## Utilizing Embryo Transfer or Artificial Insemination in Your Operation

## Season 1, Episode 28

[Intro music]

**Kiernan Brandt (Interviewer):** Welcome to Cattle HQ. A podcast from industry experts and progressive producers discussing cutting-edge info about the cow/calf sector to keep you cattlemen and women in the know and positively affect their bottom line.

**Olivia Amundson (Interviewer):** All right. Welcome to Cattle HQ. Brought to you by South Dakota States University Extension. I am Olivia Amundson, cow/calf field specialist based out of the Sioux Falls Regional Center, with my sidekick, Kiernan Brandt, from the Watertown Regional Center. Today joining me on this episode is Dr. Jessica Drum, assistant professor in SDSU Extension, beef reproductive physiologist out of Brookings, South Dakota. I'm excited to have Dr. Drum on this episode of Cattle HQ to share her experiences and expertise in embryo transfer and artificial insemination. Welcome to the podcast, Dr. Drum.

**Jessica Drum (Respondent):** Hi. Thanks, Olivia and Kiernan, for having me here. So, I'm a veterinarian, and I did my master's and my PhD back in Brazil with reproductive physiology. Then I moved to US and I did my postdoc at the University of Missouri. In the past, I've been working with a lot of estrous cycle synchronizations and physiology, fixed-time AI, embryo development, and pregnancy establishment. So, I started two months ago here in SDSU as an assistant professor and beef reproduction extension specialist. Moving forward, I plan to keep working with the suffix that I've worked before, such as embryo development and pregnancy establishment, focusing on reproductive physiology and reproductive efficiency.

**Interviewer:** What do you got coming down the pipeline for producers and cow/calf stakeholders throughout the stake - throughout the state? Anything that you've got coming immediately or are you still getting set up and rolling on your first projects?

**Respondent:** So, I'm still trying to gather some funds for doing my research for now. I have some plans moving forward. We already submit some grants, so hopefully, we can get granted, but it would be focused on health and reproductive physiology answers for the - that would be mostly for the immediate response to the producers. So, we want to keep working on that. Moving forward, I believe by the next spring, I will be up and going this with my research.

**Interviewer:** That’s exciting. So, I have a big question for you. Are you prepared for South Dakota winters?

**Respondent:** [Laughter] Kind of. [Laughter] During my PhD, I spent some time on north of US, in Wisconsin. So, I had some experience with the cold. I really like better the cold than the summer. The hot weather is too much for me sometimes. [Laughter]

**Respondent:** [Laughter] I don’t know if you’re going to regret saying that once we’re in the thick of winter, but yes, I don’t know, I agree. I always think summer is nice, but I'm always ready for cooler weather. Must be a true Midwestern mentality, yes.

**Interviewer:** Just got to invest in good coveralls.

**Interviewer:** Yes, good coveralls.

**Respondent:** Yes, I’m doing that. [Laughter]

**Interviewer:** Awesome. All right. So, in the past, you've done some work associated with embryo transfer. So, I guess, in an applied sense, how do you see that work being beneficial for producers, specifically producers here in South Dakota?

**Respondent:** So, I believe it all depends. [Laughter] I'll say a lot of depends today. It can be beneficial, especially from the genetic point of view. Using the embryo transfer technology, you add up to the females as well as a contributor to the genetic merit for fertility and for other stuff. So, basically, you are helping them to get another level of input on the genetic merit. Pretty much the females can contribute to decrease the interval between generations, which is one of the main factors in the calculation of genetic improvement. So, basically, if you use younger females especially. Nowadays, there are some technologies that can be used, even weaned heifers, weaned calves, you can use for using this for doing this type of biotechnologies. That allows the producers to open their business for different activities, such as selling heifers, for example or selling bulls, or something like that. In the different activities, you can have another strategy to get better results and better genetics faster. So, that's what I think about it, and that could be used both for the producers that really want to focus on the breeding part of their herd.

**Interviewer:** Yes, I remember when I was working in a position prior to the one I'm in now and yes, pulling oocytes from weaned heifers just seemed so progressive in terms of pushing that genetic program needle in a more positive direction. I guess I saw that mainly in the dairy industry. Do we see that a lot in the beef industry?

