



Knowledge

The Fundamentals of BVD

SUMMARY

Bovine viral diarrhea (BVD) virus is a troublesome disease complex that significantly affects both beef and dairy cattle. There are hundreds of BVD strains, which fall into two broad genotype categories – BVD Type 1 and BVD Type 2. Within BVD Type 1, there are at least two subtypes: BVD Type 1a and BVD Type 1b. In two separate studies, researchers determined that the predominant subtype was BVD Type 1b.¹

BVD viral strains are further classified according to their biotypes. A virus is classified as cytopathic (CP) if it causes cell pathology, and noncytopathic (NCP) if no pathology of tissue culture cells is detected. Both CP and NCP biotypes can occur in BVD Type 1a, BVD Type 1b and BVD Type 2. NCP is the more damaging variation – NCP BVD has been found to be the major isolate in clinical BVD, accounting for 90 to 95 percent of all clinical outbreaks.² The NCP biotype also is believed

to be the cause of all BVD persistently infected (PI) animals, and is the major cause of BVD-induced abortions.

A vaccine should provide the broadest possible range of protection against BVD virus genotypes and subtypes, as well as biotypes. For maximum protection, veterinarians should choose a BVD vaccine that offers broad-spectrum protection against several field strains, including BVD Type 1 and Type 2.

BVD – a growing, evolving challenge

BVD consists of hundreds of different BVD viral strains, making it difficult to diagnose, hard to control and economically disastrous to the cattle industry. BVD virus infections can result in costly respiratory and reproductive diseases, including the deadly mucosal disease.

BVD infections are increasing by 10 to 15 percent per year.

Diagnosis can be challenging, because the number of strains continues to increase due to the mutating nature of the virus. Its genetic diversity is one of

the factors affecting control of disease, along with the lack of long-lasting immunity and persistently infected (PI) animals entering a herd.

Economic impact of BVD

Because BVD is an immune-suppressing virus, much of the economic impact is the result of an infection weakening the immune system, which leads to secondary infections from other pathogens. The virus often is a precursor to *Pasteurella multocida* and *Mannheimia (Pasteurella) haemolytica*, along with other bacterial species.¹

The direct and indirect financial losses associated with BVD are difficult to gauge, because many BVD infections go undiagnosed or are misdiagnosed. However, the annual economic loss in the U.S. is approximately \$3 billion – and rising. Estimates in the U.S. dairy industry indicate that BVD infections cost between \$35 million and \$65 million per one million calvings.³

It is a worldwide – and growing – problem. While percentages vary among different geographic regions, 60 to 85 percent of cattle are exposed to the BVD virus, and 1 to 2 percent are persistently infected.⁴ And BVD infections are increasing by 10 to 15 percent per year.²

The genetics of the BVD virus

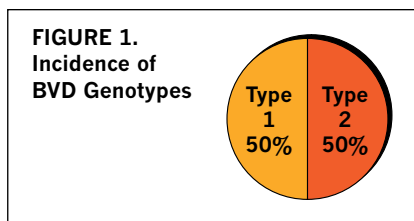
BVD is a single strand RNA virus. This is significant because it means that the BVD virus can mutate rapidly, which is why there are literally hundreds of strains, with more likely to emerge.³

It is estimated that a mutation occurs once every 10,000 base replications. While some of these “new” viruses die and are rendered harmless, others can thrive and become highly virulent, emerging strains of the disease.

The changing nature of BVD helps explain why even vaccinated, well-managed herds may not be completely protected from the disease.

Genotypes, subtypes and biotypes

All BVD strains in the United States presently fall into two broad genotype categories: BVD Type 1 and BVD Type 2 (see Figure 1).



Within BVD Type 1, there are at least two subtypes: BVD Type 1a and BVD Type 1b. Immunity to a particular type or subtype – as a result of vaccination, colostrum antibodies or natural exposure – does not necessarily provide immunity to BVD viruses of other types or subtypes.

BVD viral strains are further classified according to biotypes (see Table 1). The biotype is determined by evaluating whether or not an isolated BVD virus causes visible cell pathology in tissue culture.

TABLE 1. BVD Types

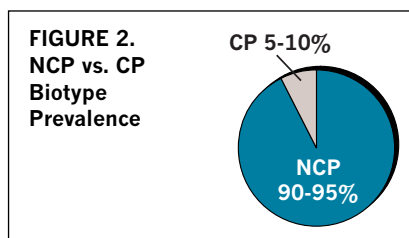
Type 1		Type 2			
Subtype 1a		Subtype 1b			
CP	NCP	CP	NCP	CP	NCP

A BVD virus strain is classified as cytopathic (CP) if it causes cell pathology, or noncytopathic (NCP) if it does not cause cell pathology in tissue culture. Both CP and NCP biotypes occur in BVD Type 1a, BVD Type 1b and BVD Type 2.

