

RB51 Adult Vaccination: What is known and what is not known



Brucellosis Coordination Team Meeting
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Brucella Abortus Vaccine (Strain RB-51)

- First licensed in 1996.
- A stable strain which produces protective immunity while not inducing antibodies which react in standard serological tests.
- RB-51 has been tested to verify safety and efficacy.
- For use by or under the supervision of a veterinarian.

Brucella Abortus Vaccine (Strain RB-51)

- **Directions**

For use in healthy female cattle **4 to 12 months of age** as an **aid** in the **prevention of infection and abortion** caused by *Brucella abortus*.

Do not administer to pregnant cows.

RB51 is not absolutely safe in pregnant cattle – 3 episodes of abortion at WSVL due to RB51 vaccination of pregnant cattle in 2006-2007, 2008-2009, and 2011.

Data suggest that cattle vaccinated with RB51 as calves can be safely booster-vaccinated with RB51 as pregnant adults.

Do not vaccinate within 3 weeks before slaughter. Rehydrate with accompanying vial of sterile diluent. Shake well after rehydration. Administer 2.0 ml subcutaneously.

Brucella Abortus Vaccine (Strain RB-51)

- **In South Africa, the label reads:**

Proposed Dosing Schedule:

1. *Brucella abortus* negative herds:

i) Herds which have not been vaccinated against *Brucella abortus*:

Vaccinate heifers 4 - 10 months of age with 2 mℓ administered subcutaneously.

Revaccinate with full dose between 12 – 16 months of age.

Adult cows, non-pregnant – administer 2 mℓ subcutaneously.

ii) Herds with established immunity by previous vaccination *against Brucella abortus*:

Vaccinate heifers 4 - 10 months of age with 2 mℓ administered subcutaneously.

Revaccinate with full dose between 12 – 16 months of age.

Yearly boosters can be administered if desired but it is not a prerequisite.

Brucella Abortus Vaccine (Strain RB-51)

- **In South Africa, the label reads:**

Proposed Dosing Schedule:

2. *Brucella abortus* positive herds:

Vaccinate heifers 4 - 10 months of age with 2 ml administered subcutaneously.

Revaccinate with full dose between 12 – 16 months of age.

Adult cows, non-pregnant – administer 2ml subcutaneously.

Factors to consider when deciding on a vaccination program

1. Presence and degree of challenge of the particular diseases on the farm/ranch
2. Medical and economic consequences of infection
3. Vaccine efficacy
4. Vaccine cost
5. Adverse side effects associated with vaccination



Factors to consider when deciding on a vaccination program

There is no “standard” vaccination program that can be recommended for all animals; each situation must be evaluated individually.

Animal age, type, number, use, stocking density, exposure to diseases, cost, operations facilities and management, geographic location, etc., etc.

Why even consider brucellosis adult-booster vaccination program?

- If exposed, cow (likely) still gets infected with wild-type *Brucella*, (likely) develops antibodies, (likely) tests positive on serological test, still requires quarantine and 3 consecutive negative whole-herd tests.
- Some other States don't "allow" adult-booster vaccinations?

Why even consider brucellosis adult-booster vaccination program?

- BUT, vaccinated and adult-boosted animals less likely to abort, less likely to spread disease within and between herds
- *Possibly* less likely to become infected, therefore fewer positive animals to cull, increase likelihood of 3 negative whole-herd tests, greater chance of quarantine being as short as possible

Criteria for determining vaccine efficacy (VE)

1. Produce antibodies
2. Prevention of infection
3. Decreased shedding of agent after infection
4. Prevention of disease
5. Decreased severity of disease
6. Economic – vaccinates more profitable than non-vaccinates



What is Vaccine Efficacy?

- Definition: the percent of vaccinated animals that obtain total protection against infection, or alternatively, the percent by which vaccinated animals show a decrease in susceptibility to infection.
- The proportion of disease prevented by the vaccine in vaccinated individuals.

What is Vaccine Efficacy?

- If VE is 0.7, then 70% of the vaccinated animals became totally immune from infection, or all the vaccinated animals show 70% diminished susceptibility.
- VE should be defined for a given period of time, depending on the nature of the vaccine.

VE = 70%

- Could mean disease in vaccinates vs non-vaccinates of:
 - 30% and 100%
 - 15% and 50%
 - 7.5% and 25%
 - 0.15% and 0.5%
 - Relative versus absolute difference important

Factors affecting Vaccine Efficacy

- Nutrition
- Environmental stress
- Concurrent infection with other microorganisms
- Exposure dose

Vaccine effectiveness

- Includes not only VE, but also proportion vaccinated and incidence within population
- Even though vaccination may not prevent infection, it could reduce either the amount of agent shed or the duration of shedding, thereby reducing transmission

Economic analysis

Need to know:

- Total cost of a clinical case (DC)
 - Treatment and mortality, decreased growth, productivity
 - Quarantine
- Total cost of annual vaccination (VC)
- Expected incidence of disease (DI)
- Vaccine efficacy (VE)

Economic analysis

Vaccination considered worthwhile when:

losses prevented $>$ costs involved

$$RI \times DC > VC$$

- RI = reduction in incidence
- DC = cost of disease
- VC = cost of vaccination

$$RI > VC/DC$$

Economic analysis

- *Vaccinate as insurance*
 - Producer may be willing to pay to avoid disease

Cost of vaccination

- WLSB compensates accredited veterinarians for administering adult-booster vaccines to cattle located in or originating from DSA.
- Producer pays non-veterinarian labor cost, squeeze chute depreciation, abortion risk, and meals.
- Producer costs therefore only a portion of 'cost to society'.

