

THESIS

ATTITUDES AND COMPETENCIES OF THIRD YEAR VETERINARY STUDENTS TOWARDS THEIR ROLE AS AN ANIMAL WELFARE ADVOCATE AND ATTITUDES TOWARDS PAIN AND PAIN MITIGATION PRACTICES IN BEEF AND DAIRY CATTLE IN THE UNITED STATES BY VETERINARIANS AND PRODUCERS

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ABSTRACT

ATTITUDES AND COMPETENCIES OF THIRD YEAR VETERINARY STUDENTS TOWARDS THEIR ROLE AS AN ANIMAL WELFARE ADVOCATE AND ATTITUDES TOWARDS PAIN AND PAIN MITIGATION PRACTICES IN BEEF AND DAIRY CATTLE IN THE UNITED STATES BY VETERINARIANS AND PRODUCERS

Although leading veterinary organizations emphasize the importance of animal welfare knowledge, there exists a gap in current veterinary student animal welfare education and training. A survey instrument was created to assess third-year Doctor of Veterinary Medicine (DVM) student knowledge of key animal welfare topics, opinions regarding the inclusion of welfare education in the veterinary curriculum, and views on veterinarian responsibilities as advocates. In Spring 2018, Colorado State University added a required animal welfare course to the DVM curriculum. Pre- and post-course paper surveys were distributed to the third-year students enrolled in the animal welfare. One hundred thirty one completed pre-course surveys were collected and 125 completed post-course surveys were collected. Of the pre and post-course surveys collected, 61 were paired with identification codes and utilized for statistical comparison. Results indicated that the course led students to view the inclusion of an animal welfare course in the veterinary curriculum more favorably ($p=0.009$) and improved their confidence in conducting research on animal welfare topics ($p<0.001$). The course did not change students' sense of responsibility towards welfare advocacy. Associations were not found between attitudes towards these issues and demographic variables of home community,

respondent gender, and track selection ($p>0.06$). Veterinarians were consistently ranked by students as the most influential member of a community in matters of animal welfare.

Future research on the lack of veterinary student knowledge of animal welfare should be done on a national scale to facilitate strategic development of mandatory animal welfare courses in veterinary curricula. Future research should be designed to gain knowledge regarding DVM students' opinions and attitudes regarding effective methods of incorporating animal welfare education into their professional training.

The objective of the second survey project was to evaluate the current pain management practices and opinions towards pain management in cattle of beef and dairy veterinarians and producers in the United States. Pain management strategies in livestock have evolved in the last few decades but a variety of obstacles continue to limit improvements in the use of pain mitigation by members of the cattle industries. One such obstacle is the lack of FDA-approved analgesic drugs for use in cattle in the United States which offers limited pain management options to cattle veterinarians and producers. An on-line survey was developed to investigate current use of pain mitigation by cattle veterinarians and producers. The survey was distributed electronically to multiple listservs in Summer 2018 (BEEF Magazine, American Association of Bovine Practitioners, National Milk Producers Federation Farmers Assuring Responsible Management evaluators, Dairy Moms and Dairy Girls Facebook groups; $N=46,577$). A total of 1,187 (2.5%) surveys were received; 41.9% of respondents identified as producers, 47.9% as veterinarians, and 10.2% as both. Multivariate logistic regression was used for analysis. Veterinarians (OR [95% CI] = 10.2 [7.21-14.4]) and producer-veterinarians (OR [95% CI] = 3.30 [2.02-5.39]) had significantly greater odds of using analgesia than producers in all cattle ages. Summary data suggest that analgesic use changed with cattle age; 57.6% of respondents

used pain management in calves <2 months of age, while 71.6% of respondents used pain management in cattle more than 12 months of age. Respondents agreed that “cattle benefit from receiving analgesic drugs” (76.6%) and that “US/USDA/FDA regulations limit my ability to use analgesic drugs in cattle” (64.01%). Fifty-eight percent of respondents indicated their use of pain management had increased in the last 10 years. Data identify impediments to improving pain management practices in cattle. Results indicate the need for education and communication between veterinarians and producers on the necessity of pain management.

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CHAPTER I: LITERATURE REVIEW

Animal Welfare: How Is It Defined and Who Is Responsible for Its Endorsement and Protection?

