

Dairy Toolkit

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Introduction – Dairy

The bovine viral diarrhoea (BVD) virus is endemic in New Zealand cattle and is the cause of animal health, welfare and economic losses on infected farms.

It is estimated that, at any point in time, about 15% of dairy farms have the virus circulating among herds and/or youngstock. Most dairy herds in New Zealand will become, or have been, infected with this virus.

What follows is a stepped approach that veterinarians and farmers can use to help manage this important viral infection on farm. It has the flexibility to be implemented according to different farming systems, the relative importance of BVD on farm, financial factors, herd infection level and risk profiles.

The control measures implemented must be practical and sustainable (financially and physically) and, over time, significantly reduce the economic, animal health and welfare effects of the virus on farm.

For some farms, the most practical and economical approach will be to put in place a “test and cull” policy, followed up with good biosecurity and regular monitoring. For others, the most realistic solution will be to vaccinate the whole herd and screen keeper calves* for persistent infection (PI), while gradually improving biosecurity over time.

Whatever the control programme agreed to on a farm, the most important step is the first one.

** A keeper calf is any calf that stays on the farm until after it turns two months old and/or is released on to the farm from the rearing shed.*



Tools are now available for farmers to use to:

- establish whether their herds are currently infected
- eliminate infection from their farms if the herds are infected
- reduce the risk of re-introducing the virus
- check that the virus has not been re-introduced.

Getting Started

Read the sections that follow to familiarise yourself with the process and the options often available for each action. Become familiar with these options so that you can pick the most suitable for a particular farm system.

Follow the four-step process outlined in the next section.



The Four-Step Process

Setting up a BVD-control programme on an individual dairy farm is a four-step process.

- 1 Define the BVD status of a herd.
- 2 Assess the level of biosecurity practiced on farm.
- 3 Action the most appropriate course of control for the farm.
- 4 Monitor progress.

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1 Define the herd's BVD status in broad terms with a bulk tank milk (BTM) antibody (Ab) test

- Is the herd, or has it been, exposed to the BVD virus in the past few years (sample to positive control ratio (S/P >0.75)?
- Is the herd naïve or been BVD virus-free for the past few years (S/P ≤0.75)?

Supporting documents

Appendix 1: Method of Collecting Bulk Milk Samples from the Milk Vat/Silo
Screening a Dairy Herd for BVD, page 14.

The Four-Step Process

2 Assess the level of biosecurity practiced on farm by going through the risk assessment questionnaire with the farmer

- Is there a low probability that the BVD virus will be re-introduced (once removed, if it is an infected herd)?
- Is there a moderate to high probability that the BVD virus will be re-introduced (once removed, if it is an infected herd)?

Work with the farmer to fill out the risk assessment questionnaire (Appendix 2 or 3). Make sure you prompt the farmer to remember odd stock movements that can easily be forgotten. If using the “Quick Risk Assessment” (Appendix 2), use page 2 as the memory jogger.

Highlight the farm practices that incorporate a risk of BVD virus entry, and discuss with the farmer how they feel about making changes to limit this risk.

Supporting documents

BVD Biosecurity

Appendix 2: Quick Risk Assessment for BVD Virus Introduction in Dairy Herds

Appendix 3: Full Risk Assessment for BVD Virus Introduction in Dairy Herds

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3 Decide on the most appropriate course of action, taking account of points 1 and 2, plus the farmer's and vet's motivation, costs to be incurred, levels of benefit, practical issues and timeframe for progress

Refer to the table below and work through the options listed based on the herd infection level and current level of biosecurity. Farmer buy-in is a must, so go through each step carefully to make sure the farmer fully understands how much effort and cost is involved. Then review the "Actions to Control BVD in Dairy Herds – Checklist" (Appendix 4) to ensure all aspects have been covered.

The farmer does not need to do all the options outlined in the table, but on many farms more than one option will be required. For example, with an infected herd where biosecurity is a problem, one farmer may choose vaccination instead of improving biosecurity because of the costs or farm system. Another may find it simpler and cheaper to improve biosecurity and not vaccinate, whereas a more risk-averse farmer may prefer to do both for a few years.

BVD options based on herd status and level of biosecurity

BVD status	Infected now or recently	Infected now or recently	Not infected	Not infected
Biosecurity level	Good biosecurity	Questionable biosecurity	Good biosecurity	Questionable biosecurity
Options	<ul style="list-style-type: none">• Screen and remove Pls• Target vaccinate• Monitor	<ul style="list-style-type: none">• Improve biosecurity• Vaccinate• Screen and remove Pls• Monitor	<ul style="list-style-type: none">• Monitor• Target vaccinate	<ul style="list-style-type: none">• Improve biosecurity• Vaccinate• Monitor

Supporting documents

Actions to Control BVD

Screening a Dairy Herd for BVD

BVD Biosecurity

BVD Vaccination

Appendix 4: Actions to Control BVD in Dairy Herds – Checklist

The Four-Step Process

4 Monitor progress

All herds undergoing some sort of BVD-control programme must have at least an annual monitoring step, so that:

- progress can be measured
- any viral incursion can be detected before it has a major impact.

Supporting document

Monitoring the BVD Status of a Dairy Herd



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Screening a dairy herd for BVD involves a systematic approach as follows:

Request a BTM Ab test.

Request a BTM polymerase chain reaction (PCR) test if BTM Ab S/P is >0.75 .

Sample lower-producing individual cows for the BVD virus if a PI is confirmed in the milking herd from the BTM PCR test.

In all herds, screen youngstock for the presence of PIs.

