Clinical Forum: Control of the Bovine Respiratory Disease Complex

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ABSTRACT: Bovine respiratory disease (BRD) complex remains a significant cause of calf morbidity and mortality in both dairy and beef production in the UK. The respiratory tract offers a vulnerable interphase between the animal and the viruses and commensal bacteria involved in the complex. The defence systems of the respiratory tract are described and the main factors that impair these are explained, allowing a systematic farm specific approach to the management and prevention of BRD to be developed. The article is further informed by the experience and views of four bovine practitioners.

INTRODUCTION
The bovine respiratory disease (BRD) complex is a multifactorial, multi-agent disease which is of considerable importance to cattle rearing systems in the UK. The financial losses caused by BRD arise from the costs of treatment, reduced growth rates and mortality, but for the modern cattle producer the additional labour costs arising from handling and caring for sick animals may be as significant as any of these. There is a dearth of recent information on the morbidity and mortality due to BRD in the UK, but studies in the UK carried out more than 10 years ago placed the cost of the disease at £38 for each dairy calf at risk in an outbreak of pneumonia and £22 for the beef calf. In monetary terms costs will clearly be higher today, but there is no systematic collection of information on the outbreaks of pneumonia to define these losses more accurately in...
Indeed any differences in clinical manifestation underlying pathology observed in these conditions. The control of multifactorial disease is by definition not simple and a proper understanding of how causal factors impact on the disease resistance of the young bovine is required in order to work up a systematic approach to the control of BRD.

DEFINITIONS

A range of terminology is in common usage: enzootic pneumonia has been used to describe the disease as it occurs in young dairy bred calves and shipping fever or pneumonic pasteurellosis in weaned beef calves; bovine respiratory disease complex finds favour in North America. However, while around 10 viruses and many more species of bacteria or mycoplasma have been identified in this disease complex, there does not appear to be any difference in the pattern of agents or in the underlying pathology observed in these conditions. Indeed any differences in clinical manifestation probably owe more to the husbandry systems and the factors they bring to bear on the calves. For example the continuous throughput systems where susceptible animals are added intermittently to a group of calves, as occurs in many dairy herds, results in less well defined outbreaks, but similar morbidity when compared to groups of calves from the beef cow herd which are exposed simultaneously to risk factors such as housing or a change in feed.

AETIOLOGY: INFECTIOUS AGENTS

Despite the extensive list of viruses that have been associated with the respiratory disease complex, bovine respiratory syncytial virus (BRSV) and parainfluenza 3 (Pi3) virus are widely recognised as the most prevalent. It is not known how these viruses persist in the population, but they are generally considered to be present in most reasonably sized cattle herds and infection in the first year of life is common. Recreating clinical disease through experimental infections with these agents is difficult, mostly resulting in mild or inapparent disease. Field observations indicate that BRVSV is the more significant of the two, and has the capacity to cause outbreaks where deaths can be solely attributed to lung damage caused by the interaction of the virus and the host. In contrast Pi3 infection is commonly detected in calves in the first three months of life and is most likely to be associated with clinical disease at this time, which unless complicated by secondary bacterial infection is mild.

Unlike the uncertain epidemiology of BRSV and Pi3, the biology of bovine herpes virus 1 (BHV1) is well understood. The carrier state for BHV1 has been demonstrated and infection is often introduced to a herd through the introduction of latently infected animals. BHV1 is an important cause of disease in units where young cattle are purchased and on those larger breeding herds where infection is endemic and social stress is significant. The virus is an important pathogen of the upper respiratory tract, but is less commonly involved in outbreaks of undifferentiated respiratory disease than is BRSV or Pi3 virus. As with BHV1 the biology of bovine diarrhoea (BVD) virus is considered to be well understood. Acute infection in young cattle is most often the consequence of the presence of a persistently infected animal in the group. The main effect of BVD virus in this context is to impair respiratory tract immunity and so act synergistically with other infections.

Several other viruses have been associated with BRD, including adenovirus and coronavirus, but there is insufficient evidence to suggest that these viruses, whilst relatively widespread in the cattle population, have a significant role to play in calf pneumonia.