**Respondent:** So, where I came from, in Brazil, the pressure for breeding is big. It’s really big, especially because our animals are mostly based on Bos indicus. So, they have long ways to improve in the genetic sense. Here in US, I think it's growing up. International Embryo Transfer Society report showed that with the past years, the producing embryos industry has been growing, especially on the in vitro-produced embryos because they are injecting a lot of investments on this area. This can grow a lot in the next years. Mostly this impact is coming from the dairy mostly because their interest in females are higher. I think it's a matter of time for the activities start to know how this works and then they can use in their best intentions.

**Interviewer:** Do you see there being a benefit for beef producers to gather oocytes that quickly?

**Respondent:** Yes. It depends again.

**Interviewer:** I guess that's my question. What would be the benefits of a beef producer to go in a direction like that?

**Respondent:** It depends on the activity, again. [Laughter]

**Interviewer:** [Laughter] I don’t know.

**Respondent:** It’s like if you have a producer that sells bulls, for example, it will be a faster way to get their interest characteristics like show animals. Mostly show animals, they are using that for show animals for a long time because you can select for specific characteristics and you can get the best out of it. So, if you sell heifers, for example, it's a big field for that because you can't focus on one gender and then you can keep breeding them in a way that you have better characteristics for any type you want. In dairy, it's been, nowadays, they are selecting for fertility. Many of them are selecting for fertility. In beef, you can sell for weight, for gain, for even fertility as well. So, it opens for selection, that's what I mean.

**Interviewer:** Yes, I think you said it really well. It really depends what game you’re playing and what you’re trying to accomplish. If you’re a seed stock producer that’s constantly trying to push that genetic progress needle as fast as you can. Not to say that we should ever sell out and just select for number-based cattle, trying to achieve any PD or any one end goal. If you're putting a little bit more pressure in that area than the average person, I mean, yes, you absolutely might want to flush a yearling heifer that has no accuracy behind her, no additional data, no mature data, not even a mature phenotype because she's still growing, but that might be worth the gamble because you’re metaphorically trying to hit the lottery every year and incentivize a bull stud into buying one of your bulls or being that next high selling six-figure really talked about bull because I mean, that's free press. It's free advertising, it's great for your program if you can get it done and it's probably worth the duds, the ones that don't work out. If you're a commercial guy that gets paid by the pound, that's probably not your end goal. You're probably not going to want to roll the dice quite so hard. You're probably going to want to be a lot more conservative and do something with a lot more accuracy and data behind that you know the end result that you're going to get or at least a lot closer idea.

**Respondent:** You need to have a long-term goal as well in your herd. How do you see your herd 10 years from now? “I see my herd producing this much weight, this much cows per year, something like that.” I think the embryo transfer technology can be a good tool to get to these goals. If you want to increase the number of females in your property, it can be a long-term goal. Since the embryo transfer has the technologies of freezing the embryos, keeping them in the tank, you can keep for long term. So, you can have these genetics saved for the long term. If you don't have the opportunities to transfer right now, years from now, you may have it. So, it's an investment, I think and it can be determined by the long-term goals of the specific herd. Of course, it also will depend on the availability of resources. We need to be real. Some places don't have the access to closed nitrogen tanks, for example, to keep the semen in an AI technology or to keep the embryos. It depends also on the availability of that and also your cost of production. That's why I say that this depends on where you are in your long-term goals at the farm and as a producer.

**Interviewer:** That is an interesting point. Even from the commercial guy, which is probably the sector where - I mean, it's definitely the sector where embryo transfer is the least utilized, that's an interesting thought on how to preserve good genetics because I mean, realistically, the only way we're ever going to get more of our best commercial cows is to - I mean, obviously, we can AI them to better bulls and try and improve them and replicate them. If we want to take that one step further and do some embryo flushes on her and try to replicate that in mass, even in a year like this where many parts of the state were destocking or out of resources and were having to get rid of some cows, we may not want to replicate that in terms of replacement heifers right now and it gives us the option. Five, 10 years down the road, we have a cow that may be good and dead and gone at that point, but we've still got some consistent - I mean, not necessarily predictable, but if she's a Pathfinder S cow that's been around for 10 or 12 or 15 years, producing a calf every year, we can still relatively assume from a commercial cattleman standpoint, that that's probably a good cow to go ahead and flush, and the good genetics to preserve for even 10 years down the road, like you said.