1.1 Determining the herd's exposure level with a bulk tank milk antibody test (BTM Ab)

This is generally the starting point for defining the BVD status of a herd of dairy cows. The level of antibody in the BTM is proportional to the herd's level of BVD exposure. Antibody is expressed as an "S/P" ratio; the higher the S/P ratio, the more antibodies are present in the bulk sample and the higher the prevalence of seropositive cows in the herd.

■ S/P ratio <0.75

These herds are unlikely to be currently infected. The BVD virus is unlikely to be spreading from cow to cow in such a herd. This means there is no need to search for any PI cows in these herds, as the probability of finding one is low ($<1\%$).

These herds may still occasionally generate PI calves if one or more cows becomes transiently infected (TI) (e.g. by neighbours' stock) in the first four months of pregnancy. Therefore the next step in these herds is to screen the youngstock for any PIs. Proceed to 1.2 "Screening youngstock for PIs".

■ S/P ratio 0.75-0.99

Up to 10% of these herds have a positive BTM PCR test, but in most cases further testing indicates these are due to TI rather than PI cows. However, an occasional herd in this range will have a milking PI cow, as indicated by a persistent positive BTM PCR test.

The next step in herds with a BTM Ab S/P in this range is to request a BTM PCR test and repeat it in two to four weeks if it is positive. Irrespective of these results, the youngstock need to be screened for PIs. Proceed to 1.2.

■ S/P ratio ≥ 1

These herds are either currently or have been recently infected. At least 40% of these herds contain at least one PI cow. In these herds, the next steps are to:

- identify whether the herd contains PI cows by doing a BTM PCR test
- screen the youngstock for PIs. Proceed to 1.2.

This is the end of Step 1. "Defining the dairy herd's BVD status". The remainder of this section describes how to find a PI in a dairy herd. To go to Step 2, go to the Biosecurity section on page 23.

1.2 Screening youngstock for PIs

The BTM Ab test only measures the exposure level of the cows in the milking herd. PI youngstock are still possible in herds within all three BTM Ab ranges.

- A herd in the lower BTM Ab category of S/P <0.75 may occasionally have a PI in the youngstock if one of the cows or previous R2 heifers has become TI in the first four months of pregnancy (e.g. by the neighbours' or other heifers co-mingling while grazing).
- In contrast, a herd with a very high BTM Ab S/P ratio may not always have any PI youngstock. It depends on whether there has been any viral transmission in the herd during the first four months of pregnancy, and whether any PI calves born have been kept (e.g. they may have been bull calves or heifers' calves, or died before being tested).

PIs may also be present in one of the youngstock age groups but not the other, i.e. calves or heifers.

To define fully the BVD status of a dairy herd, it is important to screen both age groups of youngstock, irrespective of the herd's immunity level as determined from the BTM Ab S/P ratio.

There are two methods for doing this screening – direct testing for PIs and indirect testing.

Screening a dairy herd for BVD involves a systematic approach as follows:

Request a BTM Ab test.

Request a BTM polymerase chain reaction (PCR) test if BTM Ab S/P is >0.75 .

Sample lower-producing individual cows for the BVD virus if a PI is confirmed in the milking herd from the BTM PCR test.

In all herds, screen youngstock for the presence of PIs.

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1.2a Direct testing each animal for PI

This is the recommended procedure.

In this method, either blood (serum) or an ear notch sample is taken and examined for the presence of the BVD virus. PCR and/or ELISA technologies are used for this purpose.

The decision on which sample to take and which test to request will depend on the relative importance of convenience and cost. However, as colostral antibody can interfere with the ELISA test on blood and ear notches it is important to wait until calves are older than 35 days of age before sampling.

A positive result confirms an animal is PI in most cases. However, some transient infections can also be detected by these technologies, so any positive animal should be re-sampled three or four weeks later. Two positive results confirm a PI. A positive followed by a negative result is consistent with a TI animal.



1.2b Indirect testing for the presence of PIs

The indirect method is recommended only if the cattle are unvaccinated and there is a low chance that a PI is present in the group (e.g. there is good biosecurity and the herd BTM Ab S/P ratio is <0.75).

This test relies on the fact that in groups of cattle with one or more PIs, there is a high prevalence of seroconversion in the cohorts. Sampling a group for antibody can determine indirectly if there is likely to be a PI present.

There are two possible approaches:

Sample (sera) from 15 animals at 10 months or older:

- Fewer than three positive – there is no PI in the group, and there is no need to hunt for a PI.
- Three or more positive – a PI may be present in the group. Test all animals for a PI (see 1.2a).

Or

Request that all 15 sera be pooled:

- Pooled serum BVD Ab S/P <0.17 – there is no PI present in the group from which the sample was taken or in the wider group.
- Pooled serum BVD Ab S/P $0.17-0.75$ – PI is unlikely in the group.
- Pooled serum BVD Ab S/P ≥ 0.75 – a PI may be present in the group. Test each animal in the wider group for a PI (see 1.2a).

The advantage of this indirect technique is that it is cheaper if few samples contain antibody. If antibody is found in some animals, direct testing for PIs is required, which makes it more expensive than just sampling all animals for the BVD virus at the beginning.

However, there are major limitations to the indirect method:

1. Unless the herd is naïve (BTM Ab S/P <0.25) the test cannot be used on cattle less than 10 months old because colostral immunity can give a false-positive result during this time. Direct testing for PIs is still required for the younger age group of youngstock.
2. Vaccination can sometimes give a false-positive result, depending on the particular type of antibody test used.
3. The antibody status of yearling cattle that are at a run-off or out grazing and are mixed with other cattle may have no relationship to whether their group contains a PI or not. The PI may be present in the other cattle.

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1.2c Delayed screening of youngstock for PIs

This is recommended only in herds that are having an initial BVD screen at a time when the rising two-year-old heifers are off the property.

