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ANIMAL WELFARE

A focus group approach: Bovine Respiratory Disease

Understanding Indiana stakeholder views on novel technology for improving BRD treatment
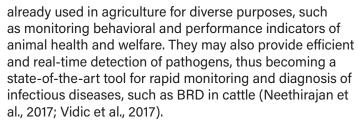
Introduction

Bovine Respiratory Disease (BRD) is one of the most important health issues in cattle worldwide. It is the costliest and most frequently reported disease in US feedlots (USDA, 2013). In dairy cattle, it creates similar challenges, topping (or approaching the top of) the list of diseases impacting both pre- and post-weaned dairy heifers (Short and Lombard, 2020). Its harmful effects contribute to greater antibiotic usage and the potential for increased risk of developing antimicrobial resistance and may lead to poor herd performance and high mortality rates. The total cost of BRD (including labor, cost of antibiotic, reduced production and carcass quality, and increased days of feed) has been estimated at $38/head, $167/head, and $230/head for beef cattle treated once, twice, and three or more times (Wilson et al., 2017). For dairy heifers diagnosed with BRD, the first 120 days of life costs an estimated $250 more when accounting for reduced weight gain, higher culling risk, and delayed age at first calving (Overton, 2020). Additionally, incidences of BRD increase the cost of raising replacement heifers by 12-15%. In Indiana, cattle and calves are a significant part of the state's economy – cash receipts totaled $460 million in 2022 – so prevention, accurate diagnosis, and timely treatment of BRD are essential (NASS, 2023).

Issues

Among the most common preventive measures for addressing BRD are vaccination programs, improved management practices (i.e., biosecurity), and medication to prevent infection or reduce disease transmission within groups where some animals have been diagnosed with infection (Stokstad et al., 2020). However, due to the multifactorial nature of BRD (Centeno-Martinez et al., 2023), these measures may be insufficient. Alternative strategies to quickly diagnose and treat this disease are needed.

Biosensing technology has the potential to greatly assist with early, accurate detection and treatment of BRD. Biosensors are

already used in agriculture for diverse purposes, such as monitoring behavioral and performance indicators of animal health and welfare. They may also provide efficient and real-time detection of pathogens, thus becoming a state-of-the-art tool for rapid monitoring and diagnosis of infectious diseases, such as BRD in cattle (Neethirajan et al., 2017; Vidic et al., 2017).

However, for research and development investment to be realized, potential obstacles to adoption of the technology must be carefully considered to avoid inadvertently alienating the intended audience(s), especially in circumstances where people may feel that a new technology is being forced upon them. Before implementing a new technology, it is important to gauge stakeholders' perceptions. Adoption by end-users and others who might be impacted is more likely if the technology is well understood.

Focus groups have been used to explore the views of farmers and veterinarians on various aspects of animal agriculture, animal health and welfare, such as the use of antimicrobials and antimicrobial resistance (Cobo-Angel et al., 2021), constraints to improving farm biosecurity (Gunn et al., 2008) and cull cow management (Marshall et al., 2023). Focus group interviews are semi-structured discussions used to explore participants' views through a group interaction where individuals are encouraged to reflect on their own perspectives (Morgan, 1997; Tong et al., 2007). These kinds of group discussions provide an opportunity to gain insights and include the voices of farmers and veterinarians in decision-making about technologies related to animal health and welfare. This is critically important given the direct responsibility of these stakeholders for animal welfare. Given the significance of beef and dairy cattle production to Indiana, it is essential to understand farmers' and veterinarians' perceptions of novel technologies that potentially advance BRD diagnosis and treatment and identify factors that might influence adoption of such technologies.

In this article we explore Indiana beef producers' and bovine medicine practitioners' perceptions of BRD and its relative importance as an animal health and welfare issue. We also examine their views on existing methods of detecting BRD and the relationship to the antimicrobial resistance. We then delve into their perceptions of a new technology intended to assist with identifying pathogens that might guide treatment of BRD and reduce unnecessary use of antimicrobials.

Situation

Indiana beef producers and bovine veterinary practitioners were recruited to participate in focus group interviews as a preliminary step toward developing and refining a novel biosensor intended to facilitate BRD

treatment. The paper-based BRD biosensor uses a nasal swab sample to detect bacteria, viruses, and antimicrobial resistance genes at pen-side. It is designed to be easy to use, provide results in under an hour, and potentially guide treatment decisions (Mohan et al., 2021, Pascual-Garrigos et al., 2021; Centeno-Martinez et al., 2022).

