

## **Brucella abortus & Brucellosis Frequently Asked Questions**

### **What is *B. abortus*?**

*B. abortus* is a species of bacteria that falls under the genus *Brucella*. *B. abortus* causes the disease brucellosis in bovines, including domestic cattle, yaks, and bison. Other animals can become infected with the *B. abortus* strain, but cattle are the preferred host.<sup>1</sup> Wild elk and bison in the Greater Yellowstone Area are currently the major source of *B. abortus* exposure risk to the cattle industry.<sup>2</sup>

### **What is brucellosis?**

Brucellosis is a costly disease that affects a wide variety of animals. *B. abortus* strain typically has the following signs in cattle:

- Abortions (usually in late gestation)
- Birth of weak calves
- Decreased fertility
- Retained placenta
- Enlarged or arthritic joints
- Decreased milk production
- Orchitis

Another important characteristic of brucellosis is that it can be passed from animals to humans. This makes brucellosis a public health concern, and one reason the United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS) has a brucellosis eradication program in place.<sup>1</sup>

State brucellosis Designated Surveillance Area (DSA) regulations have been effective in preventing the spread of brucellosis in domestic livestock.<sup>2</sup> In the U.S. brucellosis still exists in elk and wild bison in areas in and near Yellowstone National Park (YNP). Periodic transmissions from wildlife to livestock (cattle and domestic bison) do occur. The three states around YNP (Idaho, Montana and Wyoming) have each created a brucellosis Designated Surveillance Area (DSA) within their respective state. Livestock that utilize the DSA have brucellosis testing requirements for movement out of the DSA as well as change of ownership testing requirements. Vaccination and identification requirements also exist.<sup>2</sup>

### **How is brucellosis transmitted?**

There are multiple routes of transmission. The most common routes are ingestion or inhalation of the bacteria. The brucellosis organism can be shed by an infected female in placental membranes, fluids, vaginal discharge, and aborted fetuses, which may then be ingested and subsequently infect another susceptible animal. Worldwide, the most common way a human becomes infected is through consumption of infected animal products especially unpasteurized dairy products. Food safety is not a concern when tissues are properly handled and cooked. Accidental exposure to the RB51 vaccine via injection or splash can cause clinical disease in humans, which is very rare, especially if the exposed person is treated with the proper antibiotics within the first couple of days post exposure.<sup>1</sup>



### **Can brucellosis be prevented?**

When working with infected animals, the best way to prevent the spread of brucellosis in humans is through the use of personal protective equipment (PPE) such as gloves, protective goggles, and masks. To prevent foodborne brucellosis, only consume pasteurized dairy products. Hunters in areas where brucellosis exists in wildlife should practice proper carcass cleaning (field dressing) and disposal techniques.<sup>3</sup>

Within the DSA, officials work with livestock owners to minimize the risk of spread and transmission through variable vaccination protocols (including adult vaccination) and methods to minimize exposure to infected wildlife through spatial and temporal separation. This is especially important during the season of February through June when diseased wildlife are most likely to abort and through the calving period.<sup>1</sup>

## Introduction to the RB51 Vaccine

### **What is the RB51 vaccine?**

The RB51 vaccine is used to protect cattle against the *B. abortus* strain of brucellosis. The vaccine induces cell-mediated immunity via a genetically stable (in-vitro and in-vivo), rough morphology of *B. abortus* strain RB51.<sup>4 6 18</sup> In pregnant cattle, the RB51 strain is immunogenic which results in humoral and the protective cell-mediated immune responses.<sup>6</sup> The RB51 organism is cleared from the bloodstream through the cervical lymph nodes within 6 to 10 weeks post-vaccination. In most cases, the RB51 strain cannot be cultured from the blood within the first 3 days post-vaccination.<sup>5 6 7 8 9 10</sup>

### **How effective is the RB51 vaccine?**

The RB51 vaccine has been proven to protect against abortion and natural infection and is highly effective at preventing abortion in herds with low to high brucellosis prevalence.<sup>11</sup> The RB51 vaccine has a similar degree of efficacy in bison as it does in cattle, however bison must be given a booster to achieve the same response.<sup>12</sup> The RB51 vaccine is not efficacious in elk.<sup>13</sup>