In this method, the screening of rising two-year-old heifers is delayed until they are milking in the herd, at which time a BTM PCR test is requested. A positive result in a herd that was PCR negative the previous year indicates that:

- a PI cow has gained entry to the herd somehow (e.g. when a cow is bought in or leased, a neighbour's cow comes over the boundary fence or the farmer is milking a cow from another herd)
- one or more of the new heifers in the herd is PI
- there is a transient infection within the herd.

If the BTM PCR is positive, sample all suspect individual animals as per 1.2a "Direct testing each animal for PI".

1.3 Determining if there is a PI in the milking herd

Proceed with this step if the herd's BTM Ab S/P ratio is >0.75 .

PCR test on BTM

The PCR technique used in New Zealand laboratories is sufficiently sensitive to detect the BVD virus in milk from one PI cow in a milking herd of any size in New Zealand.

Occasionally it will also detect the presence of TI cows in the herd.

What does a negative BTM PCR test mean?

A single negative PCR test on a BTM sample identifies those herds that do not currently contain a PI milking cow, as long as all the milking cows contributed milk to the bulk tank that was sampled.

As PI cows are more susceptible to infectious diseases, and also tend to produce less milk than their herd cohorts, there is a real chance that a PI will not be contributing milk to the vat on the sampling date. This is because, for example, they are being treated with antibiotics or have been dried off early.

This means that, around the time the BTM PCR test has been requested, cows not contributing milk to the vat need to be recorded. These can then be tested individually for the BVD virus or a second BTM PCR test can be requested once these animals are back into the supply.

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What does a positive BTM PCR test mean?

Those herds that test PCR positive on the BTM will most likely contain one or more PI cows. The next step is to either:

- start screening for PI cows (as per 1.3a) if the BTM Ab S/P was ≥ 1 , or
- request another BTM PCR test in four weeks (recommended if the BTM Ab S/P was 0.75-0.99).

A second positive result strongly suggests a PI is present. Proceed with 1.3a.

A negative second test result would indicate that:

- the PI cow(s) has gone from the milking group (e.g. died, been culled, dried off), or
- the PI cow(s) did not contribute milk to the vat sample for another reason (e.g. it was on antibiotics), or
- the original positive result was due to TI cows.

Test all cows for the BVD virus that did not contribute milk to the vat at this second sampling, and review herd records to detect if any cow has gone from the milking herd in the time between the two BTM PCR tests.

1.3a Identifying the PI cow(s) in the milking herd

If the BTM PCR result is positive due to the presence of a PI cow or two in the herd, the farmer may wish to clear the milking herd of these cattle. The following method has been shown to be an efficient way of identifying a PI cow(s).

Rank the herd from lowest to highest kilogram of milk solids (kg MS) production at the latest herd test. This can readily be done in MindaPro or Mistro. Blood sample the lowest 10%.

1. Request pooled serum BVD PCR tests on these animals.
2. If the BVD virus is detected in one or more animals, remove these PI cows from the milk supply. If no cows are identified as PI in the first screen, select the next 10% of low producers and repeat the process until a PI cow is found.
3. Arrange another BTM PCR test once the PI cows have been removed. Record all cows not contributing milk to the vat at the time the BTM sample was collected.
4. If the BVD virus is not detected in the BTM sample and in the individual samples from the cows not contributing milk to the vat, all the PIs have been identified.

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1.4 Screening miscellaneous cattle on the farm

Dairy farms often have a few other cattle at times, such as steers for meat, grazing cattle for friends/family, cattle for fundraising projects, bull calves and mature bulls for mating. If these animals have direct or indirect contact with any pregnant animals on the dairy farm, they need to be screened for PI as well. Refer to 1.2a.

NB: TI animals may return positive results. These animals will be non-viraemic a few days later, and there is an option to retest in 28 days. A second positive result will confirm that they are PI, while a negative retest result will be consistent with their being TI.



Becoming BVD biosecure involves setting up and implementing a set of preventative measures designed to reduce the risk of the virus being introduced to and spreading on the farm.

The three words **In**, **Out** and **Over** can help to jog your memory on the key biosecurity areas when talking to farmers.

Improving animals' immunity by vaccination is also a biosecurity measure, but for the purpose of this document vaccination has been separated from biosecurity. However, when formulating a control programme for a farm, it may be helpful to consider vaccination under the biosecurity umbrella.

2.1 How do you assess the biosecurity practices on a particular farm?

Fill out a "risk assessment" questionnaire with the farmer (Appendix 2 or 3).

You can choose between the full and the quick risk assessment questionnaire. The "full risk assessment" questionnaire has all the questions you may need to ask the farmer. It is designed to make sure nothing is left out and is the recommended questionnaire to use on the first few farms.

As you become more familiar with the questionnaire, you may find it simpler and faster to use the "quick risk assessment" version. In this version, the questions are condensed but you will need to expand the questions to make sure the farmer thinks of all the possibilities underlying them. Refer to the back of the questionnaire (Appendix 2) for help with this process. Also use your knowledge of what can happen on farm to help with this risk assessment. Depending on the farm/farmer, you may also find it necessary to travel around the farm, looking at the state of boundary fences, river floodgates, land slippages etc that could impact on biosecurity.

The key areas of biosecurity on which to concentrate for BVD are:

In

Cattle coming on to the property, including their foetuses.

People coming on the farm, as well as their instruments and vehicles.

Out

Cattle going off the property and returning pregnant at a later date.

Over

Contact with neighbours' cattle.

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2.2 What is the next step once the questionnaire has been completed?

The questionnaire will identify areas of good biosecurity practice and those that need addressing.

