## The Different Vaccine Types and How They Work in the Animal

## Season 1, Episode 59

[Intro music]

**Kiernan Brandt:**

Welcome to Cattle HQ, a podcast from industry experts and progressive producers discussing cutting edge info about the cow calf sector to keep cattlemen and women in the know and positively affect their bottom line.

**Robin Salverson:**

Welcome to Cattle HQ, brought to you by South Dakota State University Extension. I am Robin Salverson, your host for this episode of Cattle HQ. Joining me is Dr. Russ Daly to discuss the differences between vaccination types and how they work. Thank you, Dr. Daly. I know we had you on other episodes of Cattle HQ. Even though I know you’re not a new guest, but if you could share with your listeners a little bit about yourself. If they are new to our podcast, they know who you are.

**Dr. Russ Daly:**

Sure. I’m serving as the extension veterinarian here at South Dakota State University. I’m based in the veterinary biomedical sciences department. I’ve been here at SDSU for almost 20 years and before that, I was in practice – mixed animal practice, probably mostly beef/cattle when it came down percentage wise in Southeast and South Dakota for about 15 years. It’s where my background is. Right now I do mostly extension work and do a little bit of teaching and get involved in a little bit of research once in a while too.

**Robin Salverson:**

I know you’ve been across the state, doing a lot of different talks with producers. I think I’ve told you this in the past that there are some people that maybe considered groupies to Dr. Daly. [Laughter] Wherever Dr. Daly is, they try to be. That just really tells me that you do an excellent job in your position.

**Dr. Russ Daly:**

That’s really high praise.

**Robin Salverson:**

[Laughter] With that, like I said, this episode of Cattle HQ is going to be talking about the different vaccination types and how they work. Dr. Daly, there are several vaccines out on the market to help protect our animals against diseases. To help the listeners navigate all of those different vaccines, could you share what those different types of vaccines are such as modified, live, or killed and how they work in the animal system?

**Dr. Russ Daly:**

Yes, we do have the opportunity for a lot of choices with our vaccinations that we give to cattle and I’m mostly thinking about respiratory disease protection, reproductive disease protection as well, but then some other things. For those particular vaccines, we do have a choice between what we refer to as killed vaccines and modified live vaccines. I should just stop and say too that some vaccines we don’t have a choice. Like our seven way vaccines, for example, they’re all killed. There’s no modified, live version of them. For those that we do have both versions, it can be kind of using which ones were best and so we spend a little bit of a time trying to understand how each one works and they do work in different ways. I’ll start with a killed vaccines. Of course, a killed vaccine is something that a vaccine is made out of inactivated microbes, whether it’s bacteria or viruses and there’s no way that they can cause disease ever because they’ve been killed. That’s in the name of the vaccine. Some interesting things about killed vaccines is they require adjuvants. So if you’ve ever picked up a bottle of vaccine and it looks kind of milky white, that’s the chemical, the adjuvant in there that helps stimulate the immune system even further, even more than just the antigen’s – the germs in it. I’ll probably refer to the germs and vaccines as antigens quite a bit because that’s what the body responds to. Then killed vaccines by their nature, they have a lot more of those antigens in a certain dose because that’s all that the animals are going to see, is just what we give into that animal. We’ll talk about modified lives later on where those viruses and those bacteria multiply within the host. Killed vaccines, again, we have our choices in respiratory vaccines, we have our choices for reproductive vaccines, our seven-way shots, scour shots for cattle – for cows. In late gestation, they’re all killed vaccines as well. The way they work is the body processes those antigens in the vaccine and for the – there are certain cells in the body called antigen presenting cells and I’m going to probably make some die-hard immunologist mad with how I describe this but I’m going to oversimplify it probably but these antigen presenting cells are roaming around the body and looking for something foreign to the body and they’ll see this vaccine and they’ll basically process the vaccine and basically eat it and – eat it up and spit it back out, so it’s processed by the immune system in a certain way. The way it’s processed by the immune system, it gets the attention of cells to produce antibodies. We know about antibodies, what we talked about being in colostrum and the things that help roam around our system, waiting for an antigen that it corresponds to and then binding them up and getting – helping get rid of those germs from the body when they’re – when they’re exposed to – when the animals are exposed to those germs. That’s the killed vaccines. The way the body responds to them is by producing antibodies. That’s important to realize for killed vaccines. Now, modified live vaccines, they are live like the – their title mentions they’re live vaccines, so we have to depend on them being alive once they get into the animal. We talked on the last podcast about some of the ways we keep those modified live vaccines viable by the time we get them into the animals. Because they’re alive, when they get into the animal, they expand and they reproduce just like live viruses and bacteria. In the case of viruses, live virus vaccines, they get into body cells just like the normal viruses do and then they change the outside of those cells so that the immune system recognizes them, this change as something foreign. Then they, the part of the immune system that they get involved with is called the cell mediated immunity. They stimulate the immune system in much the same way that they’re getting into the cells themselves and the same way the viruses get into body cells as well. It’s an oversimplification too but killed vaccines, antibody production, the germs that are floating around the calf’s body or the cow’s body and they’re going to respond to it that way. Live vaccines, cell mediated immune response. They’re really after those changed cells and usually that’s viruses, viruses getting into the body cells. You can categorize them in that way, killed vaccines and modified live vaccines. That’s the nutshell on how they stimulate the immune system in different ways.