### **Is the RB51 vaccine cross-protective against other strains of brucellosis?**

The RB51 vaccine is effective against *B. abortus*, however, it is not effective against *B. suis* in cattle.<sup>14</sup> The RB51 vaccine is not an effective vaccine against *B. suis* in swine, but there has been some efficacy shown against *B. melitensis* in sheep and goats.<sup>15 16 17</sup>

### **How is the RB51 vaccine administered?**

The vaccine can only be administered by a licensed, accredited veterinarian or by a state or federal animal health official. According to USDA APHIS, and the vaccine label instructions, heifer calves are to receive the vaccine between 4 and 12 months of age. At this age, heifers will receive the calf dose (10 to 34 billion colony forming units) of the vaccine.

### **How are RB51 vaccinated cattle identified?**

After the vaccine is administered, the calf will receive an official identification ear tag and a vaccination tattoo to prove they have been vaccinated. The tattoo begins with an "R" followed by the U.S. shield, and finally followed by the last number of the calendar year in which the animal was vaccinated (i.e. - R, U.S. shield, 8). In adult vaccinated cattle, the tattoo begins with "RAV" followed by the last digit of the year the animal was vaccinated (i.e. - RAV8). Along with the ear tag and tattoo, there is an APHIS brucellosis vaccination certificate that must be submitted to state and federal animal health officials.

The vaccination tattoo was originally required as proof of vaccination when the Strain 19 vaccine was in use to distinguish vaccinated cattle from naturally infected cattle. The Strain 19 vaccine periodically caused a residual titer on diagnostic tests, resulting in false positives. Heifers were vaccinated between 4 and 12 months of age to try to prevent false positive testing. Despite this, some cattle that were vaccinated with Strain 19 as heifers tested positive many years later, resulting in regulatory action on

herds of origin and the need for tattoos as a means of identifying vaccinated cattle. The RB51 vaccine does not cause false positive test results.<sup>5,6</sup>

### **Should cattle over 12 months of age ever be vaccinated?**

Generally, only animals in risk areas receive the RB51 vaccine as an adult after approval from a state or federal animal health official. In the United States, the only risk area for exposure to brucellosis from infected wildlife is the Greater Yellowstone Area. Studies conducted by the USDA-ARS-NADC indicated the immunogenicity of the vaccine begins to wane around 5 to 6 years of age in cattle, therefore, producers in areas where the disease exists in wildlife are encouraged (if not required) to vaccinate adult cattle after receiving direct permission from state or federal animal health officials. If in a risk area, bison should be given a booster vaccination for the best response.<sup>12</sup> The booster vaccination is given after the animal is 12 months of age.

### **Does the RB51 vaccine produce a reaction?**

The RB51 vaccine typically does not produce clinical signs of brucellosis after vaccination or a local reaction at the injection site.<sup>6,10</sup> The RB51 vaccine has a decreased risk for systemic reactions and arthritic signs compared to previous vaccines, and immunosuppression does not cause recrudescence after vaccination.<sup>5,6,10,18</sup>

### **Is the RB51 vaccine safe?**

The RB51 strain cannot be spread from a vaccinated animal to an unvaccinated animal.<sup>18</sup> The vaccine is safe in cattle over 3 months of age. In some cases, a small percentage (1-3%) of pregnant cattle may abort after vaccination.<sup>5,9</sup> Abortions caused by the RB51 strain require a culture to differentiate from field strain *B. abortus*.<sup>6</sup> There is a very low incidence of RB51 vaccine-associated disease or abortions after off-label vaccination of adult pregnant cattle with the calf hood dose.<sup>5,9</sup> Vaccination of a sexually mature bull with the RB51 strain does not result in colonization, orchitis, shedding, or sterility in bulls.<sup>7</sup>