Maintain good areas of biosecurity and concentrate on those that need addressing and explore each of them. Are there practical and cost-effective steps that the farmer can take to reduce the risk? If the risk cannot be reduced sufficiently, is there a way to detect a viral incursion early, before it can affect the herd?

For example, if direct contact between cattle across a boundary fence cannot be prevented, think about screening keeper calves for PIs before they leave the rearing shed, to minimise the impact of viral entry from the neighbours. Also consider vaccinating at-risk animals as a means of mitigating any risk. Cattle in the “Out” category are an obvious target group for potential vaccination.

Supporting documents

Appendix 2: Quick Risk Assessment for BVD Virus Introduction in Dairy Herds

Appendix 3: Full Risk Assessment for BVD Virus Introduction in Dairy Herds

Appendix 4: Actions to Control BVD in Dairy Herds – Checklist. This gives you most of the options for each of the biosecurity risk areas

Actions to Control BVD. This provides in-depth information on each of the possible control actions

BVD control can be challenging to achieve. PIs are the main source of infection and the main mechanism for maintaining infection within a herd. The goal of BVD control should be to prevent PIs entering the herd, which happens most often through the birth of PI calves.

For example, although calves and yearlings out grazing might suffer the consequences of exposure to BVD, they are not a long-term risk to the herd unless they come back with PI foetuses that are then kept. Similarly, a few cows' over-the-fence contact with a neighbour's PI may be very bad for those cows, but unless transient infection is maintained long term (there is currently only weak evidence of this being an issue), it is only a significant problem for the herd if that contact results in PI calves being born the following season and remaining in the herd.

There are basically three possible actions to control BVD in a herd:

- Test for the virus and cull PIs.
- Vaccinate.
- Change management to reduce the risk of exposure.

These three actions can be applied to just five routes through which a PI might gain access to the herd:

1. Bulls.
2. Bought-in cows and "Trojans" (PI foetuses inside immune cows that are formed early in pregnancy, usually in bought-in cows. When born, they are a potential source of infection in the herd).
3. Neighbours' stock.
4. Calves, especially from heifers, and from stock away from the herd during the first four months of pregnancy.
5. Indirect contact through people coming on to the farm (vets, scanners, AI technicians, embryo transfer procedures), and through transporters that could introduce BVD-contaminated biological materials.

See Appendix 4 for a full checklist.

Screening animals to find a PI is also an action to control. This has been covered previously on pages 15 - 22.

There are basically three possible actions to control BVD in a herd:

- Test for the virus and cull PIs.
- Vaccinate.
- Change management to reduce the risk of exposure.

The table below summarises where the three actions can be targeted to control each risk. The text that follows describes these in more detail and is arranged in the same way as the table. Note each section is designed to stand alone, so there is some repetition.

Actions available to deal with the risks to a herd posed by the main BVD sources

Options for control are broken down into “test and cull”, which involves looking for PI animals in the target group listed and culling any found, “vaccination” of the target group listed to protect it from the effects of BVD, and “management” options that reduce or prevent exposure. Options may be sufficient on their own, or best used alongside other options for a given source of risk. See the text following the table for more detail.

Options for control

Risks to herd	Test and cull	Vaccinate ^λ	Management
Bulls	bulls	bulls	AI only
Bought-in cows Trojans	cow/bulk tank calves	depends depends	do not buy in cows calve separately and do not keep calves
Neighbours' stock	calves	herd	border fence, outrigger, hotwire or avoid adjacent grazing
Calves from heifers	calves calves	herd heifer/herd	manage calf-cow contact calve separately and do not keep heifers' calves
from cows away in first four months of pregnancy	calves	before leave	isolate cows while away or calve separately and do not keep
People (vets, scanners, AI, ET, transporters)	calves	herd	best practice/no contact
Risks to individuals			
Calves away	-	calves	isolate
Heifers away	-	heifers	isolate
Cows away (e.g. carry overs)	-	before leave	isolate

^λThis assumes that the vaccine has a label claim for foetal protection.

Note this protocol focuses on preventing the creation of PI foetuses.

Although some control measures will not control some costs associated with transient infections, the primary aim is to prevent long-term infection of the herd, especially during the period when cows are less than four months' pregnant.

Vaccination will stop or reduce the spread and the cost associated with bought-in PIs, but will not prevent a PI from getting into the herd. Testing incoming cows and their calves, or not getting or keeping any, are the only ways to keep the herd free from this risk.

3.1 Risks to the herd

3.1a The risk from bulls

- Testing is absolutely essential to protect the herd from the introduction of BVD.
- Vaccination is also vital.

Control by test and cull methods

- All bulls should be tested for the BVD virus before contact with the herd and ideally before arriving on the farm.
- It is recommended that the farmer request a veterinary certificate for each bull to show that it has been tested virus-free and is not persistently infected.
- Testing can be done with a blood sample or ear notch at any age,* as one negative test result proves that the bull is not PI.

**Ag Elisa is not recommended on blood if calf less than 35 days old.*

Control by vaccination

- Vaccinate bulls to protect them from immune suppression and the negative reproductive effects of BVD infection, and to prevent them bringing transient infection on to the farm if exposed shortly before arrival or during transport.
- Vaccination will also prevent bulls spreading the virus on the farm.
- Vaccination will not have any effect on a PI bull, so testing is essential.

Control by management

- Herds that do not use bulls are not exposed to this risk.

It is possible for a bull to be infected around puberty, then persistently shed the virus in semen while being antibody positive and virus negative on serum. However, this is thought to be very rare, so semen testing for BVD is probably not necessary.

Bulls must be:

- BVD virus negative.
- Vaccinated before use.