Pasteurella multocida, Mannheimia haemolytica and Histophilus somni in that order or prevalence have been found to be the most frequently isolated bacterial pathogens in cases of calf pneumonia investigated by SAC and VLA, but a range of other bacteria, including Arcanobacterium pyogenes can be found in pneumonic lesions. The causal importance of these other organisms is dubious and A. pyogenes in particular, is an opportunistic pathogen colonising devitalised tissues, important in fatal or chronic supplicative pneumonias, but only as a consequential infection following significant lower airway pathology.

All of the above organisms are to be found as commensals in the oropharynx in many populations of young cattle, with the prevalence of carriers increasing in the population with the occurrence of stress factors such as transport, mixing and housing.

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Of the mycoplasma species *Mycoplasma bovis* is involved in outbreaks of acute disease and severe chronic disease while *Mycoplasma dispar* has previously been implicated in the chronic cuffing lesions observed in housed dairy calves, but may now be of minimal significance. Other species of Mycoplasma are commonly isolated in the investigation of BRD outbreaks, but their significance has not been fully evaluated. It has been suggested that the ability of *Mycoplasma bovis* in particular to cause udder infections may be important in the spread of infection from cows to young calves in the dairy herd.

**MANAGEMENT RISK FACTORS**

In the UK BRD is a disease of the winter months indicating that either winter weather or housing conditions are involved in the disease. Certainly outbreaks are often associated with extreme diurnal temperature variations, but of greater importance are likely to be the housing conditions. Poor ventilation resulting in dust and moisture laden air is widely considered to be a major causal factor for BRD. Surveys have shown that 50% of naturally ventilated buildings provide inadequate ventilation for the livestock they house, suggesting a failure to invest adequately in the design of new buildings or the upgrade of older buildings as the stock carrying capacity is increased.

The mixing of animals from different age groups and multiple sources challenges the animals with pathogens that they may have not encountered before and the social stress may have importance in reducing the animals' ability to respond immunologically to the challenge. In beef systems further management stress such as late castration and dehorning may lead to a similar stress response.

In the North American feedlot high starch rations for animals entering feedlots have been associated with an increased frequency of treatment for BRD compared to a forage ration. Acidosis may be the critical factor in this relationship and chronic acidosis is a common occurrence in many cereal based finishing rations in the UK.

**PATHOLOGY AND DISEASE RESISTANCE**

As the bacteria which cause most damage to the lungs can be found as part of the flora in the upper respiratory tract of groups of healthy cattle, it is clear that the surface defences or the airways and lungs must be intact and effective if respiratory disease is to be prevented. These defences consist of a layer of mucous covering the epithelial surface which is moved from the lower airway to the nasopharynx and external nares by the beating of cilia on the surface epithelial cells. Depending on size, inhaled particles impact onto the gel at various points throughout the tract and are then moved out of the respiratory tract. Speed of removal varies with depth into the tract; particles penetrating to the lower airways will be removed within 24 hours but the majority of material is removed within one hour of inhalation.

Lymphoid tissue is closely related to the mucosa, permitting the effective processing of inhaled antigen and the secretion of IgA onto the surface. The immunoglobulin antigen interaction can inactivate agents or promote phagocytosis. Indeed both IgA and T lymphocytes appear to be essential elements in the surface defences against viruses, particularly BRSV. Within alveoli immunoglobulins of the IgG and IgM classes replace IgA as the major type of antibody and aid phagocytosis by the alveolar macrophages. Few particles or organisms penetrate to the level of the alveoli but those which do are removed more slowly and once phagocytosed can either leave on the mucociliary escalator or through the alveolar wall into the circulation. In the event of inflammation, neutrophils and circulating immunoglobulins add to the system. The neutrophils are more effective than macrophages at destroying phagocytosed bacteria; however this ability is not without its penalty as disrupted neutrophils release enzymes and metabolic products which cause further damage to the lung. The importance of this has been shown in experimental models of pasteurellosis where calves depleted of neutrophils did not develop pneumonia lesions. A range of immunomodulators, including interferon, lysosomes and lactoferrin are produced by leukocytes and epithelial cells of the tract to further support the surface defences.