In both the companion animal, lab animal, and animal agriculture industries, the welfare of animals has been a growing public concern during the past twenty years as information and images regarding animal treatment are rapidly disseminated via the internet and social media. Researchers and academics have confirmed the ability of animals to feel pain, fear, and suffering¹⁻⁴. With the scientific support of an animal's ability to suffer and with the exposure of industries that, when badly managed, have been shown to cause animal suffering, the public has begun to demand change. Consumers and animal purchasers consistently demand heightened standards in companion, lab, and agricultural animal industries to protect animals from experiencing pain, fear and distress. To make these changes effectively, there must be agreement between the scientific, veterinary, and animal production communities on what defines animal welfare and its economic, social, and political elements.

The term animal welfare means different things to different groups of people---some people believe the term encapsulates the prevention of cruelty and animal suffering during an animal's lifetime while providing a humane end. Others may believe good welfare cannot involve ending a life. To many in the animal production sector, good animal welfare benefits the animal's quality of life but also ensures quality products and helps ensure economic success. Industries that maintain a good welfare image tend to boost consumer confidence in both how they raise their products and the resulting product quality, which can increase sales and increase

market shares. Yet for others, the animal's experience is paramount to any other consideration and product quality should be secondary.^{1,5}

Animal welfare standards suggested by the United Kingdom's Brambell Committee in the 1960s focused on the prevention of physical deterioration and the physical manifestations of compromised welfare such as disease, loss of production, and death.^{6,7} The Brambell Committee's recommendations stated that livestock production animals should have the freedom to "stand up, lie down, turn around, groom themselves, and stretch their limbs."⁸ Following this report, the Farm Animal Welfare Committee was assembled in 1979. This committee produced a document that combined these five freedoms with the acknowledgement of the need to protect of an animal's mental state.⁹ The Five Freedoms are formally: 1) the freedom from hunger or thirst; 2) the freedom from thermal or physical discomfort; 3) the freedom from pain, injury and disease 4) the freedom from fear and distress 5) the freedom to indulge in normal behavior patterns.⁹ In recent years, the focus of animal welfare research in both the UK and the US has attempted to emphasize the connection between an animal's physical experience of pain and the resulting mental suffering.^{10,11} Mellor (2014) argues that a physically and mentally suffering animal may be capable of sufficient production for a period of time, making identification of welfare issues complicated for the average producer. For example, a cow may produce large quantities of milk and from a production standpoint and seem to be a healthy and valuable cow. Yet, this same cow may suffer from the constant pain of hoof rot caused by poor environmental management.¹¹

Nationwide programs have been developed to assess and monitor the welfare statuses of both production and companion animals, but many of these programs include minimum standards for welfare and many regulations do not universally apply to food animals.^{9,12,13} Advances in animal welfare research and regulations are often met with resistance by those who

believe welfare cannot be empirically measured. Due to the challenges with objective measures of welfare, reaching a consensus on welfare standards is challenging, further complicating the development and implementation of animal protections. The current standards set by the Five Freedoms act as idealistic recommendations and do not provide a way to measure the suffering of an animal in a visible or tangible metric.^{5,13,14} The Five Freedoms framework outlines an unachievable utopia for an animal, specifically production animals. In the constructs of our society where mass production of food animals, pets, and animals needed for research is necessary for human existence and progress, it is impossible for any living thing to be completely free from situations of discomfort, pain and disease, stress, and the prevention of natural behavior.¹⁴ This idealism makes it difficult to determine what level of welfare is acceptable in the immediate present--- at what point is it sufficient to strive to meet these ideals even though a producer or steward is falling far short? To resolve this confusion and fully grade or evaluate an animal's welfare requires the convergence of ethics and empirical evidence; animal welfare science directly challenges the view that animal emotion and animal suffering cannot be measured scientifically.^{15,16}

One definition of animal welfare states that good welfare is the ability of an animal to cope with its environment.¹⁷ If an animal was actively coping and not suffering, it would logically follow that it would be productive in both growth and reproduction. Using this type of definition, the measurement of an animal's welfare state is assessed objectively through the animal's productivity. Some critique this definition of animal welfare indicating that it is insufficient to encapsulate the consideration for animal awareness, natural tendencies and desires, and pain.^{6,7,15}