A Trojan cow is a pregnant cow carrying a PI foetus.

3.1b The risk from bought-in cows and Trojan calves

- Bought-in cows and their calves are a major risk for introducing BVD to a herd.
- They include any cow or calf bought on to the farm, including bought-in, leased and borrowed cows.
- Any cow that is pregnant when she arrives could also be carrying a PI foetus (Trojan) even if she is immune at the time of arrival.

Control by test and cull methods

- Cows from herds with clear BTM PCR status will not be PI as long as they were contributing to the BTM when the sample was taken. Even if they have not been tested by PCR, a low BTM antibody herd is very unlikely to have an adult PI mixing with milking cows, so it should be low risk.
- If the source herd is of unknown or positive status, each bought-in cow should be tested for the virus before mixing with other stock.
- An alternative approach would be to wait until they have all calved, then test the BTM. There are likely to be substantial costs due to disease events and lost production if a PI is left in the herd through calving.
- All calves to be kept from bought-in cows should be tested for the virus as soon as possible after birth, and definitely before leaving the calf sheds.

Control by vaccination

- Vaccinating the cows in a herd will protect their foetuses from any bought-in PIs, and vaccinating bought-in cows will protect their foetuses from PIs already in a herd, but vaccination has no effect on PIs. Vaccinating cannot stop the herd from becoming infected, without virus testing as well.
- If bought-in cows have been vaccinated before conceiving, the foetuses should not be PI.
- Since a PI will always have a PI calf, a PI calf may inadvertently be kept despite vaccination if calves are not virus tested.

Control by management

- If you do not buy cows, you will not be at risk from bought-in cows.
- One option to avoid having to test all their calves if cows are bought-in is to cull or euthanise the calves as quickly as possible after birth, and take care to not carry infection from any PI calves to other classes of stock before they depart. To minimise the risk of keeping a calf by mistake due to mis-mothering, bought-in cows should be calved as a separate mob.

3.1c The risk from neighbours' stock

- Nose-to-nose contact with a PI is a very efficient way to infect cows, but BVD can also spread some distance through the air. A spread of 5 to 10 metres has been reliably demonstrated under controlled conditions, and a much further spread has been suspected in a few cases, although the practical importance of aerial spread is unclear.
- If infection enters the herd over the fence, there will be consequences for the individuals transiently infected around that time, but the infection will probably be self-limiting.
- The long-term risk for the herd will be from PI fetuses that result from that transient infection.

Control by test and cull methods

- One approach to prevent long-term infection of the herd from the neighbours is to test all keeper calves every year to detect when an incursion has occurred and prevent infection becoming established.
- As well as removing the infection if it occurs, this approach leads to all animals in the herd having a known BVD status over time (i.e. not PI). If an incursion later occurs and it is discovered that the herd is BTM PCR positive, only a small number of cows (such as any bought-in cows) would need to be tested to find the PI and clear the infection. This is because most cows will have been tested as calves and their PI status will be known.

Control by vaccination

- Vaccination of the herd will prevent most of the negative impacts from exposure to BVD from neighbours' stock.
- It should prevent long-term herd infection after contact with a PI by protecting fetuses.
- There may still be some costs associated with ongoing exposure to PIs despite vaccination, but this would only be an issue with sustained and repeated contact with PIs.

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Control by management

- Double-fencing, temporary hotwires and hedges are all likely to prevent direct contact with neighbours' stock.
- It might be possible to coordinate with neighbours to avoid having stock in adjacent paddocks, as is commonly done when bulls are present.
- BVD virus can survive for up to a week in the environment. As there is a risk of the BVD virus being transmitted via fluids and/or faeces, by use of shared equipment, shared yards/raceways and common grazing paddocks, management events should be separated by at least a week to ensure the virus is not spread via fomites.
- It is also important to consider:
 - fencing water boundaries where low water may allow crossing
 - taking additional precautions along road boundaries where stock moving down the road or wandering stock may come in contact with the herd.

3.1d The risk from calves

- Calves can be a threat to the milking herd.
- After infection with BVD, the birth of PI calves perpetuates the infection of the herd.
- Many management systems in New Zealand allow intermittent contact between calves and cows during the mating period, so a PI calf could lead to the birth of more PI calves in the subsequent season, even if it only survives for three or four months. If the young PI calf survives and has contact with pregnant cows it significantly increases the chance of maintaining infection in the herd.
- Since bobby calves are usually kept isolated and are on the farm for only a very short time well before the start of mating, the keeper calves should be the focus. Test for virus once they are older than 35 days of age.
- Heifers often graze off and may be less likely to be immune than older cows. A PI heifer or a heifer with a transient infection (in the first four months of pregnancy) will produce a PI calf. If this PI calf is kept as a “keeper” it will perpetuate the BVD infection in the milking herd.
- Keeping calves from heifers or cows that graze off the farm in the first four months of pregnancy is likely to increase the risk of PI calves being kept and introducing or maintaining the infection in the herd.

Control by test and cull methods

- Testing all keepers for the virus once older than 35 days of age (especially those from heifers or cows grazing off in the first four months of pregnancy) is the most effective way to manage this risk.
- If heifers have been tested for the virus, the only additional risks their calves pose would be due to having grazed off in early pregnancy. A heifer with a negative antibody test could be “at risk” of a transient

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Control by vaccination

- Vaccinating the herd will mostly protect it from PI calves.
- Vaccinating cows grazing off the farm in the first four months of pregnancy will protect foetuses so they don't become PI and threaten the herd after birth.
- Vaccinating heifers will similarly protect their foetuses while away grazing, but will not prevent a PI heifer having a PI calf.