Both ciliated epithelial cells of the airways and the type II pneumocytes lining the alveoli are extremely susceptible to damage and have limited ability to recover. Once destroyed, they are replaced by cuboidal epithelial cells and type 1 pneumocytes respectively, before they in turn transform to the required cell type. Consequently during the repair process there is loss of function which can last for several days in the bronchi and seven to ten days in the alveoli. Therefore the damage that viruses cause to the ciliated cells is critical in reducing the mucosal protection. Bacterial pathogens are then more successful in multiplying in the nasopharynx and from there establishing in the lower airways and alveoli. At this site their multiplication rapidly results in the severe pneumonia which becomes apparent clinically. Additionally Pi3 virus and BRSV have depressant effects on macrophage and lymphocyte function further favouring secondary bacterial colonisation. There are other factors which depress or damage ciliary epithelium or macrophage function and so contribute to the conditions which allow bacterial survival and growth. Dust overload of the mucociliary escalator; noxious gases reducing the ciliated cells’ ability to beat and propel the mucus gel; micro nutrient deficiencies, acidosis and stress can all be involved in the pathogenesis of the disease. Indeed in most cattle production systems in the UK
several of these factors are likely to be significant contributors to the morbidity due to BRD.

Bacterial pneumonia varies in its severity from relatively mild bronchopneumonia to severe lobar pneumonia with extensive necrosis of tissue. The minimum repair period for the former is 7 - 10 days while complete resolution of lobar pneumonia is likely to take between 60 and 90 days, but may never be achieved where necrosis is followed by extensive fibrosis or abscessation. These time courses have implications for the duration of therapy required.

**BRSV SPECIFIC EFFECTS**
Apart from the damage to surface defences BRSV infection has also been shown to cause airway obstruction and hyper-reactivity which can persist for 30 days, resulting in impaired live weight gain. The exact cause of these changes is unknown but evidence for mast cell de-granulation and histamine release has been used to explain this and the widespread and often fatal emphysema which develops in some BRSV infections. For these reasons BRSV infection has significance beyond being an initiating factor for bacterial bronchopneumonia.

**THE ROLE OF LUNGWORM INFESTATIONS**
*Dictyocaulus viviparus* is responsible for significant disease in grazing cattle, but residual damage or persisting subclinical infestations will compromise the defence systems of the respiratory tract. Treatment and control programmes for this parasite are essential and the goal should be to remove infestations prior to housing.

**AN APPROACH TO THE PREVENTION OF BRD**
Control of BRD lies in providing management conditions that facilitate optimal function of the specific and non-specific disease resistance of the animals in the unit; providing a vaccination programme tailored to the risks specific to the unit; and having an outbreak management plan that addresses standard treatment as well as the investigation of causal factors and infectious agents as required.

**Managing to prevent BRD**
Foremost in this aspect is to ensure best practice husbandry and care of the cattle in the particular system whether this is newborn dairy calves or purchased weaned beef calves. The system should be designed to minimise stress, provide the requisite dietary requirements (including colostrum provision) without compromising the disease resistance of the calves. If there is any possibility of the client misunderstanding the risk and required actions, clear guidelines should be made in writing to cover each aspect. Most experienced cattle clinicians can make a subjective judgement on the environment that is sufficient to identify building faults. Smoke bombs can be used to estimate ventilation rates and to demonstrate whether effective natural ventilation is occurring. However a more objective assessment is required to determine where the fault lies and the requisite remedial action. This involves measuring floor area, inlet and outlet areas and relating that to the number of calves and their live weights. Farm building engineers provide a service to analyse these data and to provide solutions for inadequately performing buildings.

The nutritional management should be reviewed particularly where cereals or cereal by-products make up a significant part of the ration. Feed supply can be interrupted for several reasons and result in animals overeating once the supply is re-established. Where cereals are fed on one or more occasions during the day there is also potential for variable food intakes and acidosis in those animals that exceed the planned intake. Micronutrient deficiency can impact on disease resistance and to assess micronutrient status it may be enough to ensure that a general purpose mineral and vitamin supplement is included in the ration at the required rate, but in areas where animals may be expected to end a grazing season deficient in selenium or copper an assessment of the status of the group by blood sampling a representative sample from the group is advisable. A minimum sample size of six is recommended and ten where the group size exceeds 60.
Factors that can be expected to cause significant stress to the calves should also be investigated. Castration, dehorning or weaning should not be carried out during the risk period for pneumonia. Mixing of calves from multiple sources should be avoided, but if it must take place this should be done when calves can still be run outside.