**Interviewer:** Well, then, I guess I’m just going to play devil’s advocate in the terms of why could we not as a commercial cattleman - what’s to say we can’t get that same genetic progress by using high-quality semen and AI-ing our cattle? Like you just said, maybe we have this top female that maybe we want to replicate our herd as and we don’t necessarily have the time, energy or money, or maybe resources at this time. So, maybe 10 years down the road, we do that, but by that point, if we've been using some sort of reproductive technology and utilizing some high-quality semen, shouldn't we have progressed the genetic of our herd way past that female that we potentially had 10 years ago?

**Interviewer:** I think we'd all like to think that, but especially on the - maybe from an EPD profile standpoint, we might have. We might have doubled or tripled some of our index performances in that time point. I think that's totally realistic, but a good functional potential heifer in an embryo is still going to be a good functional productive heifer 10 years down the road, whether her numbers are moderated or not. I still just like the idea of, “Absolutely, AI-ing, maintaining that solid nucleus cow herd.” but the philosophy of being able to play matchmaker a little bit and get a little specific with this - a little bit of this bull, a little bit of this bull and then be able to say, “I’m not even” - “I'm out of grass, and hay is $300.00 a ton. I'm not going to even mess with it this year. They're going in the tank.” Sure, I'm going to breed her to have a natural calf because I still want to try and make heifers out of her while I can, but I've got 40 good solid embryos while she's a five-year-old cow that are going in the tank for when I've got the time, money and resources. Just an interesting option, I thought.

**Interviewer:** Yes.

**Respondent:** There’s data and literature talking about all that. The sires contribute much more for the genetic merit. There's no question on that, but why not use both sides? Why not use the females as well? You can do different matches. We can play around, play the matchmaker, like you said, [Laughter] and do different matches, and then you can have more variability and more variation. For the genetic point of view, it's a good [Laughter] thing. So, if you have more variation, you may have more traits that you under - that you have interest on and keep only this on your herd. To me, the genetic point of view, it's really hard because you can use on females as well as in the males. You brought up to more than one calf a year to more like five calves a year or more, depending on the donors that you have available.

**Interviewer:** Yes, definitely. I guess, really, the main point of this conversation is to just compare and contrast some of those reproductive technologies like artificial insemination and embryo transfer, and just throwback different opinions and just have a conversation on why would this make sense or why wouldn't it. Allow producers to start thinking about if this is something that would make sense for their operation. I guess to move into the next point of the conversation is, what are some of those benefits or limitations in regards to artificial insemination?

**Respondent:** Well, to me, what I heard the most is how hard it is to implement it, but it's like you have to have some sort of investment. Tanks, personnel, and even veterinarians, you have to have some investment and then semen, of course. That can be hard in the beginning, but once this is up and going, you can have the return really fast. You can change your bulls each time you want. You can just go and buy another one and it will be top-line genetics, and you can change that as you please. It depends on situations. For example, if you don't have a lot of space in your farm to keep a bull for a long term, you keep more than two, three bulls, for example. You can have 10 bulls in a tank. It's not going to use that much space and you're not going to use your pasture, your food. So, it's something that you need to put on the balance. You need to measure that, know how it would work better for your operation. Even this investment can be returned fast. Why am I saying that? Because if you use AI in a systematic way, if you organize your - in a way that you can shorten time of breeding, you will be beneficial for the next year, for example. You can have shortened calving season. You can have calves that are more uniform and early calves that can produce more, can have better weaning weights and stuff like that. So, that would be the most beneficial part, in my opinion. You can optimize your work as well. You're going to work a lot for a short period of time and then you're going to be okay to the next year, in the reproductive physiology point of view, what I mean. To me, that's the most beneficial part. Everything can depend on the situation, of course. If you don't have availability of technicians, for example, of people to work with, so it's hard to implement that. So, I understand that maybe a bull would be a better option if you have more offers of bulls to sell around you or the market for bulls is cheaper to get a bull than to implement all this, why not? So, it depends on the situation, but the most beneficial part to me is the genetic improvement that it can have and optimize your farm long term.