Control by management

- Grazing weaner calves in isolation from the milking herd will minimise the risk they pose to the herd.
- Keeping cows in isolation when grazing off the farm while up to four months pregnant will minimise the risk from other stock, although infection during transport may still be a risk.
- Keeping calves from heifers is probably always a risk unless their calves are tested for the virus. Incorrect cow-calf identification is often a risk if they are calved with the cows.

3.1e The risk from people

- Anyone coming on to a farm could be a risk for introducing BVD if they are in contact with animals on other farms as well.
- Embryo transfer has additional risks that must be managed.
- Any equipment used with other animals should be considered a risk for at least a week unless it is well cleaned and disinfected.
- If infection enters the herd through indirect contact, there will be consequences for the individuals transiently infected around that time. However, the infection will probably be self-limiting unless PI foetuses result from that transient infection and are kept next season.

Control by test and cull methods

- An acceptable approach to prevent the long-term infection of the herd is to test all keeper calves for the virus every year, to detect when an incursion has occurred and prevent infection from becoming established (see “Control by test and cull methods” in 3.1c).

Control by vaccination

- Vaccinating the herd will prevent most of the negative impacts from exposure to BVD, including the formation of PI foetuses. It should prevent long-term herd infection after indirect contact with a PI as well as minimise the impacts of transient infection.

Control by management

- Any veterinarian or technician should be aware that even small amounts of biological material from a PI may be infectious, especially if applied directly to a cow (such as on a scanner probe or nose tongs).
- Spread within an infected herd is probably not an important issue as it will be readily occurring through direct contact, but spread between herds will be a problem.
- All equipment, boots and protective clothing should be properly cleaned or replaced between herds.
- Where possible, visitors such as transporters should be kept away from the rest of the herd and from areas to which stock have access, so that infection cannot be introduced through biological material on wheels or boots.

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3.2 Risks to individual cattle

- Stock grazing off the farm may be at risk of BVD infection as a result of transportation or contact with Pls.
- Calves, heifers and cows that are going to graze away from the home farm can be protected with vaccinations before they leave.
- In some situations it may be practical to keep them isolated from other cattle where they are grazing, but this will not protect them from the risks associated with transportation.
- The only way to protect stock from transportation risks (other than vaccination) is to thoroughly disinfect the vehicle before use and ensure they are the only stock on the vehicle. However, this will be impractical in most cases.



3.3 Costs – calculator

Based on a herd of 100 cows with 20% replacement rate

Vaccine cost per dose		\$ _____ (A)
BVD Elisa cost		\$ _____ (B)
Ear notch kit price		\$ _____ (C)
Pooled PCR cost		\$ _____ (D)
Consumables and collection charge/sample		\$ _____ (E)
Ear notch cost	B+C =	\$ _____ (F)
Pooled PCR cost	D+E =	\$ _____ (G)

3.3a Whole herd vaccination

First year – vaccinate all stock twice

140 x 2 x (A) \$ _____ = \$ _____ (+ veterinary charges and consumables?)

Subsequent years – boost all stock and calves primed

160 x (A) \$ _____ = \$ _____ (+ veterinary charges and consumables?)

3.3b Calf test and cull

Ear notch: 20 x (F) \$ _____ = \$ _____ (+ ear tagger and postage?)

PCR: 20 x (G) \$ _____ = \$ _____ (+ veterinary charges, consumables and postage?)

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For vaccination to be useful as part of a BVD control protocol, it must protect the foetus and therefore prevent PIs being born. In order to achieve this:

- The vaccine must be administered at a time and in a way that results in good immunity to prevent foetal infection during the first four months of pregnancy. Refer to the vaccine manufacturer's recommendations for this information.
- Only vaccines with a label claim for foetal protection must be used.
- The vaccination date and identification of all the animals that have been vaccinated should be recorded on a farm database (e.g. Mindapro).

3.4 BVD vaccination

A well managed and implemented vaccination programme is likely to significantly reduce viral transmission and consequent production of PI calves in BVD-infected dairy herds. It will also limit the economic and animal health impacts of viral introduction in BVD virus-free herds.

Vaccination therefore fulfils one of the objectives of on-farm BVD control by minimising the risk of BVD viral infection in susceptible (non-immune) cattle.

3.4a Integrating vaccination into a BVD-control programme

When developing a BVD-control programme on a farm, there may be a group of cattle whose risk of exposure cannot be minimised. If this is the case, it may be a good idea to vaccinate the group.

This will often be the case when:

- heifers and/or carry-over cows go off farm to graze. These animals may co-mingle or be next to cattle with an unknown BVD status. Vaccinating this group before it leaves the farm and again 12 months later will protect it from any health effects from transient BVD infection. Vaccination before mating will also protect the group from impaired reproductive effects during mating and pregnancy and, most importantly from a disease-control perspective, minimise the chance of a PI calf being born on the milking platform
- cattle go to shows or are leased out for a period while pregnant
- introduced cattle that are naïve or of unknown BVD status go on to a known infected farm. This most commonly occurs with rising two-year-old cattle returning home from grazing where the dairy farm is known to be infected. It also applies to bulls coming on to an infected property.

Essentially, any cattle that go off the farm and become pregnant should be fully vaccinated while off farm if there is any chance they could become exposed to BVD during pregnancy.

3.4b Using vaccination as the only control strategy

Vaccinating the whole herd once a year is one way to control BVD on a farm. However, it should only be done after other control methods have been examined and eliminated based on cost, practicality, sustainability etc. It is worth noting that vaccination may not prevent production costs associated with ongoing contact with a PI animal.