**Tailored vaccination programmes**

The traditional approach to vaccination against BRD was often to carry out diagnostic tests one year with a view to implementing vaccination against the pathogens identified in the following BRD season. Yet studies have clearly demonstrated that almost all young calves are exposed to BRSV and P13 in their first year of life and therefore vaccination against these viruses is a priority in almost all units. Perhaps the only caveat is that vaccination against P13 may be less necessary in animals older than six months of age due to the milder affects of the virus in older calves. Where BHV1 is endemic in the dairy or beef cow herd or where the herd is not closed and significant numbers of purchased stock enter the herd each year then vaccination against BHV1 is also required. BVD control can be best achieved through a programme of biosecurity, removal of PI animals and vaccination of the breeding herd preventing the birth of PI animals and therefore removing the challenge of BVD virus from the calf groups. There is no commercial vaccine available against *P. multocida*, *H. somni* or *Mycoplasma bovis*, but *M. haemolytica* vaccines are available. They may well be of value in particularly troublesome units, but may be unnecessary where management factors can be controlled and effective vaccination against the major viral agents achieved.

In general more effective and long lasting immunity is achieved with live virus vaccines compared to inactivated ones. Furthermore a specific advantage of priming local mucosal immunity is claimed for live intra-nasal vaccines. These may be particularly valuable in young calves, having the potential to bypass the blocking effect of colostral antibody on parenterally administered vaccines.

But a further factor to consider, particularly in beef systems is the timing of vaccination in relation to exposure to the major risk factors. Best practice is therefore to ensure that the full vaccination course is completed, allowing a minimum of two weeks from the second booster before exposure to risk occurs. For many vaccines this requires two handlings and a programme that begins around six weeks prior to housing. This is unattractive to many farmers, but the benefits of a planned use of labour over managing BRD outbreaks that follow an ineffective vaccination programme should be clear.

The recommendations for the storage, administration and recommended age range do vary from vaccine to vaccine and it is important to ensure that data sheet recommendations are followed and that the farmer is clear about the proper use of the vaccine.

In conclusion there is a good range of vaccines against the major viral components of the BRD complex to allow a tailored approach to a unit’s needs to be met.

**Outbreak management plan**

Antibiotic treatment of all animals that are exhibiting clinical signs of BRD is generally the course of action followed. There are several antibiotics that have pharmacodynamic qualities that ensure good penetration of the respiratory tract and of the affected areas of the bronchial tree and alveoli in the early stages of bronchopneumonia. But it should be recognised that where lung damage is severe, a rapid response to antibiotic therapy cannot be expected and prolonged antibiotic cover may be required. Written treatment plans should be part of the control plan for BRD on all cattle rearing units, but it is also necessary to detail when veterinary consultation should take place. This may be a threshold of cases over a specified time period or where the clinical disease is of abnormal severity or where a failure to respond to treatment occurs. There is likely to be an argument for varying the intervention thresholds with the unit depending on the clinician’s assessment of the degree of competence of the workers looking after the stock.

A deviation from the expected pattern of disease or response to treatment should prompt a review of the control programme and diagnostic

| **TABLE 1: Laboratory investigation procedures** |
|------------------------------------------------|
| **Investigation** | **Test** | **Sample size** |
| Evidence of virus involvement | Paired serology | <4 months: sample 12  
>4 months: Sample 6 |
| To confirm IBR | FAT on nasopharyngeal swabs | 4 acute cases |
| To monitor antibiotic sensitivity | Bacteriology on nasopharyngeal swabs | Minimum of 4 untreated cases |
| To detect mycoplasma | Mycoplasma isolation on BAL samples | Minimum of 4 untreated cases |
| Trouble shooting in event of failure of control programme | Paired serology; FAT and Bacteriology on BAL | Minimum of 4 acute cases |
intervention. To investigate the possibility of antibiotic resistance nasopharyngeal swabs from at least four fresh cases should be collected. The diagnostic lab can advise on the appropriate swabs and transport media for the diagnostic objective. Where investigation of virus involvement is required then bronchoalveolar lavage currently offers the best chance of success. Again acute untreated cases should be selected, showing minimal clinical signs. Screening for BHV1 is more straightforward and can be achieved with nasopharyngeal swabs or ocular swabs. Paired serology can be used to demonstrate involvement of any of the viruses and *Mycoplasma bovis*, but serological screening for *H. somnii* or *M. haemolytica* is of dubious value and the tests are not readily available. Necropsy of acute cases can help in the diagnosis of BRSV or BHV1 outbreaks, but are often of less value where animals have been treated with antibiotics and the course of illness has been several days. In these cases screening for BVD viraemia may be of more diagnostic value.

