BVDV in Australian dairy herds

Bovine Virus Diarrhoea Virus (BVDV) infection cycle

Most dairy herds in Australia experience regular cycles of infection with BVDV. Cattle usually become transiently infected (TI) then eliminate the virus and develop long lasting immunity. However, if a cow is infected in the early stages of pregnancy, her foetus may die, or become persistently infected (PI), which means that the calf does not develop immunity and continues to shed large amounts of virus throughout its life.

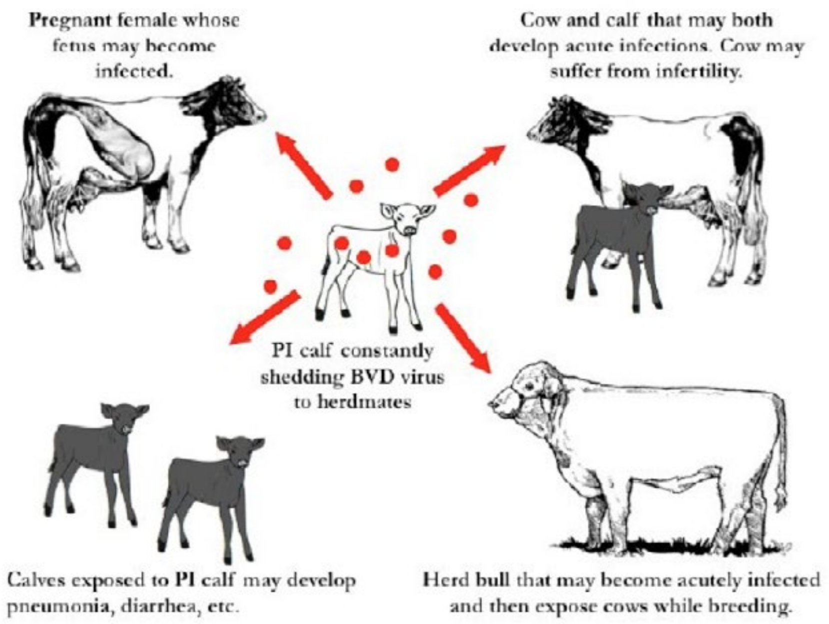
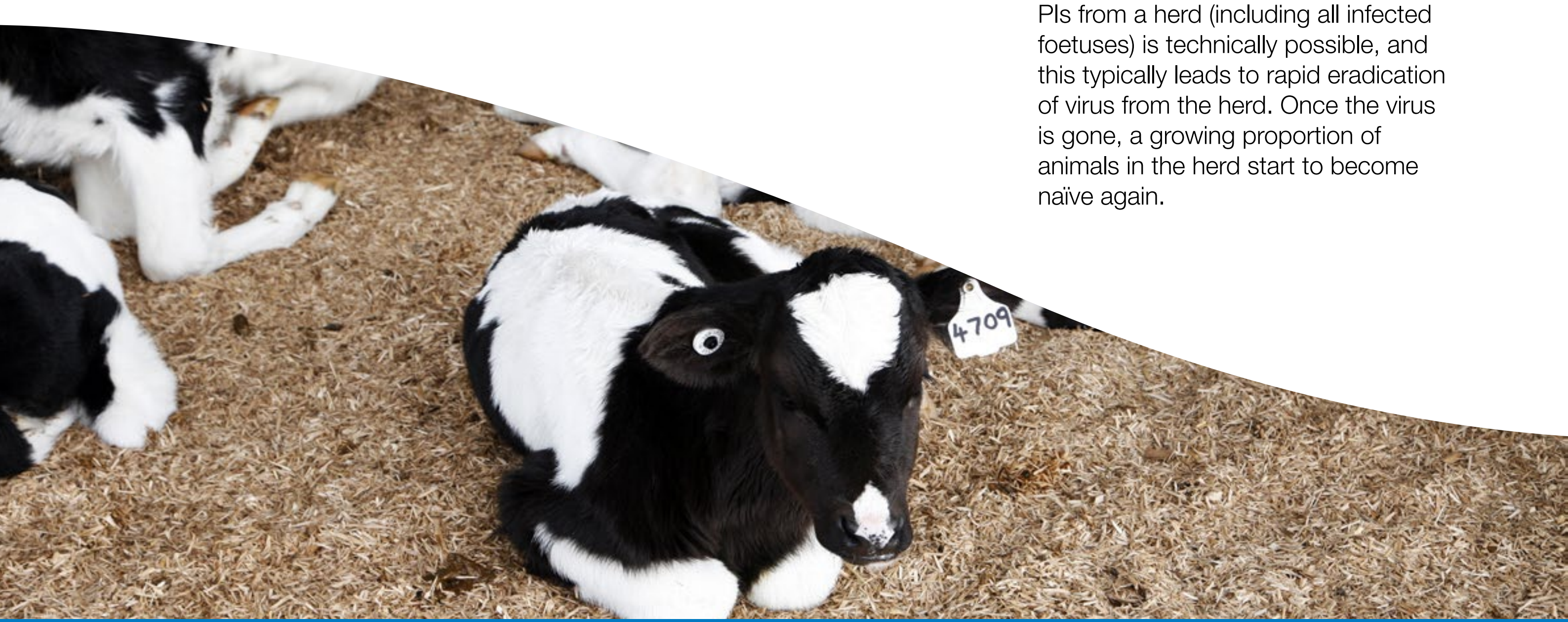