**Interviewer:** It's one of those things, like you said, it pays immediate dividends in terms of consolidated calving interval. I think it's important to note that it's one of those things that there's really truly not a hard line in the sand anywhere and then like you said, it's going to depend on the situation. There's a lot of play either direction depending on what you're fighting against and what you've got available to you, but it's important to understand that it's one of those general philosophies that we're always starting somewhere and gradually trying to improve from year to year. So, I mean, you don't have to sell the farm and kick every bull off the place and start breeding everything AI the first year. I mean, it's about keeping everything in perspective. Like me and Olivia were talking earlier this week, “If you've only got 12 head that you want to get AI-ed, let's really not - let's not think too hard and make our lives too chaotic about getting these 12 head of fall calves bred.” At the end of the day, is it worth it just to go buy a bull and kick him out - kick it out there, we throw them on corn stocks? It may be. That might be where it's at, but it's still probably worth giving them a shot or at least making sure they're all cycling and can get bred in that early time point, though. There's a lot of play and a lot of options depending on your situation. Small herds, labor and facilities, they're always that hang up to getting people implemented, but yes, once you're set up, you've got a good team around you or resources, it's easy to start doing it all at once, and it's just a waterfall of immediate dividends and returns on investment, though.

**Interviewer:** Yes, and then you really start to just move that genetic progress forward. Then you really can start playing with other things. Going from natural service to AI and then maybe you do work into embryo transfer and things like that just slowly but surely progressing forward, I guess. Again, we just talked about some of the benefits and limitations with artificial insemination, but in contrast, what are some of the benefits and limitations that you feel are associated with embryo transfer?

**Respondent:** So, the embryo transfer market right now, some limitations, again, is the personnel and equipment and facilities. That will be a thing that you need to be well thought before starting. The benefit will be, again, this reduction of the interval between generations, of course. You can sell embryos if you want, and there are some other activities that you can explore. and you can keep them for a long time, of course, but this thing with technicians and the limitations part can be really hard on the costs if not well managed. For example, most of the embryos produced in US right now are from in vitro. So, we need some specialized veterinarians to collect oocytes and take to the lab and then do all the stuff in the lab. So, you need to have some sort of proximity with our lab, for example. So, that will be a limitation for some places. So, on the other hand, you can have only females if you want, you can have only males if you want. So, you can play around with the gender that is most desirable for your activity. So, to me, that will be the best, the points that you need to balance before deciding to implement this type of technology. Another thing, if you use superovulation and flushes, it’s essential to use a lot of FSH. FSH nowadays is expensive. [Laughter] So, you need to balance these as well. So, all the investment come back eventually. Some people, even for in vitro-produced embryos, can use IVF and FSH to increase the oocyte yield. So, you need to balance that thing in your activity to see how it goes, but the long-term benefit could be the genetics, and of course, keeping the embryos for this long term.

**Interviewer:** Well, I guess, in your opinion, is there a minimum number that you need to have – I mean, I’m a reproductive physiologist at heart, I’m just going to throw a disclaimer out there, the answer is “No, there is no – you cannot have too few number to AI.” I mean, if you have one heifer - or if you have one milk cow out back, go AI or please do that, like it’s totally fine. Is there too few animals to bother with embryo transfers? What’s the minimum to make it probably start – I know you’re a repro person too, you’re not an economist…

**Respondent:** So, in dairy we can have this number, and we know the most, like it all depends again [Laughter] on your efficiency as well. Since we are inserting an extra layer of problems, like C2N handling, you can have more problems as well. So, you need to know what is your efficiency, like how efficient you are to produce embryos in those specific donors. Those donors are well select, those - your lab, your IVF system is up and going. It has a good yield of blastocyst, of embryos, in general. So, you need to take this in account. We know that the embryo transfer from in vitro embryos, they have slightly lower pregnancy rate, so you need to take that in account. What will be your return in comparison to what you can invest? There is no exceptional number yet. There is not a specific number. Even for dairy, there’s no number, but you need to take it into consideration what factors are playing. So, if you’re showing cows, some cows can be really expensive, so maybe it’s worth it to use these cows to produce embryos from them and keep the embryos stored, or sell the embryos or something like that. When you talk about buying new genetics, it can be from embryos. It depends on offer. If you have like neighbors that have embryos to sell, why not? Instead of like implementing the whole embryo transfer in your front, you can just provide the recipient. Another thing is the availability of recipients. What kind of recipients you’re going to have? Are you going to have a whole herd just for that, or you’re going to use the cows you have already? So, this is something that you need to take into consideration to make this count. So, I think the optimal number of animals to do this, it will be the optimal number to get a financial return from it.