**CONCLUSION**

Calf morbidity and mortality is a significant source of loss on many UK cattle farms and BRD is often an important component of these losses. By adopting a best practice approach to management and husbandry allied to farm specific vaccination programme BRD is likely to be effectively managed in almost all situations leading to an improvement of the welfare of calves.

**QUESTIONS**

1. Control of BRD in calves in the first month of life can be difficult to achieve due to the calves being universally immunologically naive. In your experience what are the critical factors at that time and what have you found to be the most successful ways to achieve control.

Robert Anderson replies:
In our autumn calving beef herds control of BRD in young calves begins with achieving compact calving periods, our aim is to calve over 65% of the herd in the first three weeks, and often achieve better. In addition we aim to complete calving within nine weeks. This allows easy batching of calves into distinct age groups, allows better control of diseases such as cryptosporidiosis and coccidiosis, and delivers calves to the housing or risk period that are growing well, in defined age groups with minimal spread of ages and size, and that are best prepared to respond to disease challenge and/or vaccination. In addition such compact calving periods allow the cows to be managed pre-calving according to body condition and feed needs – this allows cows to develop good udder health and colostrum production.

The use of an intranasal vaccination against PI3 and BRSV has revolutionised the control of BRD in such calves. I advise using in suitable calves, two weeks before housing, generally at least two weeks old. If I consider IBR to be a threat then I will advise a live intranasal IBR vaccination at the same time. Such a vaccination programme can be very successful at controlling BRD in these calves, and generally does not need to be repeated nor additional other vaccines used.

In addition to the suitable batching of calves on age and size, housing is best carried out as a planned activity, on a dry day into sheds where only dry, clean straw has been used. All broken drains and gutters will have been fixed to reduce excess surface water. Group sizes should be as small as possible, but are often driven by the numbers of bulls available. Calves should always have a safe creep area for rest, and this must be bedded daily, even if the main courts are restricted in straw use. Daily checks for sick calves are best done first thing in the morning when the cows are being fed and again in the evening.

To summarise:
Critical factors are:
1. Managing cow condition and feed to ensure maximal colostrum supply and management
2. Achieve compact calving periods - this allows even batching of groups
3. Control neonatal disease to maximise calf health and growth - this will positively impact on response to vaccination
4. Use of suitable intranasal vaccines, viral agents to protect against decided by disease risk assessment and should be part of the farm herd health plan.
5. Housing in good dry conditions into suitable accommodation, in a planned fashion, not when poor weather dictates
6. Provision of safe, daily bedded creep area for leisure and to escape the cows and bulls.

To achieve success:
1. Compact calvings
2. Good colostrum supply and management, disease control and growing calves
3. Effective vaccination against all necessary agents.
4. Do not stress calves by carrying out procedures such as dehorning or castrating before, during or for several weeks after housing
5. Dry, well ventilated housing with separate creep area for calves
6. Daily health checks to rapidly identify sick calves.

Keith Cutler replies:
Control of any multiagent, multifactorial disease depends on the synchronous management of the susceptible animal, particularly its immune status, the management of that animal’s environment and the removal, as
far as possible, of the infectious threat. Control of BRD in the young calf is no different.

The calf must be well nourished with a regular supply of high quality consistently mixed milk replacer (assuming that it is being bucket reared), allowing for increasing metabolic demand during periods of particularly cold weather, and access to a high quality concentrate starter ration, roughage and water. The importance of an early intake of sufficient high quality colostrum goes without saying.

The calf’s environment should be clean and dry, well bedded with good quality, barn stored straw and well ventilated without being draughty.

Vaccination may be a useful means of manipulating the calf’s immune system, with various options available for use even in the very young calf, but this should not be considered an alternative to ensuring that basic husbandry is optimised.

