on calf health. Long straw is associated with improved health outcomes in preweaned calves compared with other bedding types (Renaud et al., 2018), and improves gains in the winter compared with shavings (Hill et al., 2011). Benefits of using long straw to bed calves include, when done with deep bedding, an improved microenvironment at the calf level (better air quality) and also more insulation value in the winter. To achieve these, deep bedding must be used. The University of Wisconsin developed a score called the 'Nesting Score' to evaluate if bedding is sufficient in winter. When a calf lays down, if you can see the hoof and entire leg, it is a score of 1. If you can see the knees and hocks, but not the lower leg, it is a score of 2. When the hocks and knees are not visible when the calf is laying, it is a score 3 (Figure 2). A Wisconsin study demonstrated that having a bedding score of 3 dramatically reduced the prevalence of respiratory disease in pre-weaned calves, even more so than a reduction in airborne bacterial count (Lago et al., 2006).

Figure 2: The calf on the right has a nesting score of 3, as her hock and lower leg can't be seen in the long straw bedding.

In wintertime, use of calf coats on animals less than four weeks of age when evening temperatures are less than 10°C can help improve gains by decreasing the amount of energy calves have to expend to stay warm. As calves get older and their rumen develops, they generate more body heat and their thermoneutral temperature drops to close to 0°C. A calf coat or jacket is thought to be the equivalent of approximately one nesting score unit, so a calf with a bedding score of 2 with a jacket would be equivalent to a score 3 calf without a jacket (Van Os et al., 2021). Calves can overheat when daytime temperatures are high, so during fall and spring jackets should be removed during the day.

▪ Ventilation

For indoor housing, industry experts recommend barns with natural ventilation supplemented with positive-pressure tube ventilation (Nordlund and Halbach, 2019). The addition of positive-pressure ventilation allows fresh air to be brought in from outside without drafts during the winter, while in the summer, the positive-pressure ventilation supplements the natural ventilation, especially on still days.

Ideally, pre-weaned calves should be housed in their own airspace to decrease risk of disease. However, if calves are housed with older animals in a shared airspace, consideration must be given to how fresh air is brought into the barn so that it is delivered from the youngest to the oldest animals. Positive pressure tubes are custom designed for the building they are in and are designed to deliver fresh air to all areas of the barn, eliminating areas with dead space. They are also designed to avoid drafts, while still ensuring adequate air exchange, with the goal of delivering air to the calf level at a speed of less than 60 feet per minute, which is felt as still air (Nordlund and Halbach, 2019).

▪ Vaccination Strategies

Although vaccine programs can be of great utility, it's important to remember that even the best vaccine program will fail if there are holes in the colostrum management program, or if there are issues in the environment related to stocking density, air quality, bedding, etc. However, when these management areas are done well, they help a good vaccine program succeed. Animals experiencing stress such as crowding, mixing, dehydration, weaning, or limit-feeding have poorer immune function, which can impact their ability to respond to a vaccination (Chase and Villegas, 2016).

Determining which vaccines to give, and to who, depends on the specific risk factors and disease risks on an individual farm. Although general vaccine recommendations exist, it's best to work with your herd veterinarian to develop a strategy that will work for your farm.

There are vaccines available to improve antibody production to calfhood diseases in the cow, with the goal of producing colostrum with a high level of antibodies for specific diseases (typically scour-causing agents). While the label of these vaccines may recommend vaccination at three weeks pre-partum, it's clear that transport of antibodies from circulation to the mammary gland begins at three to four weeks prior to calving, peaking at one to two weeks pre-calving (Chase and Villegas, 2016). While non-adjuvanted vaccines are ideally given at four weeks pre-calving, adjuvanted vaccines generate higher antibody levels for longer periods of time, making them able to be successfully given earlier in the dry period (Chase and Villegas, 2016). Currently available scour vaccines in Canada are adjuvanted. When considering possible earlier calvings, and how often cows are vaccinated on a farm (e.g., weekly), it may make sense to target cows earlier in the dry period with scour vaccines than may be on the label to ensure adequate antibody production in colostrum. While there are specific antibody products available to supplement calves at birth, typically a well-managed dry cow vaccine program coupled with good colostrum management is preferred to an antibody supplement-based program.

While the antibodies that a calf receives in the colostrum are extremely important to ensuring good health in early life, they can interfere with the calf's response to systemic vaccines. Vaccines delivered parenterally (injected either under the skin or in the muscle) require a systemic response by the animal, which can be blocked by the presence of passively acquired antibodies from colostrum. However, intranasal vaccines avoid this issue by directly priming the mucosal immune system with little interference from these antibodies (Chase et al., 2008). As a result, intranasal vaccines for common respiratory pathogens have been a very successful strategy to generate protective immunity for several months (Chase et al., 2008).

Parenteral (injectable) vaccines offer a longer duration of immunity compared to intranasal but require a lack of maternal antibody interference and also require the animal to be healthy enough to respond well to the vaccine. Modified-live vaccines (MLV) are preferred to killed (inactivated) vaccines at establishing a good immune response, although there is also evidence that killed vaccines can effectively booster MLV vaccines (Chase and Villegas, 2016).

