

Bovine Viral Diarrhea: Is Your Herd Protected?

Bovine Viral Diarrhea (BVD) is an infectious disease that can sneak up on you, with devastating results. It siphons off herd profits, sometimes quite dramatically as demonstrated by research following a 1993 outbreak of BVD in Ontario that affected more than 800 dairy, beef and veal operations. Across the two-year study period, losses were estimated from \$40,000 to \$100,000 per herd, due to abortions and death, reduced milk production, and the loss of genetics.

The virus that causes BVD affects the immune, respiratory, reproductive and enteric systems.

The signs of BVDV infection are ones associated with many other diseases and “run the gamut from clinically inapparent to clinically severe,” says Dr. Julia L. Ridpath of the National Animal Disease Center, ARS/USDA in Ames, Iowa.

Adds Dr. Robert Tremblay of the Ontario Ministry of Agriculture, Food and Rural Affairs, “Almost all of the diseases caused by the BVD virus also have other causes. Laboratory tests are needed to be sure that BVDV is causing the problem.”

Because BVD can be difficult—if not impossible—to diagnose without laboratory testing, it is important that dairy producers understand the route of infection and course of disease in order to prevent its introduction and to also increase the herd’s resistance.

Background

Bovine Viral Diarrhea (BVD) refers to a group of cattle diseases caused by the Bovine Viral Diarrhea Virus (BVDV). First recognized in the 1940s in Canada and the United States, BVD is now common throughout the world. The virus has been identified in both domestic and wild ruminants, including

sheep, goats, white-tailed deer, and bison. It is a member of the *Pestivirus* genus, which also includes the virus that causes hog cholera in swine and border disease in sheep.

BVDV can manifest itself as Type 1 or Type 2, with each type containing its own set of viral strains. These strains are classified as non-cytopathic (does not cause cellular death), or cytopathic (causes cellular death). The non-cytopathic virus is the most common form, comprising 99% of all BVDV strains.

The virus is spread through direct contact with the manure, urine, blood, mucus, and semen of infected animals. It can also be transmitted by indirect contact, for example, with contaminated feed or housing facilities.

Signs of Infection

BVD is a disease of high morbidity, but relatively low mortality.

As noted earlier, most of the clinical

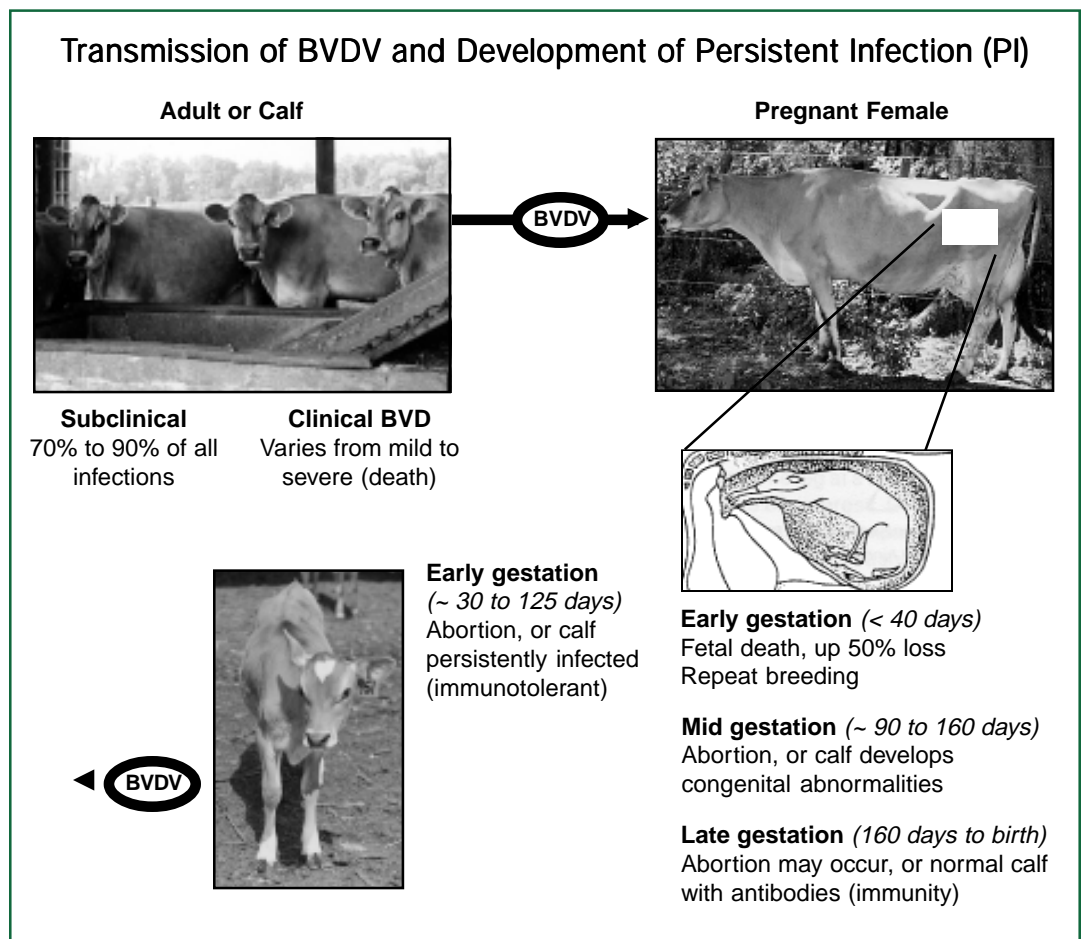
signs of an infection by BVDV can also be attributed to other agents. Symptoms can range from mild to severe in expression and include any of the following:

- Abortion, early embryonic death, or premature births;
- Irregular heats and breeding problems;
- Weak or stunted calves, usually termed “poor doers;”
- Off-feed, dull and depressed;
- Profuse watery diarrhea, pneumonia, nasal discharge, excessive salivation with oral ulcers;
- Elevated temperatures of 104° to 106° F, with increased heart and respiratory rates, which usually return to normal in one to two days before diarrhea occurs.

Infection Routes

According to *The Merck Veterinary Manual*, cattle of all ages are susceptible

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to BVD, but the disease is most common in young animals (from eight to 24 months of age). Calves can receive antibody protection through colostrum, but those levels decline over time. Infection then comes through contact with older cattle or from persistently infected, clinically normal carriers.

Subclinical infection. The BVD virus usually attacks the immune and reproductive systems in a subtle manner with no obviously expressed signs of disease. From 70% to 90% of all infections are subclinical, with no visible indicators other than a slight fever or decreased milk production.

Acute infection. Dairy cattle can contract an acute BVDV infection as calves or adults.

Signs of an acute infection include elevated temperature, diarrhea, ulcers in the mouth, signs of pneumonia, and abortion as early as one month after exposure. Acutely infected cattle begin shedding the virus three to 14 days after infection and will continue to shed for one to six days.

Although there is no treatment for BVDV infection, producers can aid in the recovery by providing electrolytes to counteract the dehydration caused by diarrhea and by treating animals with antibacterial agents to prevent secondary infections.

Infection of pregnant females and development of persistent infection. Infection in pregnant females can result in a num-

ber of outcomes, which depend upon the virus strain and the age of the fetus.

If infection occurs early in pregnancy (less than 40 days), fetal death or abortion is the most predictable outcome. Infection in mid-gestation can result in full-term calves born with congenital defects of the eyes and nervous system. Finally, if infection of the dam occurs in late gestation, antibody formation will occur, but calves appear otherwise normal when born.

There is also a window of opportunity in which calves acquire a persistent infection (PI) of the BVD virus. Persistently infected clinically normal carriers of BVDV appear to be the main source of infection for other cattle. These PI animals will carry the virus in their blood, nasal mucus, saliva, manure and urine for the rest of their lives, and shed several million viral particles a day.