John MacFarlane replies:
Our clients are predominantly beef suckler and beef finisher units. We have few dairy units.

The general transition to spring calving means that, in relative terms, BRD in the first month of life is less significant than it formerly was. Paradoxically, my impression is that late autumn-born calves seem to succumb to BRD less frequently than their earlier born cohorts.

That said, prevention of BRD in this group presents a challenge when it does occur.

My approach is:
1. Improve calving pattern to reduce numbers of late-born calves
2. Control BVD (where it is present) by vaccination of the adult herd
3. Optimise dam nutrition (we retain the services of an independent nutritionist)
4. House groups according to calf age
5. Identify the specific causal agents by BAL and nasopharyngeal swabs
6. Vaccinate using one-dose intranasal vaccines where possible.

One commercially available vaccine is licensed for use in pregnant cows and may confer passive protection to young calves. Thus far I have not had cause to trial its effectiveness.

Tim Potter replies:
Management practices play a key role in the reduction of disease in the first few weeks of life. On units with BRD in the first month of life there are frequently deficiencies in colostrum feeding resulting in failure of passive transfer, and I would certainly begin by addressing this along with any other nutritional or housing problems. On some units where we have identified specific viral components the implementation of intranasal vaccination has been useful in managing BRD in young calves.

2. Poor ventilation in cattle accommodation is an important causal factor in the BRD complex. Outline the most common failings that you recognise and how do you assess the scale of the problem and advise on improvements to your clients?

Robert Anderson replies:
Considerable improvement has occurred in this area over the last 10 years in housing for weaned suckled calves. Prior to this most sheds had low roofs, limited inlets, often no open roof ridge and sheds were often shared with weaned cows and older calves from previous years - as a result stocking rates were high, disease challenge was high and outbreaks of BRD commonplace. Changes in support payments mean that older fattening cattle are no longer around, weaned cows are often now back at pasture or held in specific dry cow sheds, and tight calving periods mean limited age ranges housed together, so coupled with lower stocking densities housing is less of a driver in the incidence of BRD than it has been. In addition the careful use of vaccination can also have an impact where housing is less than ideal. One difficulty is that you can be asked to assess an empty shed in advance of housing; it can seem fine then in terms of atmosphere and air balance, but when full of calves on a still, steamy day?? Smoke bombs help, or burning damp straw, but not in a plastic bucket!!

BUT, we still see:
1. Sheds where little attention is paid to the fabric, so lying water is common, increasing humidity
2. Too few inlets is usually the problem, often they cannot be altered
3. Covered ridges, usually historically from when grain was stored
4. Pen sizes too large
5. Farms sited and developed in low lying areas of the country.

Solutions:
1. I have found little appetite in my clients for the ‘maths’ behind air flow in buildings, but am aware of the benefits farm building designers can bring in the control of BRD.

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2. Try to affect stocking density by taking a whole farm approach to where cattle are to be housed – keep the most vulnerable in the smallest groups with the best housing facilities.

3. Make sure no rain water can get into the buildings and ensure all water troughs are well maintained and not leaking.

4. Keep the best dry straw for the main risk period - the 10 weeks after housing.

5. An outside feeding area can work wonders, pulls the calves outside to feed, reduces the need for bedding, cuts down on the moisture in the shed, and can usually be done in most situations. Need not be costly, big bales can form the barriers, and you are often surprised how many calves spend many hours outside. For me this is the number one solution to poor shed quality and ventilation.

**Keith Cutler replies:**
The most common problems I recognise with ventilation in naturally ventilated buildings include: an insufficient air inlet area, either because of poor building design or because inlets have been blocked either intentionally to ‘keep the calves warm’ or accidentally by, for example, stacking bales or piling rubbish against the side of the calf shed or by allowing vegetation to grow over the inlet; an insufficient height difference between the air inlets and outlets and modern buildings which are too wide to ventilate naturally. Assessing the scale of the problem is not an exact science. On some farms calves appear to be reared perfectly well in appalling conditions. Need not be costly, big bales can form the barriers, and you are often surprised how many calves spend many hours outside. For me this is the number one solution to poor shed quality and ventilation.