### **Can RB51 vaccinated cattle be differentiated from cattle infected with the field strain *B. abortus*?**

RB51 vaccinated cattle can be easily and accurately differentiated from those animals infected with the field strain of *B. abortus*. The RB51 vaccine does not cause false positive test results.<sup>5,6</sup>

### **Does the RB51 strain show up on standard diagnostic tests for brucellosis?**

The RB51 strain can be easily and accurately differentiated from animals infected with the field strain *B. abortus* because it lacks the polysaccharide O-side chains normally found on *B. abortus* bacteria.<sup>19</sup> These side chains cause the diagnostic antibody responses of an animal to natural infection with field strain *B. abortus*. Unlike the field strain of *B. abortus*, the RB51 strain does not stimulate an antibody response that is detectable on routinely used serological tests. The RB51 strain does not produce false positives on traditional serological tests for brucellosis.<sup>5,6</sup>

There is a separate assay available that can detect antibodies produced by the vaccine if the animal has been vaccinated with RB51.<sup>8,9</sup>

## **Human Exposure to the RB51 Vaccine**

### **How are humans exposed to RB51 vaccine?**

The RB51 vaccine is a live-attenuated vaccine with infrequent human brucellosis cases linked to vaccine exposure. Most commonly, humans contract the RB51 strain through occupational exposure such as needlesticks.<sup>20</sup> Rarely, there is human exposure to RB51 through raw milk consumption. In a recent case reported by the CDC, the RB51 strain was detected in raw milk at a dairy in Paradise, TX; 83% of households who bought raw milk from this dairy were exposed to the RB51 strain. Only one case of human brucellosis resulted from this exposure.<sup>21</sup>

### **What are signs that I may have brucellosis after exposure to the vaccine?**

The symptoms of brucellosis in a human are generally acute. According to the CDC, symptoms may include:

- Non-specific: fever, chills, headache, myalgia, arthralgia, fatigue, weight loss
- Sub-clinical infections are common
- Lymphadenopathy (10-20%)
- Recurrent fever
- Arthritis and spondylitis
- Focal organ involvement (endocarditis, orchitis/epididymitis, hepatomegaly, splenomegaly)

It is important to remember that the RB51 strain does not have an antibody response that is detectable on routine serological assays, making diagnosis and treatment of the disease in humans difficult.<sup>20</sup>

### **How is RB51 strain of brucellosis treated in humans?**

The RB51 strain is resistant to penicillin and rifampin, antibiotics that are commonly used to treat brucellosis in humans. Despite this, RB51 strain is susceptible to a range of antibiotics. In cases of human exposure, contact a physician and department of public health.<sup>4 22</sup>

### **What is the risk of acquiring brucellosis from RB51 vaccine exposure?**

Overall, naturally acquired (not due to vaccine exposure) brucellosis cases have been on the decline in the United States over the past 70 years.<sup>23 24</sup>

- 1947- 6,400 human cases
- 1997- 98 human cases
- 2011- 80 human cases
- 2017-120 human cases

A recent spike over the last 6 years can be attributed to exposure to *B.suis*-infected feral swine, as well as the consumption of raw cheese from Mexico.<sup>22</sup>

Few cases have been recorded in the United States resulting from accidental exposure to the RB51 vaccine. From December 1998 to January 1999, the CDC conducted passive surveillance on accidental inoculation with the RB51 vaccine. Reports from 26 individuals were received; 21 people reported exposure via needlestick, 4 via conjunctival spray, and 1 person reported exposure via vaccine spray into an open wound. Among reported cases, 73% had one or more systemic symptoms. The CDC rates the disease risk as “LOW” for contracting brucellosis via exposure to the RB51 vaccine.<sup>25</sup>

#### **How can RB51 vaccine exposure be reduced?**

According to the CDC, the easiest way to prevent exposure of the RB51 strain to humans is using PPE. Gloves, closed footwear, eye protection, face shield (depending on procedure), and respiratory protection (depending on procedure) should be worn to protect open wounds, eyes, and mouth from encountering the vaccine. It is recommended to have proper procedures in place to avoid splash, spill, and aerosol exposure to the vaccine.<sup>20</sup>

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