Five virtual anonymous focus groups were conducted using Zoom between Jan. 1 and March 31, 2022. Each group was composed entirely of two to five veterinarians or beef producers. A series of structured questions was used to probe participants' main concerns and perceived challenges associated with diagnosing and treating BRD. Participants were then asked about their beliefs relating to current methods and technologies available to detect and treat BRD. Last, we inquired about their perceptions of the new biosensor as a tool to facilitate BRD treatment and ultimately reduce the use of antibiotics in the cattle sector. A video describing the biosensor and illustrating its use was shown to enhance participants' understanding of the technology.

Participants in three of the five focus groups consisted of 11 beef cattle producers from northern, central, and southern Indiana, most with operations of 100 to 499 head, and five veterinary practitioners who provide service to Indiana beef and dairy operations. Each virtual session was recorded, professionally transcribed, and then thematically coded (Braun and Clark, 2006, Krueger and Casey, 2001).

Challenges identifying BRD and implications for productivity and health

Beef producers and veterinarians alike identified BRD as the most important health issue affecting beef cattle, followed by other infectious diseases, such as pinkeye and salmonellosis. Indeed, in response to the questions "*What do you think are the most important health issues that affect dairy/beef cattle?*" and "*Where does BRD rank for you relative to other health conditions in cattle?*", only a minority of beef producers considered infectious bovine keratoconjunctivitis (IBK), commonly known as pinkeye, the most important health issue in cattle. (Producer 1: "*Pinkeye would rank number one ... we did have a BRD breakout and was a big issue. Nothing severe. We were able to get it under control.*") However, all veterinarians and one producer highlighted that the age of the animals as well as the type of farm operation played an important role in their rankings of health issues. BRD and other respiratory disorders were ranked as the biggest health problems in young calves as compared to adult cattle.

Similar opinions were expressed by participants to the questions "*What concerns you most about BRD?*" and "*What is most challenging about diagnosing and treating*

BRD?" Overall, the main concerns related to BRD included negative impact on herd performance, loss of the animals, and the need to use antibiotics to address this disease.

The majority of participants perceived BRD not only as an economic issue but as a disease that is difficult to identify in a timely enough manner to avoid reduced growth efficiencies and animal loss. A common sentiment was that the disease is complicated to identify until it is too late. (Producer 1: "*I think my biggest concern on BRD is it's hard to tell when you've got a respiratory issue until it's too late.*") They also characterized the disease as difficult to treat quickly. This led to another concern expressed by beef producers: A lack of appropriate information on BRD within their own community, and a need to enhance education programs surrounding this topic.

Veterinarians identified the multifactorial nature of BRD as a cause of concern, noting that diagnosing and treating BRD may not be sufficient if other factors, such as management practices, nutrition and vaccination programs, are not properly applied.

Both categories of participants expressed concern about the lack of efficacy of using antibiotics, which was seen as one of the major challenges relating to BRD treatment. Only a few producers in one focus group also recognized the need to dedicate more time and labor to the herd as a main challenge in diagnosing BRD. (Producer 3: "*You gotta watch them like a hawk to diagnose them.*")

Current approaches to diagnosing BRD

In response to "*What is your general approach when you suspect you might be dealing with BRD?*" and "*What do you do and what current strategies and technologies you use for diagnosing and treating BRD?*", both categories of participants agreed on the importance of a visual inspection of the animals to diagnose the presence of BRD. An overall check of behavior (e.g., observation of whether or not animals are eating) and health conditions (e.g., temperature and breathing) was acknowledged as the best approach by producers and veterinarians.

Only veterinarians identified post-mortem and histopathology examinations as essential for accurately diagnosing BRD. In fact, if veterinarians were not able to carry out a post-mortem examination or transtracheal washing, they were more likely to apply an empirically evidenced approach, such as administering broad-spectrum antibiotics or medications that had historically been used on-farm.

Responsible use of antimicrobials

Another important theme that emerged concerned the use of antibiotics to deal with BRD and participants' views of themselves as judicious users. The majority of participants considered antibiotics their most important tool for dealing with BRD. Specifically, veterinarians and one group of producers recognized using antibiotics to prevent disease in healthy animals as necessary, especially for young calves experiencing stressful conditions (e.g., transportation, re-mixing). However, only beef producers were in favor of trying different antibiotics until one that was more effective was identified.