**Interviewer:** As long as you’re in the black, as long as you’re making money, yes, right?

**Respondent:** Yes. Or at least not losing. [Laughter]

**Interviewer:** Breaking even is better than losing.

**Respondent:** Yes.

**Interviewer:** My mind just – I mean, we’ve seen some pretty different things, especially out on the Angus side of stuff the last couple of years, just in terms of ownership arrangements and marketing, like a lot of these people are really starting to get their embryo flushes and their genetics really dialed in, and all of a sudden, there’s new premium embryo market, and like you said, that’s a totally real option if you’re producing a surplus of good embryos. That’s absolutely a marketable product that you can sell. I mean, you’re seeing really high-quality genetic bulls get sold and then have extremely limited supply of semen come on to the market upwards of $1,000.00 and then those bulls are being used to make kind of one-of-one embryos. I mean, you’re essentially establishing your own market and you can essentially charge whenever the other person is willing to pay for that. I mean, it’s kind of uncharted waters in terms of marketing your genetics, but kind of cool in the same way, I guess.

**Respondent:** Yes, I agree with you. It’s thinking that it’s like the beef market. It’s not only selling cows to slaughter or something like that, there’s a whole other options, you have a whole other options of market behind that and one of them is genetics. We gave them many examples right now. We can sell bulls. We can sell heifers. We can sell embryos. You’ll have a whole market behind that that can be explored and these technologists, for sure, they can provide better results from that, like faster goals.

**Interviewer:** There’ just so much information out there. I mean, we can see it’s just driving a learning curve so fast. I mean, it’s going to increase the – we already raise the best cow in the world, we’re just going to increase the consistency, increase that quality even further, just as a result of all that information. I mean, it’s kind of cool to think about it sometimes.

**Respondent:** A word that is being in fashion now is sustainability. So, if you open up your market here, the activity can help sustainability towards more long-term goals. I think it’s thinking out of the box, not where you use it to do for that many years we can’t maybe get other horizons and do different stuff.

**Interviewer:** I think it would be kind of silly for us to do an embryo transfer podcast and not have Olivia at least kind of try and walk everybody through what’s going on in her place with her embryo transfer project at home. We’ve talked about having small numbers of cows and how that can kind of affect break evens. I mean, if you’re going to be producing embryos or buying embryos, you got to have a place to put on.

**Interviewer:** Spark conversation or…

**Interviewer:** But I guess if nothing else, I think the story will describe – really, will illustrate the options that you can have**.**

**Interviewer:** I think it brings up a good point. Embryo transfer is something that I swore I was never going to do and I really need to stop saying that, because every time I say I’m not going to do something, I end up doing it. But I just couldn’t really figure out how embryo transfer was going to make itself pay in any sort of situation until I was approached about – well, I have to go back, I guess, and say that my family does something specifically where we work directly with the company, and so we breed our cattle to Piedmontese and then sell directly to them. Well, finding a bull battery of Piedmontese bulls, I mean, it’s not the easiest task in the world. In hopes of finding some more or raising our own bulls, we were down at one of the bull studs and we were having the conversation and we got talking about embryos. So, long story short, I have about 27 head of large framed and very healthy well-fed cattle, and so I decided to put embryos in these cows. So, I think I ended up putting in 18 total embryos into these cows, and essentially went on – they were sexed bull, so I’ll get purebred Piedmontese bulls out of these females, but ultimately, I guess, my end goal is not only use these bulls in our overall program to get our cows bred, I have the option of selling these bulls back to the company for - I don’t know if we want to say premium price or…

**Interviewer:** An additional income…

**Interviewer:** An additional income source. Yes. So, selling them, obviously, for way more than a market-priced animal would go far, and so, that is how I guess I’m incorporating embryo transfer into my tiny little operation. So, I do think just depending on this scenario and the situation, yes, embryo transfer can be beneficial and it can pay, but you have to make sure it’s going to make sense, and I’m surrounded with a team of reproductive physiologists, so I have that people that they know what they’re doing, and I have the facilities and I have the resources. Just like Jessica said, it depends on personnel. It depends on the availability, the resources that you have, and what’s going to make sense for your operation. So, for my little scenario, I’m sure hoping it makes sense next year. [Laughter] Hoping these cows hit the ground, but yes, just more recently, something that I’ve been dabbling in.