Persistent infection occurs when the BVD virus crosses the dam's placenta at 30 to 125 days gestation and infects the fetus. At this early stage of pregnancy, the fetal immune system is too underdeveloped to mount an immune response against the invading virus. As a result, the fetus fails to produce BVD antibodies and does not develop immunity against the invading viral strain. This condition is referred to as immunotolerance, or acceptance of the virus as a normal part of the body.

BVD-PI animals occur in every 100 to 1,000 births.

A 50% mortality rate has been documented in the first year of life for PI animals, and most will die before reaching the age of two. The majority of these deaths are caused by mucosal disease, a severe illness which causes its victims to rapidly waste away. Mucosal disease only occurs in PI animals that have been exposed to a cytopathic strain of BVDV. Signs of infection include a high fever, watery diarrhea containing blood, lesions throughout the digestive tract and mouth, depression, weakness, decreased milk production, and failure to eat. Because there is no cure, death is imminent, occurring in several days to several weeks.

Identifying PI animals can be challenging for several reasons. First, calves cannot be tested for BVDV-PI *in utero*. Second, you cannot identify them just by observation. While some will look stunted or be "poor doers," others appear quite normal.

The standard blood test used to identify PI animals can only be used on calves that are three months of age or older. Blood samples taken earlier than three months will produce false test results because of antibodies transferred to the calf through the dam's colostrum. Since persistently infected calves begin shedding the BVD virus at birth, the three-month waiting period gives the virus considerable time to spread throughout the herd before the PI calf can be culled.

Control Strategies for BVDV

Although BVD is a formidable opponent for any dairy producer, there are effective methods to prevent or control the spread of infection and to also increase the herd's resistance to the virus.

Prevention should always be the first goal of any on-farm BVD-PI program. You can accomplish this goal, by following standard herd health management practices and adopting measures specific to dealing with the BVD virus.

Vaccination is an important component of a BVD management program. Initial immunization is successful in most calves at four to six months of age, when their immunity developed from colostrum begins to decline.

Consult with your herd veterinarian to develop a program for your dairy. He or she will be able to help you identify which of the killed or modified live vaccines is best suited for your herd. "At present there are more than 140 federally licensed vaccines," notes Dr. Ridpath of the National

How Herd Owners Can Protect Themselves From BVD

Dr. Richard Tremblay of the Ontario Ministry of Agriculture, Food and Rural Affairs offers these recommendations to effectively increase the resistance of the herd and reduce the risk of exposure to BVDV.

Prevent the introduction of infected animals by:

- bringing in only animals from uninfected herds;
- bringing in only animals from herds with a known effective vaccination program;
- avoiding the purchase of animals from sales barns;
- testing new animals for persistent infection in advance of introduction; and isolating new animals for 30 days before allowing contact with animals on-farm.

Increase the resistance of the herd to BVD by:

- vaccinating strategically as directed by the herd veterinarian and the product label;
- maximizing colostrum consumption by newborn calves; and
- reducing stress on cattle caused by other diseases, poor nutrition, uncomfortable housing or poor air quality.

Decrease exposure to BVD by:

- preventing manure contamination of hair coat, feed and water;
- housing baby calves in individual calf hutches; and
- isolating sick animals.

One Family's Frustrating and Costly Encounter With BVDV-PI

In the winter of 1998, David Chamberlain of Hi-Land Farm, Wyoming, N.Y., had his first encounter with Bovine Viral Diarrhea and Persistent Infection (BVD-PI).

Chamberlain first suspected something was wrong in the 400-cow Hi-Land herd when a group of first-calf heifers began to abort. Six months later, young calves two to three months of age started dying. A number of pathogens, including BVDV, presented themselves to Chamberlain as possible sources of disease. To determine the actual cause, he sent three unthrifty calves, one of which died en route, to the Diagnostic Laboratory at Cornell University. All three were identified as PI animals, lifetime carriers of the BVD virus.

Earlier that year, David and his brother Greg had purchased a small herd which appeared to be normal and healthy. As it turned out, many of the youngstock later tested positive for Persistent Infection with BVD.

