



Knowledge

L. hardjo-bovis: quietly costing cattle producers money

SUMMARY

L. hardjo-bovis is the most common cause of bovine leptospirosis in the United States.¹ It is host-adapted to cattle, which can make it difficult to diagnosis because the infection is generally subclinical and produces low antibody titers.² Once a host animal is infected with *L. hardjo-bovis*, the organism colonizes in the kidneys³ and reproductive tract, where it causes reproductive problems, such as conception failure and early embryonic death.

Losses associated with *L. hardjo-bovis* are numerous and include factors such as the cost of open cows, ranging from \$3 per day for dairy to \$300 per year for beef; reduced milk

production; reduced weaning weights; and the expense of culling open animals. Other costs include the expense of biosecurity and control measures.

Controlling this pathogen requires a combination of biosecurity, antibiotics, vaccination and culling. The first step is to eliminate carriers by treating per label with a long-acting antibiotic or culling. Antibiotic use is only indicated for treating cattle that are in carrier state.⁴ This should be combined with a vaccination program to reduce the incidence of new infections.

When selecting a leptovaccine, make sure that it contains an *L. hardjo-bovis* serovar. Vira Shield® 6+L5^{HB}

and Vira Shield® 6+L5^{HB} Somnus from Novartis Animal Health are the first bovine leptovaccines to contain an *L. hardjo-bovis* isolate of U.S. origin. Both products are available in combination featuring three-way BVD coverage, along with protection against IBR, BRSV and PI₃. *H. somnus* protection is available when you choose Vira Shield 6+L5^{HB} Somnus.

Vira Shield gives the flexibility of using in pregnant cows, as well as non-pregnant animals.



Leptospirosis is a disease that affects both animals and humans. It is found worldwide, but is more common in warm, wet climates. Several distinct disease-causing species of leptospira exist, of which *L. interrogans* is the most common. In North America however, the most common cause of bovine leptospirosis belongs to the species *L. borgpetersenii* serovar hardjo (Type: *hardjo-bovis*).¹ Until recent years this organism was included in the *L. interrogans* species; however, molecular studies using updated techniques has resulted in a taxonomic re-classification to the species *L. borgpetersenii*.

While research shows that *L. hardjo-bovis* is the most common host-adapted U.S. bovine serovar – and most frequently associated with reproductive losses² – most current leptospirosis vaccines do not contain an *L. hardjo-bovis* strain. Most of these vaccines were developed using an isolate that is

prominent in the United Kingdom (*L. hardjo-prajitno*), which is not known to have been identified in the United States.

L. hardjo-bovis can be extremely costly for dairy and beef producers, due to significantly lower conception rates and early embryonic deaths. The pathogen can be transmitted during breeding, as well as from cow to fetus. Calves may be born as congenitally infected maintenance hosts.

Diagnosis and the maintenance host problem

Disease-causing leptospira can be placed in one of two broad categories: They are either host-adapted (maintenance hosts) or incidental strains. The *L. hardjo-bovis* serovar is host-adapted to cattle. The four incidental serovars of leptospira that are pathogenic to cattle are: *L. pomona*, *L. grippityphosa*, *L. canicola* and *L. icterohaemorrhagiae*.

Diagnosing a host-adapted infection can be difficult because a disease associated with the infection of the maintenance host is generally subclinical and produces low antibody titers.² Once a host animal is infected with *L. hardjo-bovis*, the organism colonizes in the kidneys³ and reproductive tract, where it causes reproductive problems such as conception failure and early embryonic death.



L. borgpetersenii serovar *hardjo* (Type: *hardjo-bovis*) is the most common cause of bovine leptospirosis in North America. When viewed under a microscope, it appears as tightly coiled bacteria with a characteristic semicircular hook at the ends.

Infected cattle can continue shedding the pathogen for years through urine and other bodily fluids. Infection can spread quickly via mucous membranes of all orifices, as well as through small cuts in the skin. Unfortunately, with no symptoms, the reproductive problems associated with a host animal may instead be blamed on human error or protocol problems.