Whole-herd vaccination is most often considered when:

- the herd immunity is relatively low (BTM Ab S/P <0.75) but there is still a reasonable risk of viral introduction that cannot be significantly reduced by other means (e.g. screening keeper calves for virus, testing all incoming cattle)
- the herd is infected and whole-herd vaccination is used to reduce and eventually eliminate infection over time by minimising the production of PI calves. An alternative or supplementary strategy is to screen all keeper calves for PI.

As a minimum, whole-herd vaccination should only be recommended to a farmer once:

- the adult herd's BVD status has been established by doing a BTM Ab test
- a risk assessment has been undertaken to assess the biosecurity risks, and high-risk practices have been corrected where possible
- other control strategies, such as screening keeper calves, have been assessed.

Note that:

- vaccination may not be necessary in herds that are not currently infected and have good biosecurity. Instead, annually screening calves for PIs might be all that is required
- where there is a desire to clear infection quickly in an infected herd, a test and cull policy with follow-up vaccination as part of biosecurity would be more appropriate than vaccination alone
- in heavily infected herds where most adult cows are immune, it is likely to be more cost effective to test keeper calves for PI and vaccinate youngstock before they enter the herd.

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Once a decision to vaccinate the whole herd has been made, the vaccination programme needs to be well managed and conscientiously implemented to achieve the best possible results. All animals that have been vaccinated should be recorded.

Biosecurity measures should also be in place to limit the risk of introducing PI animals.

Supporting documents[Actions to Control BVD](#)

4

Monitoring the BVD Status of a Dairy Herd

4.1 Why monitor?

Once a herd's BVD status has been defined and control procedures put in place, regular monitoring of that status is generally recommended.

The purpose of this monitoring is to:

- identify whether control procedures are improving the infected herd's BVD status
- detect as quickly as possible any new viral introduction in a non-BVD-infected herd, to minimise its impact on the herd.

Supporting documents

Screening a Dairy Herd for BVD

Actions to Control BVD

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4.2 Monitoring methods

There are two ways to monitor a herd's BVD status:

1. Undertake a BTM Ab test.
2. Determine the virus status of young calves using skin or serum samples.

4.2a Undertaking a bulk tank milk antibody test

In this monitoring method, a BTM Ab test is undertaken:

- in mid-spring, once most/all cows are in milk and before mating for seasonal herds
- twice (spring and autumn) in a split calving herd.

Testing in both spring and autumn is also recommended for seasonal calving herds with a moderate or high risk of BVD introduction, as it has the potential to detect viral incursions earlier than a single spring test.

Any significant increase in S/P ratio needs to be investigated and explained:

- Has the herd been vaccinated since the previous test?
- Have immune cows been purchased or are the new entrant two-year-old heifers immune?
- Has there been infection since the previous test?

What is a significant increase in the BTM Ab S/P ratio?

A change in the BTM Ab S/P ratio of ± 0.25 is considered significant and warrants further investigation. Such an increase could be the result of herd vaccination, buying in a moderate number of cattle with a quite different antibody status from the herd, sampling the herd late in lactation, or exposure to BVD.

Smaller changes in the BTM Ab S/P ratio (<0.25) in either direction are not considered significant and probably do not warrant further investigation. Even in BVD-free herds that are not vaccinated, and where farms do not buy or sell animals, the BTM Ab S/P ratio will vary from sample to sample with a range of $\pm 10\%$. The factors that contribute to this variation include:

- normal test variations
- the stage of lactation (BTM Ab S/P ratios increase as cows' milk production drops towards the end of lactation). In spring-calving herds, it is recommended that the second test is done before March (NI) and late March (SI)
- the introduction of newly calved cows
- the removal of cows at the end of lactation.

What if there is a significant increase in the BTM Ab S/P ratio?

If the herd has not been vaccinated for BVD and cows have not been bought in, and a herd is sampled before late lactation, a new infection is the most likely reason for a significant increase in the BTM Ab S/P ratio. In this case:

- request a BTM PCR test and/or
- virus screen all keeper youngstock that have conceived between the two annual tests.

The BTM PCR test will identify whether a PI cow has been introduced to the herd – either as a BVD unscreened two-year-old heifer/carry-over cow or as an unscreened bought-in two-year-old heifer or cow.

Screening keeper youngstock has two benefits:

1. A positive test in one or more calves will confirm that the BVD virus was introduced to the milking herd during the previous pregnancy.*
2. It enables the removal of any PI calf before it can cause significant harm to the herd.

The procedure used will depend on the likelihood of a PI cow being introduced to the herd. If it is unlikely, it is best to screen the calves.

**As keeper calves represent only 20-25% of calves born on most dairy farms, a failure to find a PI calf in this group does not rule out viral introduction to the milking herd during pregnancy. For example, the PI could have been a bull calf that was bobbied or a heifer calf that died before testing.*

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4.2b Determining the virus status of young calves using skin or serum samples

In this monitoring method, all keeper calves (including any being kept for beef or sale) are screened for the BVD virus before leaving the calf-rearing shed. Delaying testing until the calves are grazing in paddocks poses a significant infection risk to the herd and other animals grazing the property.

Which monitoring test is best?

There are advantages and limitations for each:

BTM Ab test

Advantages:

- It is simple and cheap and therefore relatively easy to sell to farmers.
- It will detect a new PI animal introduced to the farm earlier than the calf screening test (unless the PI is a calf).

Limitations:

- An increase is not always due to viral introduction (see 4.2a).
- The test is unlikely to be sensitive enough to detect the exposure of one or two animals in the herd to a PI in a neighbour's herd. If such exposure results in the birth of a PI calf, calf screening has distinct advantages.
- Further testing is required to identify the PI animal.