Prior to the outbreak, Chamberlain was already well-informed about the BVD virus and had established a BVD vaccination program. At the time he purchased the infected cattle, all animals on Hi-

Land Farm, six months of age and older, received a killed 9-way vaccine twice a year. Calves under six months were also vaccinated and given a booster two weeks later.

When the BVD diagnosis was made, Chamberlain initiated an intensive testing and culling program to prevent further spread of infection. "We tested 100% of the milking animals and heifers to locate positive PIs," he says. "We also tested every calf at four months of age." All PI animals were immediately sold for slaughter.

"It destroyed our breeding efficiency," says Chamberlain, a Director of National All-Jersey Inc. "BVDV is devastating eco-

nomically."

In 1998 alone, there were 36 abortions in the herd, plus numerous early embryonic deaths. Of those calves that survived to term, many were either poor-doers or died later from the BVD infection. Once ranked among the top 10% of herds in the Northeast region for breeding efficiency, Hi-Land is still recovering from the damaging effects of BVD.

Today, Chamberlain has established a thorough BVDV vaccination program that has cut the spread of infection by 100% percent. To eliminate the virus from the herd, his veterinarian advised him to test all calves for BVDV-PI at four months of age for one year. Taking a proactive approach, he decided to continue the testing for several years.

According to Chamberlain, BVD testing is one of the most important steps in preventing the spread of disease. "Identify the PIs immediately," he recommends, "and remove them from the herd. If they stay, they will continually shed and infect others."

At four months of age, Hi-Land tests all calves for BVD and culls positive animals. The negative-test calves are vaccinated with a modified live form of Bovi-Shield and receive a booster in three to four weeks. Because

BVDV-PI vaccines offer limited protection, animals must be re-vaccinated against the virus on a regular basis.

Prior to breeding, Chamberlain administers a third dose of modified live virus to his heifers. From then on, all cows are vaccinated with a killed strain of BVD. He notes that show animals are constantly introduced to new disease pathogens, including BVDV, and that proper vaccination can prevent the spread of infection. As a final precaution, Chamberlain screens all new purchases with a BVD blood test before allowing them to enter the herd. Today, the herd is gradually approaching the goal of zero BVDV infection.



Introduction of BVD-PI "destroyed the breeding efficiency" at Hi-Land Farm, a 400-cow Jersey operation run in partnership by brothers Greg and David Chamberlain of Wyoming, N.Y.

Animal Disease Center, offering a range of options in protecting against the numerous strains of BVDV.

Your veterinarian will also advise you about the limitations of vaccination for BVD. First, it does not provide complete protection. Rather it keeps most cows from getting sick, or at least not so sick that they die. It offers some protection against fetal infection. Pregnant heifers and cows might still abort, but vaccination may decrease the number of abortions. And even if an animal is vaccinated, she can still get infected and shed the virus, thus spreading it to her herdmates.

It is extremely important to follow the manufacturer's recommendations for use and the schedule for booster vaccinations. If the wrong vaccines are used, or not administered properly, their effectiveness decreases.

Most BVD infections are introduced to the herd by new purchases that are either persistently infected, acutely infected, or are carrying PI calves. One method to counteract this threat is to buy replacements only from herds that are known to be free from BVDV or that have an effective BVDV vaccination program. To determine if the animals are adequately pro-

tected, find out which vaccines the seller administered and when.

When you purchase animals, quarantine them for at least 30 days. This window of time may allow you to identify diseased cattle. Your own herd should also be vaccinated against BVDV before new animals enter the facility.

Good sanitation practices, always advisable, pay big dividends when it comes to dealing with the BVD virus. "Routine cleaning and power washing or disinfection will kill the BVD virus," notes Ontario's Dr. Tremblay. The virus can also

(continued to page 68)

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be killed through exposure to sunlight and drying equipment and pens.

Clean and disinfect calf hutches before introducing newborns into them, and take appropriate measures to eliminate direct contact between young calves. Keep bottles, feeders and waterers clean and regularly disinfected.