**Respondent:** Did you have to produce the girls?

**Interviewer:** No, actually. These embryos were – I just bought these embryos and they were produced by the company. I probably would need to dig into that a little bit more but I think they work with a specific vet clinic that produce these embryos. Yes, I guess if I’m just being extremely out in the open here, those embryos are probably $100.00 an embryo, but the cost of a replacement bull is anywhere from $3,500 to – I guess if we’re talking, probably $10,000.00, so in my mind, it paid to put those embryos in.

**Respondent:** Yes, if you think about how many rounds you would have to have a bull, for example, if you inseminate with conventional semen…

**Interviewer:** There’s a 50% chance, right.

**Respondent:** Fifty percent chance of having a bull out of like, I don’t know, if you do one round, 60% of pregnancy. So, from 60% pregnancy, half of it will be bull.

**Interviewer:** Right. And then on top of that, these are their pure-bred Piedmontese…

**Interviewer:** Angus cow.

**Respondent:** Yes.

**Interviewer:** Yes, and I’m putting them into Angus cattle. That’s the hard thing, you can’t just go and buy a Piedmontese female for the price of an Angus female.

**Interviewer:** Still a very niche market.

**Interviewer:** It’s a very niche market.

**Interviewer:** It hasn’t established enough.

**Interviewer:** Yes. Well, heifers, in themselves, virgin heifers - way more money than I want to spend. So, I think this was just – it made sense and I’m able to put this potential different breed of animal into an Angus cow and hopefully start building up a bull battery ourselves.

**Respondent:** Again, it will depend on your efficiency as well. [Laughter] If you transfer these embryos and they do not get pregnant or they get lost on the way, then you’re losing money. [Laughter] It will depend on the synchronization, of course, that I’m sure you did well, but sometimes, in some places, it’s not that possible. You cannot watch heat of the recipients to check the best time to transfer these embryos, so it depends on that as well.

**Interviewer:** I will say, out of – so, I had 19 cows and I had 19 embryos and we put in 18 embryos out of the 19 cows. I was stoked. The only one that we didn’t put an embryo in, she actually got stuck in the shoot, and so we just kind of – we’re like, “No, she’s not going to – we’re not going to…”

**Interviewer:** Some kind of a rescue mission at that point.

**Interviewer:** Yes, it was a little bit more of a rescue mission. I thought we had a really good response right now, granted, I had eyes on those cows because I was just very anxious to know, and I did see a few of these girls come back into heat, which obviously, is expected. So, I will be honest, I still need to preg check these cows, which I know I’m way behind. I’ll be really interested to see what I get on the ground here this spring.

**Respondent:** Those embryos are produced in in vivo or in vitro?

**Interviewer:** That’s a good question. I don’t know that.

**Interviewer:** So, yes, talk about that a little bit. What is going to be a better option, in vivo or an in vitro? I know, I read one of your papers, talking about in vivo and in vitro, and actually, the differences between genders based on the differences. Why don’t you go ahead and just give us a little bit of background on that, and then also, like how is that beneficial for the producer? What does the producer need to know in terms of that?

**Respondent:** So, when you think about establishing an embryo transfer program in your situations, you need to consider the efficiency of both and the investment of both. So, the in vitro-produced embryos, you just have the cows available. Somebody will go there and aspirate the oocytes and go to the lab and they would go on with that. They want to give you embryos frozen or fresh to transfer right away, so you don’t need to worry about that. When you are dealing with superovulation, it’s going to have an extra set of handling with the cows and you’re going to need to give shots, FSH shots for sure, and FSH can be expensive. again, like we said before. So, we need to take these in consideration. However, the in vivo embryos produced in vivo embryos for superovulation, they are very close to the ones we have by AI. Many studies already analyzed that in guiding gene expression or even pregnancy. In a good system, they can be very close to an AI embryo. Physiologically, they are pretty much the same thing. The in vitro embryos, they have an extra layer of problems in the sense that you are taking - you are producing an embryo in a lab situation, so you’re putting a lot of stressors on that. It can cause a little bit of deviant gene expression, physiology, and that will reflect on your pregnancy rates and also pregnancy loss. So, embryos produced in vitro, they have a higher pregnancy loss than those produced in vivo, so you need to consider that.