Research highlighting an animal's ability to feel pain and suffering from that pain brought about more inclusive definitions of animal welfare.^{3,18,19} Pain can be defined as both physical and mental---pain from an injury or disease can cause an animal to suffer in addition to prevention of fulfilling an animal's instinctual needs and behaviors, or the "matterings" to an animal, as described by Rollin (2011). Psychological suffering should be considered equally with physical suffering. Dr. Grandin (2002) states that animals, mammals in particular, are capable of experiencing pain much like humans and have similar neural mechanisms to transmit signals creating fear, anxiety, and mental and physical pain.¹⁸ These experiences lead to suffering and warrant animal welfare protections. Grandin defines animal welfare in part as the prevention of painful experiences in species that have neural mechanisms to suffer.^{18,20}

The prevention of animal suffering is the cornerstone of modern definitions of animal welfare but this seemingly simple definition lacks a key element--animal welfare should also include the encouragement of animal satisfaction. Merely preventing negative experiences does not necessarily create positive experiences. The concept of animal welfare can therefore be expanded to include a concern for animal suffering with a simultaneous concern for animal satisfaction, perhaps even happiness.^{14,19,21} Rollin (2012) similarly argues that animal must be allowed to pursue its desires and find satisfaction in doing so. Rollin defines an animal's "telos" as its species-ness, or its inherent way of being, i.e. the "cowness" of a cow or the "dogness" of a dog. By allowing an animal to live its best life where it can act upon preferences for shelter, food, social interaction and seek what matters, rather than merely preventing negative experiences, the animal is allowed to find pleasure beyond the baseline of mere existence.²¹ The Five Domains concept introduced by Mellor and Green (2011) similarly emphasizes a "comprehensive and multifactorial" life for an animal that includes rewards, fulfillment of

mental and physical desires, and the encouragement of “curiosity and playfulness”. Mellor and Green argue that the term “animal welfare” should indicate that an animal’s life has real quality rather than a life that is merely tolerable.²² Rollin (2012) goes further to argue that preventing an animal’s telos from being expressed may potentially be more damaging to an animal’s welfare than causing physical pain.

Similarly, this telos can be called an “inelastic demand” for a natural behavior or preference, i.e. an intractable need to act in ways that a species’ evolution intended for that animal to behave; for example, the way a predator animal communicates with other species, hunts food, finds shelter, or attracts a mate.⁵ When an animal is prevented from doing what it is highly motivated to do, an animal will continue working towards this goal and in the process suffer by not achieving it. By nature, compared to humans, animals have less of a sense of consequences and time and are more likely to continue striving towards their desires, despite negative or painful consequences.⁵ When an animal is placed in a situation where it is prevented from fulfilling its natural desires, such as in a confinement operation or breeding cages, it will usually continue to make attempts to escape. In these attempts, that animal will likely experience pain but will be so determined to try again that they will endure self-inflicted suffering as a result of this compromised welfare.¹⁸ If we must use animals for our needs, we as stewards of these animals have the responsibility to alleviate suffering by creating environments as amenable to that animal’s telos as possible, thereby protecting their welfare. The issue remains how to determine when we have achieved a life worth living for the animals we raise rather than merely a tolerable one.

Comparisons between welfare conditions are impossible for different species as good welfare for a goldfish is not good welfare for a veal calf. Producers and caretakers need

achievable standards order to remain operational with healthy animals, a good public image, and successful economic returns. As discussed earlier, the Five Freedoms provide a limited framework that may only, at best, lift a poor welfare state to create a net neutral one.¹¹ Efforts need to reach beyond that neutral state and focus towards achieving a positive welfare state for every animal by encouraging healthy mental and physical stimulation and development. It is not enough to eliminate the negative.^{6,11,23} A dog may be provided a clean and comfortable barn to sleep in, away from the elements, with sufficient food and water and the freedom from any physical pain and disease. Yet, this dog is a social creature and without social interaction with others of its own species or the ability to develop a bond with humans, or physical and mental exercise from environmental stimuli, this dog will suffer from boredom, anxiety, and depression.