Figure 1. A PI calf constantly exposes herdmates to BVDV via saliva, urine, feces, tears, mucous, and any other bodily secretion.

The frequency of infection cycles depends largely on the proportion of cattle within the herd that have no immunity to BVDV. This proportion changes continually and when combined with the natural turnover of animals within a herd, it means that BVDV risks are never static in infected herds. The timing and extent of cycles of infection can also differ between groups of cattle (calves, yearlings, cows) within the herd. The frequency of introductions to the herd and the biosecurity measures applied also influence the way BVDV infection behaves in different herds.

The risk of re-introducing BVDV in herds that have eradicated BVDV is high unless specific actions are taken to manage this risk. Modelling of BVDV infection within dairy herds suggests that a 7–10 year virus eradication and re-introduction cycle is typical when no BVDV controls (including no BVDV-specific biosecurity measures) are undertaken.

PI animals are the main reservoir of viral infection. TI animals are only infectious to other animals for a few days. In herds with TIs, but no PIs, the virus usually disappears from the herd within one month. Removal of PIs from a herd (including all infected foetuses) is technically possible, and this typically leads to rapid eradication of virus from the herd. Once the virus is gone, a growing proportion of animals in the herd start to become naïve again.



Infected herds, and smaller management groups of cattle within herds, often self-eradicate the virus when all permanently-infected (PI) cattle (including infected foetuses) are removed (culled or die) and all transiently infected (TI) cattle recover or are removed. Herd size is important - large herds are less likely to self-eradicate BVDV than small herds as infected animals are more likely to be present in the herd.

Calving system also has an important impact on BVDV ecology. Year-round calving herds tend to have more prolonged periods with circulating virus than similar sized seasonal or split calving herds, as there is more likely to be a PI animal present in the herd.

Economic impact of BVDV in dairy herds

Amongst herds with no BVDV control strategies, infected herds experience some ongoing financial losses from BVDV due to the impact on reproductive performance, calf health and cow immunity, compared to herds remaining uninfected.

Despite this negative effect on productivity, it is difficult to identify the physical or financial losses from BVDV. This is partly because infection of animals outside the vulnerable stage of their reproductive cycle typically causes few obvious signs. The impact of BVDV on a small proportion of animals within a herd is easily lost in the background "noise" caused by many other factors that result in variations in milk production, reproductive performance, disease levels and overall profitability.

The economic impact of BVDV over the long-term is modest, even in herds with no BVDV control, because at any point in time, many animals will be immune, and of those that are not, few become infected in the critical period between when mating starts to when they are 4 months pregnant. In most herds, few infections occur in these susceptible animals at one time. On average, approximately 5% of adult females will become infected with BVDV each year in seasonal-calving herds that do not control BVDV. Of these new infections in adult females, only around 2-3% occur within this high-risk period, and not all of these females will be pregnant.

The reduction in profit due to BVDV in seasonal and split calving herds on average over the long term is small –

and much smaller than long term losses from mastitis, reduced fertility and sub-optimal nutrition in most herds. Year-round calving herds typically lose slightly more profit than seasonal - or split-calving herds of similar size because more animals are infected at the vulnerable stage of their reproductive cycle.