People can unknowingly spread BVD via clothing, boots, or vehicles contaminated with manure, urine, blood, mucus, or semen from infected animals. All boots, equipment, and vehicles that have been used on other dairies should be thoroughly disinfected before entering your premises. The same recommendation applies to moving between the milking herd and calf areas.

Take steps to limit the number of unnecessary visitors who enter your farm. If your dairy is hosting a tour, provide plastic booties to prevent your guests from possibly tracking infected manure into your facility.

Infected bulls spread the virus through natural breeding or A.I. Any young bull that you plan to use in natural service should be screened for BVDV before he is used, then regularly tested.

BVDV can also survive in semen stored in liquid nitrogen. You can eliminate this worry by using only "Health Certified Semen" purchased from a semen producing business with CSS certification. The National Association of Animal Breeders (NAAB), through its Certified Semen Services (CSS), has established protocols to prevent transmission of infectious disease through frozen semen. Testing for BVD is a requirement of CSS. Participating firms will not freeze semen from a bull that tests positive for BVD-PI, nor from one in which the BVD virus has been isolated. Major A.I. organizations are CSS certified, as are many custom collection businesses. For a complete list, contact NAAB or visit its website at www.naab-css.org.

For More Information About BVD-PI

Auburn University publishes the BVD-PI web site at www.vetmed.auburn.edu/. The site provides a history of BVD, steps for diagnosis, prevention, and control, as well as an extensive reference database. To access this information, log on to www.vetmed.auburn.edu/ and click on "People at the College". Click on the name "Kenny V. Brock" to immediately arrive at the BVD-PI web site.

The Ontario Ministry of Agriculture, Food and Rural Affairs has provided answers to frequently asked questions about Bovine Viral Diarrhea on its website. The address is <http://www.gov.on.ca/OMAFRA/english/livestock/dairy/facts/bovinevi.htm>.

Michigan State University has published several articles regarding the signs of BVD as well as its control and prevention in the *Michigan Dairy Review*. Log on to www.canr.msu.edu/dept/ans/extens.html and click on "Dairy Extension Programs" to reach the *Michigan Dairy Review* home page. To locate the first article, click on November 1998, and then click "Prevention, Control Tips for Avoiding BVD Disease." The next paper is under November 1996, "Control and Prevention of BVDV Infections." To access the third report, click on August 1996 and then "BVDV Infection: Clinical Manifestations."

Background information for this article was also obtained from an article by Dr. Julia Ridpath of the National Animal Disease Center, Ames, Iowa. "Bovine Viral Diarrhea Virus Types 1 and 2, Detection and Vaccination" is published in the 1998 Proceedings of the United States Animal Health Association.

Our research also turned up a very interesting educational website at the University of Saskatchewan: <http://duke.usask.ca/~misra/virology/BVD/BVD.html>. It includes a diagram of BVD transmission that was adapted for this article and used on page 65, and also a number of additional slides in PowerPoint format.

To download a list of state veterinarians and their contact information, log on to <http://www.aphis.usda.gov/vs/sregs/> and click on "OFFICIAL". For information on U.S. state and territory animal health regulations, select any state and click on its link.

If you exhibit cattle, you should be aware that show cattle are at a higher risk of bringing BVDV into your herd because of their contact with animals from other farms. Consult your veterinarian on preventative health measures to protect your show animals and the entire herd from infection.

If You Suspect BVD

Talk to your veterinarian to determine which diagnostic tests are indicated. The most common test is a blood test that takes approximately seven to 10 days to run and costs between \$5 and \$10 per sample. It has limited use for testing calves because

of colostral antibodies interfere with the test, and is therefore recommended for calves that are at least three months of age.

If tests are positive, you will then need to distinguish between acute infection and persistent infection. One positive test is not sufficient to differentiate these.

With this information in hand, you can then decide on the best course of action. Acutely infected animals can recover, with proper treatment, and you may not need to cull. All persistently infected animals should be sent to slaughter as soon as they are identified.