Where improvements are required, the solution may be obvious and easy: increasing air inlet area for example by removing bales, rubbish or overgrown vegetation. Removing boards from space boarding, or blocks or sheets of wall cladding may also be useful and necessary. Any advice involving changes to the structural integrity of a building should, in my opinion, be referred to a suitably qualified and experienced structural engineer.

**John MacFarlane replies:**
The single most common failing in cattle accommodation is overstocking. This applies whether the building is of traditional or modern design - an overstocked modern building is worse than a sensibly stocked traditional one. It is often necessary to calculate stocking densities to demonstrate this fundamental flaw.

Generally, finances constrain the extent of achievable improvement. More often than not I find myself concocting corrals as run-out areas to provide a breath of fresh air. I have, on occasion, resorted to building design consultnts to press home a point and I should do this more often.

**Tim Potter replies:**
Overstocking is a frequent problem; but, we also see issues with small groups of animals tucked away in the corners of large barns where their body heat is insufficient to drive natural air movement. In pre-weaned animals we see a lot of problems with wet surroundings, often from the preparation and distribution of liquid feeds; this leads to problems with humidity in the environment. I will always assess the environment in the context of the pattern of disease and in light of the other risk factors identified on the farm. Smoke bombs are a useful tool for demonstrating deficiencies in ventilation and provide a great way to get the farmer engaged in talking about buildings etc.

**Robert Anderson replies:**
1. Is the herd open or closed - if open you will need to use as multivalent a vaccine as possible. If closed then herd health status and previous disease history will help decide on which vaccines to use.
2. Are purchased cattle to be introduced, if so IBR vaccination will be essential. Avoid co-mingling as much as possible
3. Compact calvings to make grouping calves on weight and age easy
4. It is crucial to introduce concentrate feeding prior to weaning, if possible the same type as will be fed after housing
5. Worm with a suitable product at the handling two weeks prior to housing
6. Complete the vaccination course at least two weeks before housing. I have seen some severe outbreaks when the course has been completed at housing and BRD has developed within 10 days - on such occasions manufacturers will point out that it will take up to two weeks for vaccine generated protection to be complete, and support accordingly
7. House when the weather is benign - dry and cold
8. Practicality now means that weaning and housing take place on the same day - I find clients are unable to wean and keep groups of cows and calves separate at grass. As such no other stressors should be present, so no injections or change of feed, dehorning etc
9. For herds that introduce vaccination at housing with no prior weaning preparation, I advise housing the cows and calves together until three weeks after vaccination is complete, and then remove the cows
10. Take at least a four week period before cattle are on ad lib feeding. This slow build up prevents ruminal acidosis playing a role in BRD
outbreaks, and also allows easier detection of sick animals when being fed twice daily instead of through a hopper.

11. Remember respiratory vaccines are an aid in the control of disease, and without management changes as above will struggle to control disease alone.

Keith Cutler replies:
Much information is provided in this question to direct the answer. The fact that the animals are home-produced means that the likely pathogen challenge can be, to some extent, predicted. In particular, the BVD and IBR status of the herd should be known and controlled. Also, because these are spring-born calves that are to be vaccinated in the autumn, interference in vaccine efficacy by colostral antibodies need not be an issue.

Consideration must be given to other management and husbandry tasks which may be being carried out at the same time. Will, for example, the calves be weaned, wormed, vaccinated and housed all at the same time, in which case the use of an intra-nasal vaccine to provide rapid protection may be indicated, or will these management tasks be separated and carried out prior to housing, in which case more time will be available to complete a two dose course of parenteral vaccination, which may give a slower onset but longer duration of protection, before the predicted time of challenge.

John MacFarlane replies:
The design of any vaccination program starts with an accurate diagnosis of the causal agents in previous outbreaks. Again, this is best done by BAL and nasopharyngeal swabs.

The most appropriate vaccine combination can then be selected. I recommend that the vaccination course is completed by two weeks before housing (although it has to be said that some farmers don’t comply with this advice).

If no confirmed diagnosis is available, I generally advise a two dose multivalent vaccine, which may mean commencing the program up to six weeks before housing.

An increasing number of clients (particularly those in CHeCS BVD schemes) now use single dose intranasal vaccines and boost them halfway through the housing period.