The test does not determine if the PI animal is in the herd or in another class of stock that has significant contact with the herd (e.g. the PI could be a calf that co-grazes with the herd or it could be in the neighbour's herd).

Keeper calf screening for virus

Advantages:

- It directly identifies any PI animal, so it can be culled early – reducing the risk of more infection in the herd.
- It will detect the exposure of one or two animals in the herd or to a PI in a neighbour's herd earlier than the BTM Ab test, if the infected dam(s) produces a keeper calf.

Limitations:

- It is more involved and more expensive than the BTM Ab test, which could be an issue for some farmers.
- It will not detect the introduction of a PI animal to the farm as early as the BTM Ab test, if the introduced animal is not a calf and the PI animal has exposure to the herd.

It is best practice to undertake both monitoring procedures, as this has the best chance of detecting viral incursion before it causes large-scale herd infection.

However, if just one monitoring tool is to be used:

- the BTM Ab test is recommended if the greatest risk of viral introduction is from untested heifers coming into the herd or from bought-in, untested cows
- in most other situations, keeper calf testing will detect an incursion earlier and also identify the PI, thus enabling the problem to be fixed at the same time.

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4.2c Can calf screening be postponed until the keepers enter the herd as two-year-old heifers?

If a herd of cows has been previously tested and does not contain any PI animals, a positive BTM PCR test (for virus detection) once all two-year-old heifers have calved would indicate that one or more of these is a PI. Follow-up testing of all the two-year-olds would then detect the PI(s) that could be removed from the herd before mating.

The advantages and limitations of this method include:

Advantages:

- It is simple and cheap (as long as no PI is detected) and therefore relatively easy to sell to farmers.

Limitations:

- A virus has been introduced to the milking herd that could keep circulating for a while after the PI has been identified and removed. If this viral spread happens during mating, reproductive performance could be affected and PI calves subsequently produced. In some herds, the interval between the last heifer calving and the start of mating could be small, increasing the risk of the virus being present in the herd during the mating period.
- A BTM PCR test is less reliable than screening all youngstock as it is possible that the PI did not contribute milk to the supply on the day the sample was collected.
- A PI in this age group could have affected the health and reproductive performance of its cohorts and any in-contact stock during those first two years of life.

Where possible, it is better to screen calves at a young age rather than wait until they enter the milking herd.

Summary – BVD Control is a Four-Step Process

1

Use a bulk tank milk antibody test to establish whether the herd is infected

S/P >0.75 Herd is currently infected or has been in previous two or three years

S/P ≤0.75 Herd is not infected

2

Assess the likelihood of the BVD virus entering the farm

Answer the following questions with a yes or no.

	YES	NO
a. Only BVD virus-negative cattle come in the front gate	<input type="checkbox"/>	<input type="checkbox"/>
b. Any cattle that are grazed off and become pregnant have been fully vaccinated before departure and mating	<input type="checkbox"/>	<input type="checkbox"/>
c. Nose-to-nose contact with neighbours' cattle is impossible	<input type="checkbox"/>	<input type="checkbox"/>
d. All keeper calves from bought-in pregnant cattle, and calves kept from heifers that have been out grazing, are BVD virus tested negative before leaving the rearing shed	<input type="checkbox"/>	<input type="checkbox"/>

If the farmer answers one or more with a no, their farm is at risk of introducing BVD.

3

Set up a control programme

Herd not infected, biosecurity good

- Screen all young stock for PIs and remove.
- Plug any biosecurity gaps as identified from 2a-d (above).
- Emphasise how critical it is to maintain good biosecurity in this herd.
- Consider BVD virus screening all keeper calves annually, especially if there could be some contact with neighbours' cattle. Remember to include any beef cattle etc that are kept.
- If good biosecurity cannot be maintained for any reason, consider vaccinating all cattle annually before mating, especially if keeper calves are not screened annually.

Herd not infected, biosecurity is questionable

- Screen all young stock for PIs and remove.
- Plug the biosecurity gaps if possible.
- Emphasise how critical good biosecurity is in this herd.
- Consider BVD virus screening all keeper calves annually, including any beef cattle etc. This is an essential step if biosecurity cannot be improved and vaccination is not undertaken.
- Vaccinate all cattle annually before mating if biosecurity gaps cannot be plugged.

BVD Control is a Four-Step Process

Herd infected, biosecurity is good

Option 1

- Use a BTM PCR test to determine if there are any PIs in the milkers, and remove these as per BVD toolkit recommendations.
- Screen all youngstock for PIs and remove as per BVD toolkit recommendations.
- Plug any biosecurity gaps as identified from 2a-d (previous page).
- Emphasise how critical it is to maintain good biosecurity in this herd.
- Consider BVD screening all keeper calves annually, including beef cattle etc.
- If good biosecurity cannot be maintained for any reason, consider vaccinating all cattle annually before mating, especially if keeper calves are not screened annually.

Option 2

- Vaccinate all breeding stock for three or four years to decrease the prevalence of PIs.
- While in the vaccination programme, plug any biosecurity gaps as identified from 2a-d (previous page) and maintain this good biosecurity.
- Proceed to option 1 or continue with vaccination.

Herd infected, biosecurity is questionable

- Use option 1 or 2 above if biosecurity can be improved to a good level. If it could take a few years to improve the biosecurity, use option 2 initially.
- If biosecurity cannot be improved to a good level, vaccinating all breeding cattle annually is recommended.

4 Monitor

Regular monitoring is essential, especially in the absence of full-herd vaccination.

“Belts **and** braces” monitoring involves BTM Ab testing biannually, plus annually screening all keeper calves for the BVD virus.

A “belts **or** braces” approach involves doing just the BTM Ab test or screening just the keeper calves for the virus.