In contrast, leptospiral infections in incidental hosts are easier to diagnose. These animals suffer more severe disease, generate high antibody titers, have large numbers of organisms in tissues and do not shed leptospires in urine for any period of time.⁴ Incidental hosts may experience abortion, typically between four and seven months of gestation; birth of premature and weak calves; milk drop syndrome; and severe kidney and liver disease.⁴

Growing prevalence – and more costly

Livestock producers can't afford to ignore this pathogen. A recent survey of cow-calf producers conducted at Texas A&M University found that the prevalence of animals in herds testing positive was 42 percent.⁵ In one West Texas herd diagnosed with an *L. hardjo-bovis* infection, a 25-percent loss was reported, due to weak calf syndrome and abortions.² In dairy herds, a Michigan State University study tested urine and serum from 15 cows in 44 dairy herds from four different regions of the United States. Results found at least one infected cow in 59 percent of the herds tested.⁶

The USDA National Veterinary Services Laboratories in Ames, Iowa, conducted a national cattle survey to estimate prevalence of *L. interrogans* infection in mature cattle. Researchers took 5,142 kidney tissue samples and 5,111 serum samples from mature cattle at slaughter. Leptospires were isolated from 1.7 percent of the kidney tissues and 49 percent of the sera contained antibodies against at least one *L. interrogans* serovar. By using immunofluorescence testing, researchers were able to observe leptospires in 41 kidney tissues. They were able to further identify the leptospires by serovar type through agglutinin-absorption testing. Results found 83 percent of the isolates to be serovar *hardjo*, 12.5 percent to be serovar *pomona*, and 4.5 percent were serovar *grippotyphosa*.⁷

Testing is tricky

Diagnosing *L. hardjo-bovis* can be quite challenging. Testing is available, but it's difficult and expensive. Since *L. hardjo-bovis* is host-adapted, searching for titers in a blood sample is not a reliable method for determining if a herd is infected.

Methods for diagnosing:

- **Microagglutination tests (MAT)** that use paired serum samples

taken three weeks apart will detect the amount of specific antibody concentration.

However, these tests are not able to differentiate between organisms in the same serovar.

- **Fluorescent antibody (FA) tests** can be done relatively inexpensively on urine or kidney samples. However, they are designed to be only genus-specific.
- **Cultures** are direct tests that can diagnose genus, species and serovar. These tests require a high skill level to get accurate results.
- **Polymerase chain reaction (PCR)** detects leptospiral DNA in tissue samples including urine. Many different techniques exist. The test is not serovar specific.
- **Darkfield microscopy** uses a dark background to offset the paler leptospire organisms and make them visible from a urine sample. The difficulty is that the urine needs to be fresh and the technician needs to be skilled in recognizing leptospires. Also, this test may not reliably identify individual serovars of leptospires.



The *L. hardjo-bovis* serovar is host-adapted to cattle, which makes diagnosis difficult. Lepto infections in maintenance hosts tend to be mild, with low antibody titers. Once an animal is infected, *L. hardjo-bovis* colonizes in the kidneys³ and reproductive tract.

- **Immunohistochemistry (IHC)** is able to detect antigens in tissues. An enzyme-labeled antibody that recognizes leptospira antigens is reacted with the tissue sample. Detection of the leptospira antigen is visualized

by the addition of a chromogenic substrate that changes color in the presence of the enzyme-labeled antibody.

Currently, *L. hardjo-bovis* is diagnosed using a combination of serology and identifying leptospire in the urine using fluorescent antibody testing. Both methods are used because animals may show limited clinical signs of an *L. hardjo-bovis* infection, but titers in host animals can be so low that serology appears negative. Testing costs are estimated at approximately \$50 per animal, not including the cost of the veterinary visit.

Recently, researchers at the National Center for Infectious Diseases, part of the Centers for Disease Control and Prevention, have worked with a real-time PCR assay that successfully detected leptospiral DNA from both serum and urine samples. This assay has the potential to facilitate rapid, sensitive diagnosis of acute leptospirosis.⁸ While this may make diagnosis easier, prevention and control are still critical.