Because they cause visible cell pathology in tissue culture, cytopathic strains are easier to identify in the laboratory, and scientists typically are more familiar with many of the CP BVD virus strains. This familiarity is likely the reason that CP BVD is used in many existing vaccines.

NCP vs. CP

According to records from the Animal Disease Research and Diagnostic Laboratory at South Dakota State University, 90 to 95 percent of the BVD strains isolated are NCP, while only 5 to 10 percent are CP² (see Figure 2).



In addition, recent data from the University of Auburn show that 98 to 99 percent of the field samples diagnosed are NCP BVD.⁵

As researchers continue to learn more about the differences between CP and NCP forms of BVD, they’re discovering that NCP is far more damaging (see Table 2).

TABLE 2. Protecting Against NCP is Essential

	NCP	CP
Major field isolate	X	
Cause of persistent infection	X	
Present in mucosal disease	X	X
Virus used in most vaccines		X

For example, NCP BVD is:

- The most common biotype in bovine respiratory disease
- Generally present in mucosal disease
- Always the cause of PI calves
- A major cause of abortions

Subtype studies

Current university research also is yielding new information about the predominant BVD subtypes involved in BRD-infected calves. In two separate studies of commingled stocker calves with acute BRD, researchers determined that the predominant subtype was BVD Type 1b.¹

These two studies also showed that the BVD Type 1 strain was associated with acute respiratory disease of calves with pneumonic *Mannheimia haemolytica* and *Pasteurella multocida* disease. In addition, BVD Type 1 genotypes were isolated more frequently than BVD Type 2 from necropsy samples from calves with fibrinous pneumonia.¹

Exposure to BVD virus

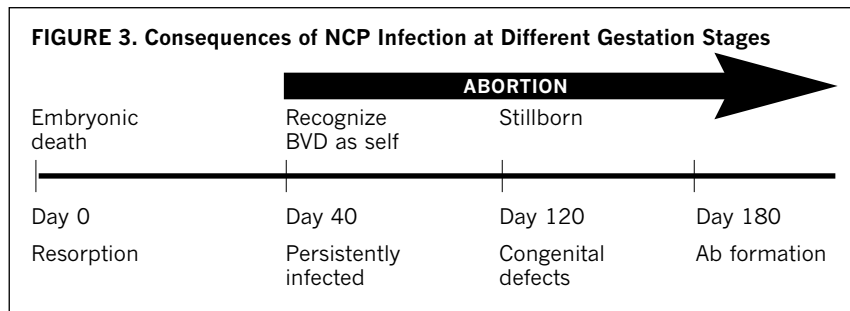
The result of exposure to BVD virus depends on several factors, including the animal's:

- Vaccination status at the time of exposure
- Age
- Stress levels
- Exposure to other diseases (i.e., respiratory infection in feedlot calves)
- Stage of pregnancy

cow to BVD before 60 days of gestation normally results in abortion (see Figure 3). Yet, cows can abort at any stage during gestation due to BVD.⁵

In addition to abortions, an acute BVD infection in heifers and cows also can lead to:

- Enteric and respiratory tract diseases
- Infertility or reduced conception rates
- Congenital abnormalities
- Birthing PI calves



While some animals exposed to BVD recover with little clinical disease, exposure also may lead to significant livestock and financial losses.

For calves that are exposed, BVD can cause reduced weight gain and weaning weights. An acute BVD infection can cause sudden death, along with costly respiratory tract and enteric diseases, including:

- Bovine respiratory disease complex (BRDC)
- Hemorrhagic (bleeding) syndrome
- Diarrhea
- Mucosal disease in PI animals

Preventing a BVD infection in young stock involves two important strategies: providing passive immunity via a good cow vaccination program, as well as acquired immunity from a calf vaccination program.

A cow vaccination program also helps protect against costly reproductive diseases. For example, exposing a pregnant

The PI problem

One of the most problematic aspects of BVD virus is its ability to cause PI calves. PI animals occur when pregnant cows are infected with virulent NCP BVD virus. Whether or not a fetus becomes PI depends on the stage of the fetus at the time of infection.

PI calves usually occur when unprotected cows are infected between 40 and 120 days. PI calves are the result of NCP BVD virus entering the dam's body, or if the dam is persistently infected, the virus is constantly present.

If the NCP BVD virus crosses the placental barrier and infects the fetus, there is a good chance the fetus will become PI if it is not aborted. Since the fetus has an immature immune system, it accepts the virus as a part of itself. Without an immune reaction, the virus resides and replicates in the fetus/calves for the rest of its life.

Exactly how NCP BVD virus reaches the uterus continues to

be debated.² Some researchers feel that it spreads via the bloodstream when a dam is viremic and has NCP BVD virus circulating in its blood. Other researchers hypothesize that the NCP BVD virus may become cell-associated and spread that way, rather than strictly from viremia. This may explain why non-viremic dams may still drop a PI calf.