BVD-PI and Merchandising Jerseys

Bovine Viral Diarrhea received nationwide attention in this country when a particularly virulent strain spread through dairy operations in Pennsylvania in 1994. Since that time, buyers of high dollar-value registered cattle have become increasingly concerned about limiting their risk of buying BVD-PI animals at public sales.

In response to the requests of prospective bidders, Jersey Marketing Service (JMS) began requiring BVD-PI testing in 1999 of all consignments to the All American and Pot O'Gold sales. Because BVD-PI infection occurs only *in utero*, once an animal tests negative for BVD-PI, it will always test negative for persistent infection. Therefore, consignors can submit negative BVD-PI test results taken at any time in an animal's life.

Protect Your Investment

All dairy business owners face the potential threat of infection from BVDV, whether through PI animals or those that develop an acute infection. When animals become persistently infected, they become lifetime carriers of the virus, constantly shedding BVDV through their bodily excretions. Animals of any age can develop an acute infection after birth. They, too, shed the virus which can spread to their herdmates. Consult with your herd veterinarian to develop an effective strategy. By understanding the route and spread of infection, you wield a powerful weapon in the battle against the threat of BVD.

Bovine Viral Diarrhea Virus (BVDV)

CAUSE

Contagious viral disease caused by bovine viral diarrhea virus (BVDV) which is widespread in cattle populations and results in a high subclinical rate.

DISEASE

BVDV type 1 and BVDV type 2 cause the same syndromes in cattle.

Acute BVDV of young animals, 6-24 months old

- Fever, ulcers in mouth, throat (esophagus) and intestine, diarrhea (some bloody), high mortality.
- Mild infection: off feed, depressed, mild diarrhea and recovery.
- Subclinical infection with no visible signs are most common.
- Colostral antibodies protect most calves until 4-8 months.



Oral Ulcers

Acute BVDV in adult cattle (> 2 years)

- Fever, off feed, decreased milk production, diarrhea.
- Occasionally ulcers in mouth.
- Outbreaks occur in unvaccinated cattle after introduction of new animals shedding BVD or in first calf heifers when they enter the milk string.
- During outbreaks up to 25% of adult cattle may become ill.

BVDV in pregnant cattle

Age of infected fetus determines outcome

Days gestation	Outcome
< 125 days	abortion, resorption, mummies, persistent infections (PI)
< 100-150 days	fetal brain and eye defects, stunted, weak calves
> 180 days	fetus becomes immune, born normal

BVDV - persistent infection (PI)

- May occur when fetuses less than 125 days old are infected.
- PI animals are life long carriers, shed BVDV, and have 100% infection of their fetuses.
- They have poor response to vaccination and may develop mucosal disease if infected with a similar BVDV strain.
- Some PI animals are poor doers while others are normal.

Miscellaneous syndromes

- BVDV may predispose cattle to respiratory infections.
- Bleeding syndromes in cattle have been associated with BVDV 2 strains, but not BVDV 1.

DIAGNOSIS

Acute BVD in cattle more than 6 months old:

- Rising antibody titers in paired sera taken three weeks apart.
- PCR probe testing on EDTA-blood.
- Necropsy and fluorescent antibody (FA), immunoperoxidase(IPX) or PCR probe on tissues.
- Oral ulcer biopsy, FA,IPX or PCRtest.

Persistent Infection (PI)

- PCR probe test on EDTA-blood, pooled sampling to screen herds, Serum ELISA.
- Skin Biopsy - IPX
- Animals which fail to respond to BVDV vaccination are probably PI.

Reproductive syndromes

- Precolostral BVDV antibody in term calves infected at more than 180 days gestation.
- Brain and eye defects in term or aborted calves.
- Paired sera (3 weeks apart) from cows which resorb pregnancies.
- Fetal tissue are poor samples for virus isolation.

PREVENTION & CONTROL

- ✓ Vaccination program
- ✓ Quarantine and test new arrivals.