BVDV can occasionally produce severe outbreaks, with many foetuses becoming infected and many PI calves born over a short period. This happens when the virus enters a group at a time when most females are immunologically naïve and at the vulnerable stage of the reproductive cycle. However, not all occurrences of rapid widespread infection result in large numbers of PI calves being born because the risk is also determined by the cows' stage of the reproductive cycle when virus is introduced. Table 1 shows the effect of herd calving pattern on the likelihood of serious BVDV outbreaks, based on computer modelling of infection cycles in herds with no BVDV controls in place.

Table 1. Likelihood of serious BVDV outbreaks and high risk periods by herd calving pattern in herds with no BVDV controls in place (developed from B simulation model)

Herd calving pattern	Frequency of sero conversion of 40% or more of a herd within a 3-month period	Likelihood of high risk periods for herd (<25% animals sero positive to BVDV) for at least part of the year
Seasonal calving	1 in 100 years	10% of years
Split calving	1 in 50 years	23% of years
Year round calving	1 in 20 years	25% of years

Such BVDV outbreaks can be serious and steps to prevent them are warranted. Cow and yearling heifer groups are at most risk of serious impacts from BVDV when a large proportion of the group is immunologically naïve in the period at the start of the mating period; the risk remains high until most pregnant cows are more than 4 months pregnant. If we assume herds with fewer than 25% of cows seropositive are essentially immunologically naïve, there is a reasonable likelihood that these high-risk periods will occur for at least some period of time within a year, depending on the calving pattern (see Table 1).

Profitable BVDV control strategies

Numerous BVDV control strategies are available, consisting of one or more activities. The complexity and cost of different strategies varies and must be weighed up against the expected benefits to the farm business.

Strategies to eradicate BVDV from infected herds are effective because it is easy to detect individual animals persistently infected with BVDV. The tests available have high diagnostic sensitivity and specificity. Most farms that embark on a test-and-cull program identify and remove all PIs within a year.

Economic modelling has shown that over the long-term, control of BVDV in seasonal and split calving dairy herds returns minimal extra profit on average. This is because extra returns arising from controlling BVDV usually only offset the extra costs of the control program. The long-term economic benefit of controlling BVDV in year-round calving herds is larger for some strategies. This is because the average annual economic impact of BVDV is typically greater in year-round calving herds. However, even for the most profitable strategies in year-round calving herds, the benefit:cost ratios and absolute returns from control are relatively small.

Year-round calving herds should profit more from simple control strategies than more complex control strategies (see examples below). The economic model predicts that more complex control strategies do not deliver sufficient additional benefits over the simpler control strategies to outweigh the additional costs and managerial effort required over the long term.

Example of a simple BVDV control strategy

- **routine vaccination of females - cows and/or heifers**
- **bull testing**
- **bull vaccination**

Example of a complex BVDV control strategy

- **routine screening of cows and heifers**
- **monitoring for presence of PIs, investigation and removal of all PIs**
- **Trojan-testing of at-risk calves and culling of PIs**
- **vaccination based upon screening test analysis**

Strategies to reduce the risk of an outbreak of BVDV

Even though the long-term economic benefit from controlling BVDV is generally small, outbreaks of BVDV in immunologically naïve herds can result in business-threatening losses depending on the number and class of stock affected. Investment in controls to prevent BVDV outbreaks should be considered, depending on the herd manager's attitude to risk and specific farm circumstances.

Serious outbreaks only occur when a high proportion of the cows and/or yearling heifers are immunologically naïve because the virus is not present in the herd. The elimination of the virus can occur spontaneously or as a result of the herd's BVDV control strategy.

Identifying herds containing a high proportion of immunologically naïve cows in the milking herd or replacement heifer groups is recommended, so farmers can make informed decisions to manage these high risk groups to minimise the risk of a serious outbreak.

A single bulk milk ELISA test for estimating the seroprevalence in milking cows is, at best, only moderately predictive of seroprevalence in the milking herd. If the bulk milk ELISA test result is low, the seroprevalence in milking cows is probably very low. However, if the result is high, a significant proportion of the milking cows may still not be immune. Blood or milk sampling of 20–30 representative individual cows is recommended to identify herds in this situation. The best way to define the immune status of groups of cows is to ELISA test a representative sample of animals.

Seroprevalence should be assessed at the right time to implement control strategies (should these be necessary). Measure the seroprevalence in cows in seasonal and split calving herds at least 8–10 weeks before mating starts or when cows are in late lactation to ensure enough time to implement controls if a large proportion of the herd is immunologically naïve. In year-round calving herds, routine testing of cohorts of animals 8–10 weeks before they are to be mated is recommended.