**Robin Salverson:**

Before we started the podcast, we actually had asked in the cattle side of things if there was any live vaccines. We talked about killed, modified live, and then there are, I understand, some live vaccines. I always think I got to have the opportunity to work a lot of sheep overtime and we gave a live vaccine for sore mouth, for instance. I was curious if you could talk about the live vaccine then.

**Dr. Russ Daly:**

Most of what we’re going to see with cattle is what we called modified live and that implies that those germs are still alive but they’ve been modified in the way they’ve been grown at the vaccine company so that they don’t cause illness. The sore mouth vaccine you’re referring to is almost more of a live culture and so you’re getting the body to respond to that, very controlled way that we stimulate that animal’s immune system by using the sore mouth vaccine. Modified live, that’s what we’re mostly referring to with cattle vaccines, pretty much all of them have been modified to the point where they can’t cause disease in the animals. That’s important because we don’t want to give the animals the disease that we’re trying to protect them against.

**Robin Salverson:**

Absolutely. When you read the label on those vaccine bottles, some of them require a booster while others do not. Why is that?

**Dr. Russ Daly:**

That’s a real feature of – especially killed vaccines because they are – the body responds just to what we put inside the animal with their vaccines. Oftentimes, our killed vaccines will require boosters. Some modified live ones also call for boosters as well, what we’re doing there. What we’re talking about with a booster, a booster is just using the same vaccine again later on in that animal to enhance the immune response. It’s not a case where we got one bottle of vaccine as the initial vaccine and then a totally different bottle as a booster. They’re exactly the same thing. What happens when we give the vaccine? Any vaccine just the first dose, is what I talked about before, we’re either stimulating the antibody production and we’re stimulating the cell mediated production and the body responds to it in a certain way and then if there’s no more stimulation from the disease or from another vaccination, then those cells that are producing that immune response just become, I guess, deactivated. They’re still around the body but they’re just staying there, searching around for the next time that that animal was exposed to that germ or that vaccine. When we do a booster vaccine, after the initial vaccine, it’s the same thing, only magnified quite a bit. We get a much more rapid response after we give the booster and we get a higher response too. If we had X number of antibodies that were produced by the first vaccine, we might have a thousand times antibodies produced for the boosters. That booster dose is featured by a much higher and longer lasting immune response.

**Robin Salverson:**

What you’re saying that those boosters are important because I have to admit, sometimes it’s easy to give that one initial shot, we send cows out to grass and they don’t come back in for that booster. So those boosters are important. I believe you just said that they are important.

**Dr. Russ Daly:**

Yes, they are. Because of the enhanced protection and enhanced immune response that you get after that second shot. Now, it’s not to say that just giving the one dose, the first dose, it’s not to say that it’s worthless. Because the body’s going to respond to it but that body’s going to respond to it in a lower to moderate way and that might not be enough to counteract a big, heavy exposure or a lot of stress or a lot of bad weather around windy time if we’re talking about a respiratory vaccine, for example. It’s not that just giving the one dose is worthless but in order to really make sure that we’re stimulating the calf’s immune system like the vaccine company proved it would, we need to give that booster.

**Robin Salverson:**

Is the timing between the initial shot and the booster shot important?