The economics of *L. hardjo-bovis*

Economic losses associated with *L. hardjo-bovis* often go unrecognized on dairy and beef operations, yet can be high. Losses come from many areas:

- **Extra days open** – Cost estimates range from \$1 to \$5 per day open, according to dairy reproductive specialists, with most experts settling around \$3. Miss the heat cycle, and you've extended the calving interval by 21 days. Multiply 21 days by \$3 per day and that equates to \$63 for just one dairy cow. Likewise, cow-calf producers can lose an estimated \$300 per year to feed and house an open cow.⁹
- **Infertility, embryonic death and rebreeding** – *L. hardjo-bovis* is also associated with reduced conception rates. In a study that looked at fertility data from 673 cows in five dairy



Preventing *L. hardjo-bovis* works best when a vaccination program is implemented when heifers are young. This helps reduce the risk of the animal becoming a carrier.

herds, the overall pregnancy rate of seronegative cows was 28 percent higher than that of cows with an MAT greater than 1:100 for *L. hardjo-bovis*.¹⁰ An early pregnancy loss that causes an increase of 45 days open can result in a loss of between \$90 and \$225.¹¹ For beef cattle, a report from the 2005 National Cattlemen's Beef Association Cattlemen's College estimates annual losses from reproductive diseases to be between \$13.10 and \$14.90 per cow.¹²

- **Reduced milk production** – Dairy cows that have poor conception rates may not produce enough milk in late lactation to remain profitable. A Canadian study found a mean reduction in net revenue of approximately \$4 per cow from a one-day increase in the adjusted calving interval.¹³
- **Reduced weaning weights** – Likewise, beef producers will realize a loss at weaning day on cows that were bred late in the season. Missing just one heat cycle can mean at least \$42 less on sale day since most calves are weaned on a set date. Those that were born late in the season will have fewer days to gain weight than calves born earlier. At a \$1-per-pound selling price and a two-pound daily rate of gain, a delay of 21 days in calving will cost the producer \$42.

- **Culled cow expenses** – Selling open cows means incurring the cost of raising or purchasing replacement animals.

Preventing *L. hardjo-bovis*

Controlling this pathogen requires a combination of biosecurity, antibiotics, vaccination and culling. Start by eliminating carriers through treatment with a long-acting antibiotic, combined with a vaccination program to prevent new infections.

Novartis Animal Health recently introduced Vira Shield® 6+L5^{HB} and Vira Shield® 6+L5^{HB} Somnus – the first inactivated lepto combinations to contain an *L. hardjo-bovis* isolate of U.S. origin.

This *L. hardjo-bovis* isolate is geographically distinct from the isolate in Spirovac®, which originated in Australia. The isolate in Vira Shield 6+L5^{HB} and Vira Shield® 6+L5^{HB} Somnus comes in a proven combination – for less hassle and less stress.

Vira Shield 6+L5^{HB} is available in a combination that also features three-way BVD coverage, along with protection against IBR, BRSV and PI₃. *H. somnus* protection is added when you choose Vira Shield 6+L5^{HB} Somnus. Vira Shield provides convenient and productive administration options – it may be given to pregnant cows at dry-off so there is no risk of reductions in milk production.

In head-to-head serology studies, Vira Shield 6+L5^{HB} demonstrated a superior humoral response to Spirovac L5. At two weeks after the second vaccination, Vira Shield 6+L5^{HB} had a geometric mean titer level of 2,048 vs. a geometric titer level of 512 for Spirovac L5.¹⁴ (See Figure 1.)

A vaccination program should begin when animals are young, to reduce the risk of those animals becoming carriers. For producers who cannot vaccinate the entire herd, start the program with replacement heifers, which generally are more severely affected by reproductive diseases. Replacement heifers should come from only well-vaccinated, well-managed herds, and be tested before they're introduced into the herd.

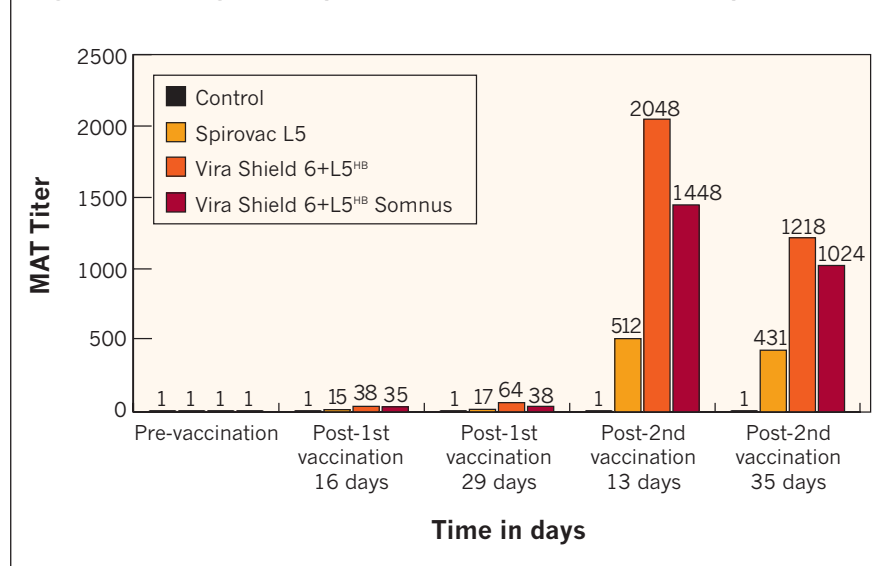
Also, be aware that spirochetes do not multiply outside of the animal hosts. However, they can survive for months in warm, wet environments and stagnant water. Research shows that *L. hardjo-bovis* can persist in water-saturated soil for as long as 183 days, but for only 30 minutes when the soil is airdried.¹⁵