Outbreaks tend to be more common in yearling heifers than cows, because younger animals are more likely to be immunologically naïve. This group may also be exposed to BVDV when grazed on boundary paddocks, out paddocks or on agistment, providing opportunity for contact with cattle from other herds. Calving heifers are a common route for introducing virus to the milking herd and to the calf rearing area (via their PI calves).

Regular and timely assessment of the proportion of yearlings that are immunologically naïve is a useful management strategy for preventing outbreaks. If a PI has been with the yearling group for some time, a high proportion of yearlings will usually be immune.

Example: recommended sampling strategy for yearlings managed as a single group for some time:

- test 10 or more animals

- **if 3 or fewer are seropositive, it is likely that most of the yearlings in the group are immunologically naïve**
- **if 7 or more are seropositive, it is likely that most of the yearlings are immune**

- **if 4–6 are seropositive then virus may have started to circulate and further testing of more yearlings at least 8–10 weeks before mating should be considered**

Where a high proportion of the milking cows are immunologically naïve, available strategies are:

- maintain effective biosecurity to prevent virus introduction
- introduce annual or bi-annual biosurveillance prior to the mating periods in seasonal and split calving herds, and/or
- seriously consider vaccination because of the potential consequences of BVDV infection of the herd.

Vaccination of at least the yearling heifers should be considered if a large proportion of them are immunologically naïve and contact with other cattle is likely during mating and early pregnancy.

Effective control of BVDV will reduce circulation of virus. If implemented in the cow herd, increasing numbers of cows will become immunologically naïve over time as natural immunity wanes. It is particularly important to maintain biosecurity, timely bio-surveillance and/or vaccination plans following any program to control BVDV.

In general, farmers adopt and sustain simpler management strategies more commonly and for longer periods than more complex strategies. Thus, farmers may be more likely to maintain an effective ongoing vaccination program than effective ongoing protective biosecurity and/or timely biosurveillance. It is challenging to routinely maintain biosecure separation of groups, and to keep virus out of herds, especially in year round calving herds.

An alternative to ongoing testing strategies to assess seroprevalence in cows and yearlings is to routinely vaccinate cows and yearlings.

Attributing a disease syndrome to BVDV

Veterinarians should exercise caution when investigating herd syndromes such as reproductive failure, increased clinical disease etc that are suspected of potentially having a BVDV component. Antibodies to BVDV are very common in Australian dairy herds and so are often incidental findings; the presence of antibodies does not prove that BVDV is the cause of the syndrome under investigation. The evidence that BVDV may be involved is stronger if there is evidence of recent exposure (high antibody levels, changing/increasing seroprevalence, etc) or if a PI animal or BVDV-infected foetus/stillborn calf has been identified. Identifying viral antigen in more than one animal is generally stronger evidence of BVDV involvement in a herd syndrome than if this is detected in only one animal. Case-by-case work-up is required to investigate any possible association.

The advisor's role in BVDV

Advisors should recognise that farmers have many alternative demands on their time and funds. Before investing in BVDV control farmers should firstly assess whether there are more profitable long-term investments.

Deciding to leave BVDV unmanaged for now may be a rational strategy for many farmers provided that most cows and yearlings are immune after the natural exposure. However, a commitment to reassess the herd risks each year should be part of this decision. A key role of the advisor is to give the farmer the relevant information about the various BVDV control options available to them for their situation. The advisor need not be the final decision-maker for the farmer. Dairy Australia has also produced a concise outline of the recommended on-farm practices for BVDV control "BVDV Control Guidelines for Farmers".

How these guidelines were developed

The BVDV in Australian Dairy Herds fact sheet was developed by Dairy Australia to provide dairy farmers and their advisors with independent, economically sound advice on the epidemiology and control of BVDV in Australian dairy herds. The guidelines were developed in consultation with BVDV specialists, dairy farmers, industry representatives and veterinarians. A whole farm economic simulation model was used to model the impact on farm profitability of BVDV infection cycles and a range of BVDV management strategies. The BVDV technical working group reviewed the outputs from this model and incorporated expert knowledge of BVDV control measures, herd dynamics and farm management to develop practical guidelines that can be applied to a range of dairy farming systems.

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