**Dr. Russ Daly:**

It is. Every time you use a vaccine, especially killed vaccine, you can read on the label. It says to give a booster dose of this vaccine in X number of weeks – two weeks, three weeks, four weeks, six weeks, whatever. They’re different for a lot of different vaccines, what’s happening there. Well, in that interval, what’s happening is you gave the first shot and then the body responds to that vaccine and then the – like I said, the cells become a little dormant and they wait around for the next stimulation. Maybe that’s the disease that they’re going to respond to. It’s interesting that after that happens, the body, whether it’s a calf or a horse or a cat or a person, the body has a way to look at those immune cells that were stimulated with the vaccine. It’s like any group of a population of animal, you got your really good ones. You really got some duds, they really don’t do very well and it’s the same way with these immune system cells. The body has a way of getting rid of those cells that didn’t really respond to the vaccine very well. The body gets rid of those duds. On the other hand, we have some that are just really overzealous. Some of those cells are really overzealous and they can cause too much reaction and that’s when we have the body go through this vaccine reactions and maybe even allergic reaction and the body gets rid of those too so that when that booster comes along, you’ve got a really solid set of immune cells ready to respond to that second shot and that’s why we have such a high, prolonged immune response to that booster. Now, the thing about that culling, you can at it as culling those immune cells out, there’s nothing we can do to speed that up. We just got to wait. That’s where that interval for the booster comes into place. So the vaccine company says we got to give the body two weeks to get that right population of immune cells or we got to wait four weeks or we got to wait six weeks. When we follow that booster recommendation to the letter on the label then we know that we’re going to have a good response. The timing is important and it’s actually a – based on what I just described, if we give the booster too early, we maybe didn’t give the body enough chance to get rid of those rogue, bad immune cells. It’s not going to hurt the body but the booster isn’t going to give us the bang for the buck that we were after. If you have a choice and you’re right, Robin, about when you look at the booster requirements, you almost never get the chance to get it right exactly when you’re supposed to give the booster. If it says four weeks from the first one – well, four weeks is going to be rainy or a blizzard or on a Sunday when you can’t get any help, whatever. If you have a choice to give the booster earlier or later, it’s actually better immune system wise to wait until later and give the body a chance to get those immune cells in the right population to respond to that booster.

**Robin Salverson:**

I think that’s a really important take home message there. To tell you the truth, I didn’t realize that, that if for some reason, you can’t give it like the label says, waiting longer is better than going too early. That’s really a great take home message there.

**Dr. Russ Daly:**

That’s as far as, just strictly speaking, with the immune system too.

**Robin Salverson:**

Absolutely.

**Dr. Russ Daly:**

You got to think about when are we weaning these calves or when is the exposure going to happen too and that might play into it too but strictly speaking with the immune system, wait longer rather than sooner with that booster.

**Robin Salverson:**

I have a question, this is in regard to the killed vaccine, for instance, the cross ordeals that we give in the spring here to our calves. A lot of times, those are only getting one shot but then in the fall of the year, when we start weaning those calves, they get another one. How do those two work together or is there really any…?

**Dr. Russ Daly:**

The question you’re asking there is if we wait that long between the shots, is it a real booster or is it like a re-vaccination? If you wait a really long time, a year or so, it depends on the vaccine a little bit too, you might just be what we call re-vaccinating or giving the first dose over again. Now, that’s not necessarily bad. You’re still stimulating the immune system. You might just not be getting the bang for the buck with your booster that the vaccine company proved that they have when they approved the vaccine. Depending on your exposure level, maybe that’s okay. Maybe those calves are exposed to not very much of the [[cluster or]](https://recordings.civi.com/cgi-bin/player.php?file=CHQ-Ep-59.mp3&starttime=1138&duration=20) organisms if we’re talking about a seven-way, for example and that that’s good enough. I think in your scenario where we would vaccinate, say branding time and then give them a booster a weaning, I think we’re still getting more of a booster effect. I think that it’s not that long between the shots. That second dose is giving us more bang for the buck than just the first one did.

**Robin Salverson:**

That’s great. [Laughter] Because I think that’s a pretty normal –

**Dr. Russ Daly:**

Very common.

**Robin Salverson:**

Very common, yes. We should back up really quick. We mentioned modified live versus killed and for maybe the listeners, just to refresh your memory, modified live vaccines are the ones that come in two different bottles – one, containing a fluid and the other one, a powder and then you reconstitute the powder. Some people are wondering what’s the difference between modified live and killed in regard to as we take them out of the box and we look at them. The killed are already a pre-mixed vaccine, if you want to call it like that.

**Dr. Russ Daly:**

Right. Easy way to tell what you’re dealing with. If it comes in a box with a glass and a plastic bottle, you have to mix up, that’s usually a modified live. There are things you want to pay attention to as far as using those up before getting – before they have been mixed and standing around too long.

**Robin Salverson:**

And lose its efficacy basically.

**Dr. Russ Daly:**

Right.

**Robin Salverson:**

Excellent. My next question really isn’t related to vaccination type but more the route of administration. A lot of times, we think about the injectable vaccination, so giving those injections on the neck but there’s also the opportunity of giving intranasal and a lot of times – and you can – tell me if I’m wrong, but a lot of those are modified live vaccines. Is that correct? Those intranasal ones?

**Dr. Russ Daly:**

Yes, they all are. They have to be live in order to replicate. That same thing that I was talking about with the injectable modified lives is applying to the nose, so those – that vaccine, the virus and the vaccine is getting into the cells of the nose and then changing the surface of those cells so that the body’s immune system responds to those changes and is stimulated by the vaccine in such a way that the next time that animal sees that same virus is going to respond in a much broader fashion.