Producers generally viewed themselves broadly as responsible users of antibiotics and did not consider antimicrobial resistance to be a growing global health threat. This contradicts the concern expressed by the same producers that some antibiotics may not be as effective in treating BRD as they were previously. (Producer 3: "*So many times you give them whatever you give them, and you check them a week later and it's like you gave them nothing.*") Only one beef producer expressed concern about antimicrobial resistance. Veterinarians recognized alternatives to antibiotics (e.g., immunostimulants, improved vaccine programs) as a possible strategy to their reduction. Interestingly, a minority of beef producers mentioned cost as a potential deterrent to using antibiotics. (Producer 1: "*As much as I don't wanna pay a lot for antibiotics, I do think that price tag keeps us from going out there and just going crazy with it.*")

Desire for innovation

Both producers and veterinarians identified the need for new technologies or more advanced methodologies to promote early diagnosis of BRD. Participants were asked "*How confident are you in current methods of diagnosing BRD?*" and "*Is there anything specific as far as technology or resources you wish you had (or that you wish was better) that would really improve our ability to diagnose and treat BRD?*" Their responses indicated lack of confidence in the current methods of diagnosing BRD. They clearly expressed an interest in the development of innovative technologies, such as improved ultrasound devices, infrared tools to detect cattle temperature, and swab rapid tests.

Time and cost as deciding factors on novel technology acceptance and use

The majority of participants expressed positive views of the proposed new biosensor in response to the questions, "*What reactions do you have to the technology*

that was described? What do you like and what concerns do you have about the technology?" and "*What do you see as the main barriers that might prevent you or others from using it?*" Only veterinarians in one focus group expressed concern about the proposed new sensor technology described in the video. They did not consider the device reliable enough in identifying the correct pathogen and associated target antibiotics, and they anticipated risks of mis-serving their clientele with this tool. They also expressed concern that veterinary expertise might no longer be required because of this new technology.

In contrast, the majority of beef producers acknowledged veterinarians as the principal stakeholders that should be in charge of using the new biosensor technology. In fact, they identified several barriers that might prevent producers from using it. These included the potential for increased effort to be dedicated to screening the herd by solo producers who are already busy on-farm, difficulty in using the device, and economics (e.g., cost of purchasing the machine).

A common concern about cost and time to obtain results was expressed by all participants with regard to the use of a single test to detect BRD. All participants mentioned the need for rapid results from the test and for costs of testing to be low. While there was no consensus on an acceptable price point, suggestions included lower than $10 – Veterinarian 1: *You're gonna have to be under that $10 head benchmark, maybe cheaper*") – and $20 to $50 per test. (Producer 2: *"But $25 I think would probably have to be the bare minimum."*)

Finally, all beef producers, although enthusiastic about the possibility of detecting the exact pathogen causing BRD symptoms, were somewhat skeptical about the accuracy of the sensor technology in detecting the specific pathogen(s) present that would then dictate treatment.

Implications

Indiana producers' and veterinarians' perceptions relating to need for novel technologies aimed at addressing BRD appear to be similar. Producer confidence in the ability to accurately diagnose BRD and to do so in a timely manner is particularly low. Producers in this sample did not think that antibiotic use on their operations contributed to antimicrobial resistance, which may imply a need to meet a knowledge gap. Nonetheless, producers and veterinarians alike recognize the need to use antibiotics responsibly, and they desire new technologies that enable early diagnosis of BRD pathogens. These findings, in concert with increasing restrictions on the use of antimicrobials without a specific diagnosis as to causative organism, may justify the need for and use of the novel biosensor technology described here.

Although enthusiastic about the possibility of rapidly and conveniently determining the correct antibiotic for BRD treatment, producers and veterinarians want to be sure that new testing technologies yield accurate results and are offered at a price that improves overall profitability. Given the diverse work demands that producers face daily, the potential cost of the proposed new technology and the difficulties of quickly and accurately diagnosing BRD, it would seem that the professional animal health care provider should be the primary target adopter of the novel biosensor. Acceptance by cattle practitioners based on demonstrated efficacy of the sensor under field conditions may increase its perceived value to the producer.