However, implementing a vaccination program does not, on its own, solve a BRD problem. The management actions described in the fourth question are crucial to its success.

Tim Potter replies:
As for any vaccination programme it needs to be tailored to the needs of the individual farm and to ensure uptake it should be practical in the context of their management system. I would advocate completion of a full vaccination course prior to risk period (i.e. housing). As has already been alluded to, this is sometimes not very attractive to producers, due to the need to handle the animals twice before housing, but the long-term benefits are clear.

4. Pre-conditioning was a term used by the beef industry in North America to cover a management programme to ease the transition of cattle from the range to the feedlot. Does this concept have any merit for the UK situation? What would be the important elements of pre-conditioning for the UK and how could it be managed?

Robert Anderson replies:
The American feedlot system is supported by essentially two types of calves. The first are Age and Source Verified calves, usually from larger well managed herds and will have gone through a range of pre-conditioning programmes that include worming and coccidiosis treatments, and numerous viral vaccine programmes plus introduction to feed. These calves are much sought after and achieve high prices in the sale barns, as feedlot operators know
they will suffer little in the way of BRD and will achieve high weight gains (with the help of hormone implants), with reduced medicine costs and low mortality rates, in the region of 1–1.5%.

The other source are light weight calves, often from small herds in the south east, often collected in small groups at sale barns, co-mingled until a truck load is reached, then hauled for 10 hours plus in many situations. They have no pre-conditioning, and suffer from high levels of disease. Growth rates are low, mortality can approach 10%, and finishing times are extended. They incur higher costs but cost substantially less to buy.

Pre-conditioning has immense benefits for the UK situation, and has been practised under the heading of weaning management in this practice for many years, before the use of respiratory vaccines became commonplace.

Important elements would be:
1. Introduce creep feeding in advance of sale
2. Keep calves in even groups according to age and weight
3. Control diseases such as coccidiosis and PGE, dosing to be done at the second handling
4. Complete vaccination programme two weeks in advance of sale – in most cases a vaccine covering as many viral agents as possible should be used
5. The use of a Pasteurella vaccine may be indicated in some cases
6. If possible wean in advance of sale, keep calves outside
7. It is important to remember that these calves still need to be managed with care on arrival at their new home. Careful feeding, remaining in their own groups with no additions, and good quality housing will be needed to ensure smooth progress into the final fattening phase.

Keith Cutler replies:
There is frequently a temptation to look at farming systems that are successful in other parts of the world and try to import them into the UK. This, in my opinion, is not necessarily sensible; we are in the UK, not in other parts of the world and while some of the challenges faced by our farmers may be similar to those faced by farmers in other places and some of the management techniques used may be useful in our situation, many of the challenges are very different. In the USA beef calves are transported vast distances to be fattened in huge feedlots on diets very different to those being fed, in most cases, to fattening cattle in this country. Pathogen challenge may also differ (type II BVD for example) and weather conditions, at both temperature extremes, are not the same in the USA and the UK. There are, however, important lessons to be learned. If pre-conditioning means knowing the health status of the animals that you are buying or contracting with the farm of origin that certain management tasks, for example parasite control or vaccination, will have been carried out prior to shipment then yes, of course it has merit in the UK situation. The important elements of pre-conditioning are dialogue and a partnership approach between calf producers and finishers and their vets to implement, dare I say it, herd health planning to the benefit of all involved.

John MacFarlane replies:
Yes. I encourage my farmers to take every opportunity they can to stack the odds in their favour and against BRD. Specifically;
1. Pre-housing worm control with a product with persistent effect – clear out lungworms and gutworms. Fluke treatment may also be necessary
2. Control herd BVD by vaccinating adults
3. Optimise nutrition including trace elements. Independent ration formulation if possible
4. Ideally, wean before housing and start feeding the winter ration for a few weeks before housing
5. Ideally, complete vaccination courses two weeks before housing
6. Ideally, leave castration and dehorning until after they have settled into the housing period.

Tim Potter replies:
The pre-conditioning programs involve a multifaceted approach to promote calf health as they are weaned and moved into the feedlots, with people often paying a premium for calves that have been through such a programme. I think the concept of a structured approach to vaccination, nutrition, and management has a lot of merit for the UK situation, as long it is designed around the specific requirements of the farms/systems involved.