When an animal, such as this dog, whose natural adaptations or tendencies are not supported by their environment, there are three major overlapping ethical areas of concern, as outlined by Fraser (1997).²⁴ Animal welfare science often focuses on segments of an animal's well-being, whether that is the animal's physical health, mental state, social interactions, or relationship with its environment. Fraser attempted to indicate the overlapping nature of all the aspects of welfare into three intertwined components: animal's basic health and functioning, its natural living, and its affective states. Animals should be provided care that optimizes physiological and behavior health. Animals should be in an environment free of fear, pain and other negative experiences, while also being allowed pleasure. Animals should be allowed to develop and put to use their natural abilities and desires.²⁴

Animal welfare science studies the relationship between inputs and outputs in an animal's daily experience. Inputs, sometimes considered resources or the experiences to which an animal is subjected to, influence its cognitive and physiological processes and produce outcomes, both

behavioral and physical. These outcomes can be studied and then traced back to identify the input that either positively or negatively affected that animal's well-being.^{5,23,25} Students of animal welfare can easily be taught this framework and when combined with their own subjective assessments, they can begin to identify solutions to welfare issues across animal industries.

To study and teach animal welfare, scientists must acknowledge the need for ethics in the scientific method. Traditionally, science resists the infiltration of morality into its practices and in doing so, makes it nearly impossible to measure an animal's suffering, which science sees as subjective.¹⁵ Yet, as Rollin (2006) argues, scientific research follows society's ethical and moral code and by nature is affected by ethical considerations.²⁶ Research is seen as permissible by society when it is deemed to be congruent with society's social values and conducted in such a way that agrees with those same principals. However, scientific research that allows the effects of morality and ethics to infiltrate how research is conducted and the quality of its results has traditionally been scoffed at for its lack of empirical purity. Subjective studies tend to be thought of as bad science upon which one should never base any conclusions.²⁶ With the shift in animal welfare science towards quantifying welfare using outcome-based variables, affective states, and the identification of blood hormones closely tied to stress and fear, studying animal welfare could be done using more empirical evidence rather than collecting purely subjective observations.¹⁶ Yet, it is the marriage of this empirical evidence and ethical reflection that provides an all-encompassing assessment of an animal's welfare status. By combining the empirical nature of traditional scientific research with subjective assessments based on human codes of ethics and morality, animal welfare science can be informed of what is as well as what can and should be.^{15,16,26}

Public pressure to improve animal welfare in the food, companion, and lab animal industries must be created through education and motivation provided by animal care experts in their communities---namely veterinarians and animal scientists. In the last decade, there has been a worldwide increase in the amount of animal-welfare related research, popular press, and legislation that demands public attention.²⁵ Navigating this wealth of information in an informed, unbiased way is nearly impossible without guidance from those in a community who have expertise in animal health and behavior. The public tends to be eager to absorb popular press information as truth when it is flashed on social media sites or quick link news applications. To combat this willingness to believe sensationalism and half-truths, animal scientists and veterinarians have an obligation to be knowledgeable and prepared to discuss current welfare issues from multiple angles. They must be advocates for well-informed understandings of all perspectives rather than emotionally-charged trending topics with little factual foundations. Only by having a rational and factually-supported backing to the public's demands will animal industry leaders take notice and push for the same changes. With the rapid spread of information in today's world, animal scientists and veterinarians have a duty to be informed of current animal welfare issues and proactive in continuing their education throughout their careers. As animal production and animal care experts, veterinarians and animal scientists must advocate for well-informed, well-rounded perspectives on animal welfare topics and be able to educate others, directing them to the right sources of unbiased information. They have a duty to be advocates for all animals who cannot advocate for themselves and this duty demands that they expand their body of knowledge, adapt to change and invention, and work together with animal industries to make improvements.

The Veterinarian's Responsibility

Protecting the welfare of animals is a human responsibility, whether they are used in production systems, as working or non-working companions, as laboratory test subjects, or as creatures with which we share the land. This responsibility includes the maintenance of adequate housing, nutrition, disease prevention and treatment, humane handling, and humane death or slaughter.^{27,28} Yet, while the responsibility to animals is universally shared, generally veterinarians are thought of as the main advocates of animals and as the champions of their well-being within their communities. Not only are veterinarians charged with maintaining animal health and welfare, they are also charged with serving and protecting the public.²⁹ Veterinarians are considered the profession that must communicate understanding of the animal world to the human world to create a cohesive, cooperative, and respectful social existence. They must create dialogue, consensus, and solutions between animal industry leaders, scientists, and the lay public.