Table 1. Participant themes and responses

Themes	Questions for participants	Producers' quotes	Veterinarians' quotes
Challenges identifying BRD and implications for productivity and health	• What do you think are the most important health issues that affect dairy/beef cattle?	• I feel like probably BRD and pinkeye.	• BRD is definitely the biggest problem we deal with, [followed by] salmonellosis and pinkeye.
	• Where does BRD rank for you relative other health conditions in cattle?	• Depends on the operation…if you're growing cattle, [BRD] it would probably be the first problem.	• It depends on the stage of production. Anything that's less than 12 months old, respiratory disease is high on the list.
	• What concerns you most about BRD?	• They are gonna have reduced performance because they were sick and didn't get the proper growth development. • When BRD hit it was, cattle were sick, they were completely off feed, you had to treat them.	• The concern about BRD is because it's an economically important disease. • Profit loss because of reduction in performance.
	• What is most challenging about diagnosing and treating BRD?	• Trying to get it kind of ahead of before it gets too bad. • I'd say it probably goes back to education. How many times in a year can you say that you tried to educate a cattle guy about BRD? • When it comes to treating, if it doesn't work, what do I go to next?	• Success is dependent on how quickly the disease is recognized. • There's something else going on – it's management … the diagnostics involves the whole picture, not just the bugs. • There are a lot of factors involved in BRD, more than just seeing what the animal is presenting. It is looking at husbandry & nutrition practices.
Current approaches to diagnosing BRD	• What is your general approach when you suspect you might be dealing with BRD? • What current strategies and technologies do you use for diagnosing and treating BRD?	• Identifying them, just ones that aren't coming up to the bunker. They're staying in, they're not really eating. • If they are kind of slow or something at all, then I always do the temperature check, or I can see [it] breathing hard. • The first thing we do is a temperature check, and then listen to their lungs.	• Simple field diagnostics. What we do is, it's specific to how their lungs sound and what their behavior is. • The post-mortem is often much more valuable… a very good indication, No. 1, if we're dealing with BRD. • The client often is not keen on doing a transtracheal washing if the animal is fairly valuable. So in those cases we'll treat empirically with an antibiotic that we have historically seen work well.
Responsible use of antimicrobials	• What is your general approach when you suspect you might be dealing with BRD?	• Some of the advancements in the drugs have really helped out with treatment. • I use those kinds of drugs more as a metaphylaxis, especially if we are bringing in recently weaned calves. • First pull I like [AB] xx or xx, and if that doesn't work I tend to follow up with xx or xx. • I think most of us are gonna be pretty judicious with how we use these antibiotics. • I'm not real concerned about it [antimicrobial resistance]. • But five years from now, I feel like there might be some resistance there.	• I think there's definitely a need for metaphylaxis, back to what the history of the cattle are. • I think it is also on us to make sure to do whatever we can to get them vaccinated and get them prepared and get their immune system ready to respond to vaccine.
Desire for innovation	• How confident are you in current methods of diagnosing BRD? • Is there anything specific you wish you had that would improve our ability to diagnose and treat BRD?	• Something like an infrared detector that you could just point at a calf and know the temperature and that it is sick or something.	• I wish my ultrasound machine was better. • Being able to just do a quick swab and then you've got your answer right there, kinda like a Covid rapid test.
Time and cost as deciding factors on technology acceptance and use	• What reactions do you have to the technology that was described? • What do you like and what concerns do you have about the technology? • What do you see as the main barriers that might prevent you or others from using it?	• If you're to try to sell this technology, I'd try to get the veterinarians onboard. • You need quick turnaround [i.e., rapid results]. • Making sure that it's actually feasible [cost] for the producer and that we can utilize it frequently. • [Increased labor] I got a labor force of three: me, myself, and I. I can spend all day treating two, three cows. • Ease of use. Labor's really hard to find out here. • The accuracy of that telling you the type of pathogen and then the type of treatment to use.	• I get a little concerned because I don't know how accurate that information would be. • We've given them some false sense of security that they've got accurate answers. Every bit of technology can be beneficial, and it can also be dangerous. • I have a great concern that now people are not gonna need us. We just put us out of a job. • [To detect BRD] as early as possible. • I'm concerned, like, how much is a machine (going to) cost?

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Funding acknowledgement

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