How often to vaccinate?


- So far, there are no experiments that evaluated the duration of immunity, but Olsen and Stoffregen suggest that a booster vaccination is required between 4 and 5 years of age to maintain high levels of protection after RB51 calfhood vaccination.
- Also, RB51 revaccination has been recommended six months and one year after calfhood vaccination in northern Mexico.

Cost of vaccination (Peck, unpublished, 2010)

- Producer's costs for adult vaccination in a 400 adult cow herd
- Scenario 1 (approximately \$800/year)
 - A herd's cows are vaccinated once in their adult life.
 - Every year thereafter, incoming 2 year-olds receive adult-booster
- Scenario 2 (approximately \$1,100/year)
 - In addition to scenario 1, all adult cows receive an adult-booster vaccination every 5 years thereafter.
- Scenario 3 (approximately \$1,500/year)
 - In addition to scenario 1, all adult cows receive an adult-booster vaccination every other year thereafter.

UWYO experiment (J. Adamowicz, unpublished)

Group	Number of animals	Calfhood vaccination	Heifer boost	Breed	“Adult” boost	Abortion	Premature calves	Full term calf
Control	4			O		1	2	1
1-dose	7	X		O		2	3	2
2-dose	7	X		O	X	0	0	7
3-dose	5	X	X	O	X	0	0	5


*Challenged
with B. abortus*

Booster vaccination in Bison (Olsen, Johnson, 2012)

- Two vaccinations with RB51, 13 months apart resulted in reduced incidence of abortion, uterine infection, or infection in maternal tissues compared to non-vaccinated controls.
- Booster vaccination of bison with RB51 enhances protective immunity against *Brucella* challenge compared to single vaccination

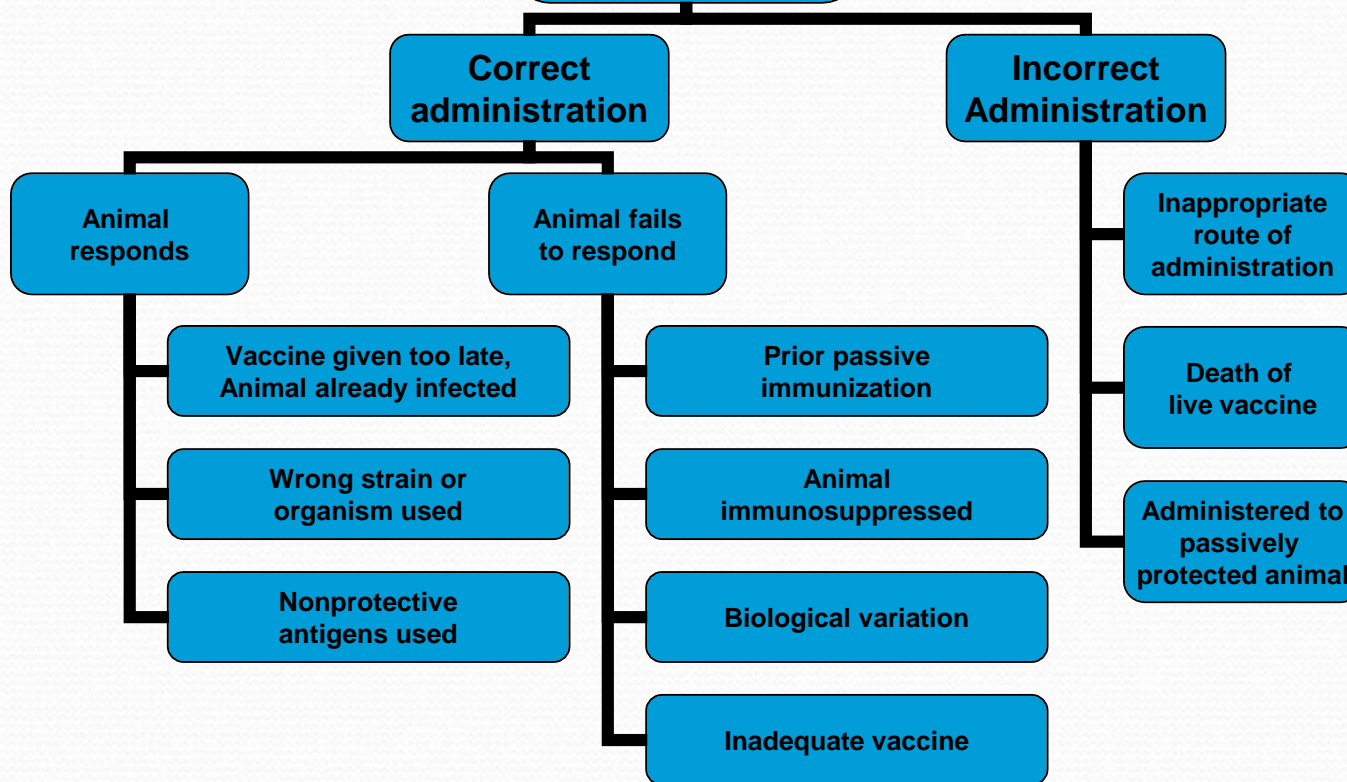
Questions yet to be answered

- Does booster vaccination protect against infection?
- How long does immunity last, i.e. how often do you need to re-vaccinate, at what age, time of year/gestation?
- If there is no immune response the first time, will a booster vaccination have any effect? Can those animals be identified?

Questions yet to be answered

- Is there an immunological marker of 'protection' that can predict whether an animal is susceptible to infection?
- How best to quantify individual producer's risk of infection?
- Why are elk so different in immune response?

Vaccine failure



Questions?