▪ Disbudding

Disbudding (removing the horn bud prior to attachment to the skull, which occurs at approximately two to three months of age) is preferred over dehorning because it is less invasive and less painful. Disbudding can be done by either hot-iron disbudding (cautery) or caustic paste (chemical disbudding); both methods are painful when done without adequate pain control (Stock et al., 2013). A large body of evidence shows that administering a local anesthetic (commonly lidocaine, given as a cornual nerve block, shown in Figure 3) and a non-steroidal anti-inflammatory drug (NSAID) effectively eliminates both the acute and inflammatory pain from cautery disbudding (Winder et al., 2018). While the nature, duration, and intensity of a chemical burn is different from a thermal, cautery burn, the use of both local anesthetic and NSAID analgesic is best practice for caustic paste disbudding as well (Stilwell et al., 2009; Winder et al., 2017; Reedman et al., 2019). While caustic paste, once applied, will take several minutes to start to cause a burn, it has been shown than an NSAID alone does not control the acute pain (Winder et al., 2017), whereas if lidocaine is also given, calves disbudded by caustic paste essentially show no differences in pain behaviour compared to those not experiencing disbudding (Winder et al., 2017). Figure 4 shows the differences in cortisol concentrations in calves disbudded with or without a local anesthetic.

Figure 3: A calf is administered a cornual nerve block. Local anesthetic (lidocaine) effectively mitigates the acute pain from disbudding but must be given in the correct location to be effective. Consult with your veterinarian for more information or training or see www.disbudding.com.

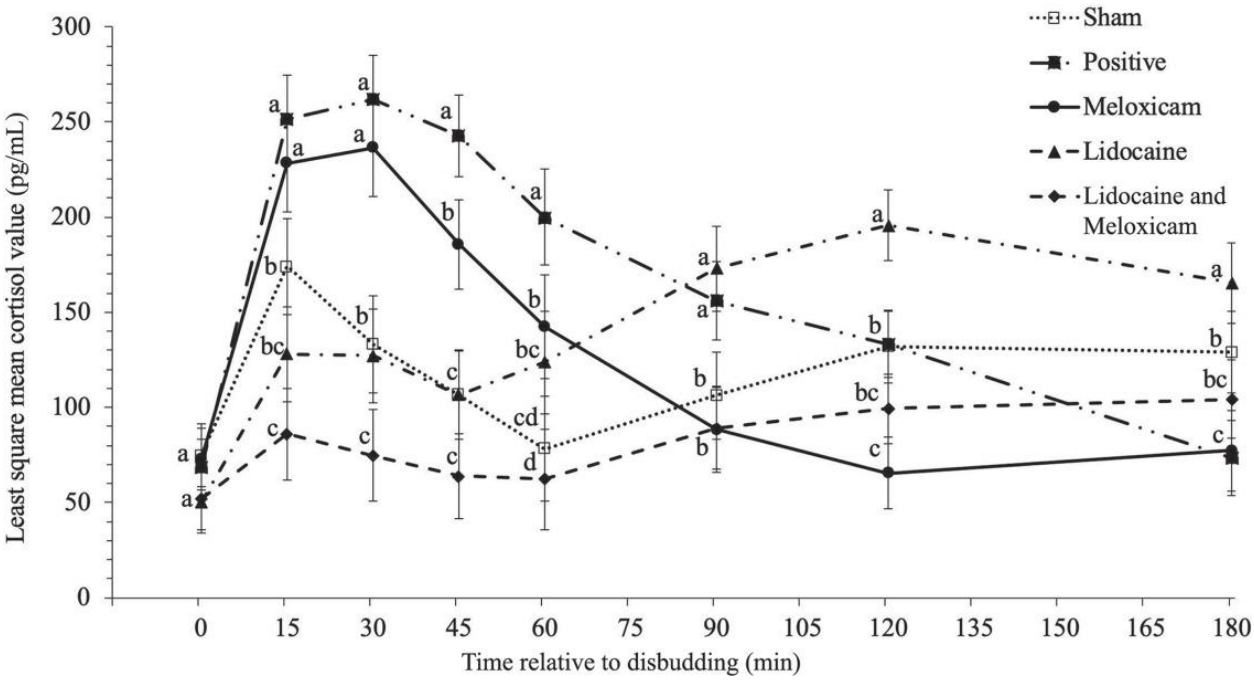

Figure 4: This graph displays the initial rise in cortisol for calves not given a local anesthetic (solid line with circles and dotted and dashed line with squares), which is mitigated for calves receiving lidocaine (dotted and dashed line with triangles, dashed line with diamonds). However, at approximately 60 to 90 minutes following caustic paste application, the inflammatory pain begins to rise in calves not given an NSAID in addition to the local anesthetic (dotted and dashed line with triangles), while calves given both lidocaine and an NSAID (dashed line with diamonds) remain low for the entire study period. The same results have been seen for pain behaviours such as head shaking, ear flicking, and head rubbing.

While it is recommended to disbud calves with enough time for them to heal before weaning, there has been little work exploring age at disbudding. In fact, a preliminary study suggests that calves disbudded at three days of age may show a generalized long-term increase in pain sensitivity compared with calves disbudded at 35 days of age (Adcock and Tucker, 2018). It is also important to avoid time periods of additional stress in calves, which may be different for different farms; working with your veterinarian can help you determine what age calves are best disbudded on your operation.

Sedation, typically xylazine, may be used to aid in handling. This drug provides conscious sedation and is not appropriate to be given alone for pain control for disbudding (Grondahl-Nielson et al., 1999; Stilwell et al., 2010). The impact of sedative on the stress of the procedure is unknown; while several recent studies have explored this topic (Cuttance et al., 2019; Reedman et al., 2021) results have been mixed.

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