In my previous work, we analyzed embryos produced in vitro versus the ones produced by AI regarding their gene expression and uterine signaling. What we saw is that especially when we separate by sex, female embryos or male embryos, the male embryos, they showed deviant gene expression when compared to the females, especially as the pregnancy progresses. So, I had embryos collected on the 18th, so when they are just – they are still not attached or anything, and on day 32 when they start to attach, you already have a heartbeat, an embryo formation. On day 32, placentas have a deviant gene expression in the males when compared to the females. I still need to investigate that deeper to understand what does it mean; if it means that these embryos will be lost or marked down to be lost or something like that. If the losses that we are seeing on the in vitro embryos are related to the males, we don’t know. So, we need to investigate that deeper. But what it means is that they are different. They are responding different to the uterine environment and growing different. That’s something that we found in my previous work that I want to keep investigating further on. So, I’ll keep you posted. [Laughter]

**Interviewer:** So, bull calves maybe more susceptible to whatever they’re missing from that uterine fluid, is what you’re saying?

**Respondent:** I’m saying that they are more susceptible to changes in the gene expression. What those gene expressions mean, we still don’t know.

**Interviewer:** We don’t know yet. Right, okay.

**Respondent:** So, what I found is like some of the pregnancy associated proteins are different expressed, which they are related to pregnancy establishment. We don’t know exactly what they do as well, so it’s something they need to be further investigated. Meaning, that - what all of these means is that males are different from the females on their development of pregnancy. That’s what it means, especially when we’re talking about in vitro embryos. The AI embryos did not have this difference, so it’s something that you need to consider when you’re thinking about establishing this type of technologies in your situation.

**Interviewer:** Yes, definitely. I guess that makes sense why you asked if they were in vivo or in vitro. Now, I’m real curious to know.

**Interviewer:** Yes. So, we were way, way high, so let’s go way, way, way down. What’s the difference – I’m sure there’s going to be a huge variation between animals and herds and stuff like that. Is there a calculable difference between the number of embryos produced on average, or are you going to get more using one versus another?

**Respondent:** Well, it depends. [Laughter] So, from the in vitro point of view, it will depend mostly from the donors you’re having. Well, in both situation, it will depend on the donors. One of the ways of selecting donors is by follicular population. So, we basically ultrasound them and count how many follicles you have, and the ones that have more follicles, they are more prone to produce more embryos, in vivo and in vitro. In vitro because, of course, they give more oocytes. So, if they give more oocytes, you have more chances to get embryos out of it. In vivo, they respond better to the FSH, so it’s a way to balance that. If you get a good donor selection, you would have better results. What is being said in vitro is that beef cows, they produce between four and six embryos in a superovulation around. It’s like a big database and it’s like an average. For the in vitro embryos, usually it depends on the amount of oocytes you have, of course, but generally, you have like 30% embryos from the amount of oocytes you have. So, it would depend much more on the oocytes. If you have 10 donors, you will have much more oocytes and then you have 30% out of this. So, it’s pretty consistent. Thirty percent of the blastocyst rate produced in vitro.

**Interviewer:** So, you get 100 eggs, 30 of those will end up being implantable embryos, and then you can expect maybe 15 of those to become calves.

**Respondent:** Yes.

**Interviewer:** Interesting. It all depends on fertility.

**Respondent:** Yes.

**Interviewer:** All right, Kiernan, do you have any other questions for Dr. Drum before we wrap this podcast up?

**Interviewer:** None.

**Interviewer:** All right. Thank you, Dr. Drum, for joining me on this podcast. Once again, this has been Cattle HQ, brought to you by SDSU Extension, headquarters for all things beef. Visit extension.sdstate.edu for the latest beef information.

[Outro music]