It's especially important to prevent leptospirosis since it can

infect all mammals, including humans. An infected employee can be one of the first signs a herd has leptospirosis. The disease often starts with flu-like symptoms – high fever, sore throat, and muscle

pain – and may last for weeks. Vaccinating a herd for leptospirosis is very affordable insurance, particularly when it can help boost conception rates and help keep employees safe.

Figure 1. Serological comparison of Vira Shield 6+L5^{HB} and Spirovac L5



Trial protocol:

- 28 Holsteins with no vaccination history or exposure to leptospira were randomly assigned to one of four test groups. Each vaccination group had eight animals and the control group had four animals.

- Animals were vaccinated according to label directions.
- Serum samples were titered for *L. hardjo-bovis* antibodies by microscopic agglutination.
- Group titers are a geometric mean of individual titers per test day and group.

1. Zuerner RL, et al. Repetitive sequence element cloned from *Leptospira interrogans* serovar hardjo type hardjo-bovis provides a sensitive diagnostic probe for bovine leptospirosis. *J Clin Microbiol.* 1988;26:2495-2500.
2. Hairgrove TB. Leptospirosis in cattle. AABP Proceedings. Vol. 37. Sept. 2004.
3. Orr HA, Little TW. Isolation of *Leptospira* of the serotype hardjo from bovine kidneys. *Res Vet Sci.* 1979;27(3):343-346.
4. Van Saun R. Leptospirosis in cattle. The Pennsylvania State University, Veterinary Science Extension. *Veterinary News.* January 2005.
5. Powell J. Hardjo-bovis in beef cattle – A new challenge. University of Arkansas, Cooperative Extension Service. *Beef Champs.* February 2005.
6. Bolin C. Leptospirosis: Clinical signs and

- pathophysiology. Bovine Conference on Investigating Pregnancy Wastage, Kansas State University, May 3, 2003.
7. Miller DA, Wilson MA, Beran GW. Survey to estimate prevalence of *Leptospira interrogans* infection in mature cattle in the United States. *Am J Vet Res.* 1991;52:1761-1765.
8. Levett PN, et al. Detection of pathogenic leptospires by real-time quantitative PCR. *J Med Microbiol.* 2005;54:45-49.
9. Webster HW. Pregnancy determination in beef cattle. Clemson Extension. *Beef.* August 1988.
10. Dhaliwal GS, Murray RD, Dobson H, Montgomery J, Ellis WA. Reduced conception rates in dairy cattle associated with serological evidence of *Leptospira interrogans* serovar hardjo infection. *The Veterinary Record.* 1996;139:110-114.

11. Kirk, J. Infectious abortions in dairy cows. University of California-Davis. Available at: <http://www.vetmed.ucdavis.edu/vetext/inf-da/abortion.html>. Accessed: 12/20/05.
12. Bellows DS, Ott SL, Bellows RA. Review: Cost of reproductive diseases and conditions in cattle. *The Professional Animal Scientist.* 2002;18:26-32.
13. Plaizier JCB, King GJ, Dekkers JCM, Lissemore K. Estimation of economic values of indices for reproductive performance in dairy herds using computer simulation. *J Dairy Sci.* 1997;80:2775-2783.
14. Data on file, Study # 05NAHLW5016. Novartis Animal Health US, Inc., 2006.
15. Radostits OM, Gay CC, Blood DC, Hinchcliff KW. Diseases cause by *Leptospira* spp. *Vet Med.* 9th ed. WB Sanders Co; 2000:971-996.



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