While they can appear normal, PI calves signify the biggest virus reservoir, because they continually shed the virus.³ PI calves represent the greatest risk as they move through market channels as feedlot animals or replacement heifers. They shed BVD virus via urine, feces, milk and mucosal secretions, exposing other animals in the herd to the disease. The devastating results of a PI animal's presence in a herd can include abortion, early embryonic death, infertility, malformed fetuses, respiratory disease, immunosuppression and the creation of more PI animals.

Many producers inaccurately perceive that if they are not experiencing peracute outbreaks, they need not be concerned about BVD in their herds. But the threat created by PI animals can have far greater impact on their herds' long-term performance. All cattle producers need to be highly concerned about BVD, regardless of whether or not they see a sudden onset of clinical symptoms.

To prevent PI calves, timing is everything. It is critically important to prevent NCP BVD from reaching the uterus of the dam between 40 and 120 days of gestation, thus preventing fetal infection. But vaccination alone cannot provide 100-percent protection from PI calves. Vigilance in biosecurity measures and thorough vaccination programs are ongoing necessities to minimize the impact of the disease in every herd.

Current vaccines

As noted earlier, BVD Type 1b appears to be an emerging BVD threat, especially in respiratory cases involving young stock, such as stocker calves commingled from other various sources. If this is so, the U.S. cattle industry could be at risk as very few vaccines contain NCP isolates or have Type 1b isolates.

New Arsenal™ 4.1 is an exception (see Table 3). Arsenal 4.1 from Novartis Animal Vaccines, Inc. is a one-dose, modified live vaccine that protects weaned calves against a broad spectrum of BVD – including BVD Type 1 and Type 2. In addition to its one-dose protection, Arsenal 4.1 also has been proven in challenge models against IBR, PI₃ and BRSV where vaccinates received a single 2-mL SubQ dose.

Proper immunization

Despite the growing awareness of the financially devastating impact of BVD in a herd, much of the U.S. cattle herd remains threatened because of exposure to PI animals and insufficient immunological protection.

According to data from the National Animal Health Monitoring System⁶:

- In U.S. beef herds, only 25 percent of calves and 17 percent of cows were vaccinated
- In U.S. dairy cattle, 70 percent of heifers and 71 percent of cows were vaccinated

Despite these statistics, immunization is crucial. For maximum protection, choose a BVD vaccine that offers broad-spectrum protection against BVD Type 1 and Type 2.

Solution	Protection Against	Dose	Route
Arsenal™ 4.1	BVD Type 1 and 2, BRSV, IBR and PI ₃	2mL	SubQ
Arsenal™ IBR BVD*	IBR and BVD Type 1 and 2	2mL	SubQ
Arsenal™ IBR	IBR	2mL	IN and SubQ
Quick Shield™** Intranasal IBR-PI ₃	IBR and PI ₃	2mL	IN and SubQ

* USDA license pending.
** Quick Shield, given intranasally, goes directly to the mucous membranes of the nose and mouth where respiratory viruses thrive, and has been shown to significantly reduce clinical signs of IBR and PI₃ infection.

	Arsenal 4.1
Branding/turnout	X
Weaning/receiving	X
*Pre-breeding	X

*Open heifers and cows should be vaccinated 30 days prior to start of breeding.

Arsenal 4.1 can be used on calves as young as two weeks of age (e.g., branding-age calves nursing open beef cows or very young dairy heifer or veal calves) or at weaning, when maternal antibodies have likely lapsed and calves are experiencing the most stressful period in their lives (see Tables 4 and 5).

Calves vaccinated prior to six months of age should be revaccinated after six months of age.

Open heifers and cows should be vaccinated again at least one month before breeding to give them good levels of immunity during the critical first 120 days of gestation.

	Arsenal 4.1
Weaning	X
Growing heifers	X
*Pre-breeding	X
Post-freshening	X

*Open heifers and cows should be vaccinated 30 days prior to start of breeding.

- ¹ Fulton RW, et al. Bovine viral diarrhea virus (BVDV) 1b: predominant BVDV subtype in calves with respiratory disease. *The Canadian Journal of Veterinary Research*. 2002;66:181-190.
- ² Chase CL. Department of Veterinary Science, South Dakota State University, Brookings, SD.
- ³ Ridpath J. Why BVD is a tough problem. *Hoard's Dairyman*. October 25, 2002:697.
- ⁴ Houe H. Epidemiological features and economical importance of bovine virus diarrhea virus (BVDV) infections. *Veterinary Microbiology*. 1999;64:89-107.
- ⁵ Brock K. Department of Pathobiology, Auburn University College of Veterinary Medicine, Auburn, AL.
- ⁶ Chase CL, et al. Trends in BVDV serological response in the Upper Midwest. *Biologicals*. 31, 2003.