**Robin Salverson:**

So it attaches right to the mucosal.

**Dr. Russ Daly:**

Right, and it’s got to get into the cells. So those modified live vaccines have to get inside the cells in order to stimulate the immune system. That’s why it’s so important that they be alive when we put them in the animal because there’s not enough germ or antigen in a dose of modified live vaccine to really stimulate the immune system if we kill it. Remember, I mentioned killed vaccines have a lot more of the antigen in those already. If we forget and leave the bottle of mixed up modified live vaccine out too long or it gets too hot, it’s not just that we made it into a killed vaccine because there’s not enough there to really do any good.

**Robin Salverson:**

We’re about to wrap up this Cattle HQ podcast but one of my last questions for you, Dr. Daly is as a veterinarian, can you identify which type of vaccine is best for an operation?

**Dr. Russ Daly:**

If I was a veterinarian, working with an individual herd, you bet, I actually can. I can’t say that right now for just overall because it really depends on so much. So some of the factors that we would go into would be what is your disease pressure, are you a herd that’s buying and selling a lot of cows, do you feed cattle and always buying and selling new feed lot cattle that are housed right next to your cows? What’s your disease pressure? If you’re in that situation rather than a strictly closed herd, then we got to pay more attention to things and we got to pay more attention to the boosters and making sure that our modified live vaccines are working and maybe even thinking about a booster for those modified live vaccines. The disease pressure really comes into play. The types of things that you’re dealing with on your farm. There’s a lot of vaccines that are out there marketed that doesn’t necessarily mean we have to use every one of them. What are the risks on your farm? Then trying to match some of the products with what your operation can handle as far as facilities and labor. Is it a situation where it’s easy for us to get those cattle in another time and give them a booster or is it going to be really tough? That might make up our decision about whether to use a modified live or a killed vaccine sometimes. All of those things come into play and veterinarians who understand the operation and the disease pressure especially can help producers make those determinations. I would say too that most of us have our set programs and you’ve probably been using the same things at the same time in the same animals for many years. If you’re thinking about a change, if you’re thinking about this is the year I’m going to buy some new animals to bring in and when I haven’t done that before or I’ve heard about this new vaccine, when you’re thinking about changes, that’s really the time to sit down with a veterinarian and say, “How should these changes effect what I give them for vaccine?”

**Robin Salverson:**

Again, just another take home message, make sure you really visit with your veterinarian and not have that relationship, that’s so important is that client relationship. Whether it’s with vaccination programs, if you have a disease outbreak of some kind or a health issue or concern, again, going to your vet because right now, when we go back and think about vaccination, you can go buy them from any store basically. It’s really important, again, talk to your vet which one should you be using based on everything you just shared of why, again, that vet-client relationship.

**Dr. Russ Daly:**

They know your herd, they know what’s going around out in your neighbor’s herds too. They know what vaccines are maybe new on the market and which ones might be – wants to try for you and which ones we should just stick with the old ones with. Especially like I said, if there are any changes anticipated in your operation or thoughts about a new vaccine, definitely, that needs to be discussed because if you don’t, you could make some real bad mistakes based on timing with those vaccines and at worse, they could – well, best they wouldn’t work and at worse, they might cause some adverse problems.

**Robin Salverson:**

Absolutely. I should also mention that when giving these vaccinations, to make sure you are following BQA guidelines and I encourage everyone to go listen to the podcast that I just recently recorded with Dr. Daly and also our South Dakota BQA coordinator, Addie Womack. Go listen to that podcast. I think you’ll find a lot of great information in that. Any last closing thoughts before we wrap up this episode, Dr. Daly?

**Dr. Russ Daly:**

I just echo that, the way we give vaccines properly to the animals is so important at making sure they work. We don’t want to put all this thought and effort into researching what vaccines we should be using and then spend all the money on the vaccines and not have them work because of some mistake we are making with handling or how we’re administering them. Those things are really important.

**Robin Salverson:**

Thank you again, Dr. Daly for joining us on this episode of Cattle HQ. Before we end this episode, my best friend is probably going to laugh at me because she doesn’t think I’m going to do this but I’m sitting currently in her house, recording this podcast because I’m on the road traveling for work and she goes, “What are you going to do for me if I give you internet access to use?” I was like, “I’ll give you a shoutout on our Cattle HQ podcast.” So thank you, Teresa. [Laughter] She’s going to be super embarrassed now that I did this. Also, another shoutout that we are doing Cattle HQ live webinars on a monthly basis and lots of great topics that we discuss, so go to our extension website and you can register for those and learn more about them. Again, this has been Cattle HQ, brought to you by SDSU Extension, headquarters for all things beef/cattle, visit extension.sdstate.edu for the latest beef information. Until our next episode, live a great story.

**Kiernan Brandt:**

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[Outro music]