The public demand for increased transparency of animal well-being in the livestock production industry, laboratory animal research industry, and companion animal industry has pushed veterinarians to thoroughly saddle themselves with knowledge of current issues and trends regarding animal welfare issues across industries more than ever before. The public has come to recognize welfare as more than just physical health including things such as an animal's cognitive awareness that elicits behavioral responses, the emotional state of an animal, and the necessary mental and physical stimulation provided by social and environmental stimuli. The public readily charges their local veterinarians with the responsibility of understanding aspects of all animals' lives, whether or not they specialize in that species. Veterinarians can no longer isolate themselves to a particular species or industry. With the public's increased awareness of

animal welfare issues and the minimal changes in the structure of veterinary education and continuing education, there exists a widening gap between what the public expects of a veterinarian's knowledge of animal welfare and what veterinarians actually know. This gap, coupled with the lack of veterinarian consensus regarding their own responsibilities towards animal welfare, not only hinders progress towards reducing animal suffering on a daily basis, but threatens to dismantle public confidence in the profession as a whole.^{30,31}

The American Veterinary Medical Association (AVMA) regularly publishes content relating to the veterinarian's role in animal welfare advocacy. A good state of welfare, as defined by the AVMA (restating guidelines published by the World Organization for Animal Health (OIE)) is when an animal has adequate health, nutrition, safety, is able to express natural behaviors, and does not suffer from pain, fear, or discomfort.²⁷ To maintain good welfare, veterinary attention is required to ensure disease prevention and treatment. Veterinarians must also put pressure on the owner or producer to provide the animal with shelter, humane handling, nutrition, and a humane death.^{27,28} A joint statement by the AVMA, the Federation of Veterinarians of Europe, and the Canadian Veterinary Medical Association states that veterinarians, "as knowledgeable and accountable professionals—have an opportunity and an obligation to help animal owners, caretakers, handlers, and policy makers protect and improve animals' welfare...veterinarians are, and must continually strive to be, the leading advocates for the good welfare of animals in a continually evolving society."³² Veterinarians are mandated to reach outside their areas of expertise and individual practice to not only correct and protect the welfare of animals in their communities but to educate community members on how to make improvements. By doing this, veterinarians can help create a cohesive and cooperative society that strives to learn and make improvements for the well-being of animals.

It is a societal obligation to protect animals from unnecessary pain and suffering and to correct injustices towards animal well-being that the veterinarian must observe, not simply those that belong to fee-paying clients. When a veterinarian witnesses cases of animal neglect or abuse in their community, or a community in which they are a visitor, they must take action to right those wrongs, either through education or through reporting to the proper authorities.²⁸ In the veterinary oath that all students must swear upon graduation, they pledge as their “lifelong obligation...to use [their] scientific knowledge and skills for the benefit of society through the protection of animal health and welfare.”²⁹ To fulfill this leadership role in society, veterinarians must realize that they are the key to enforcing animal welfare standards world-wide. They hold a unique intermediary position between the animal, owner, and the public earned through years of education and mandated by the oath veterinarians take at the onset of their careers. Only a respected and dedicated individual can successfully demand change in society that may be difficult and, for some, inconvenient.³³

The responsibility of the veterinarian to protect and advocate for the health and well-being of animals cannot be fulfilled if the veterinary profession does not maintain its ability to mediate and ameliorate misinformation and biases that are a daily consequence of a rapidly changing society. Society morphs quickly over time with its changing demographics, economy, and political environment, and so too does production animal and companion animal owner beliefs, expectations, and demands. The veterinarian is often faced with helping the food animal owner and companion animal owner understand one another. The food animal industry faces immense criticism from the general public on how they raise and process animals for food. Much of this criticism stems from a complete lack of exposure and understanding that the average member of the public has. Today, only 0.39% of Americans are involved in agriculture and 95%

are three generations off the farm.³⁴ A majority of Americans have idealized views of what it is to raise an animal for food---a dairy cow in a lush green pasture or a chicken resting peacefully in a plush nest, images that are made even more meaningful or influential on consumer beliefs when they are plastered on almost every milk carton or egg container. There is an ever-widening gap between what consumers believe animal agriculture is or should be and the reality. The true challenges of keeping that dairy cow in a sun-beaten “green” pasture or that chicken in its “free-range” environment are unknown to most consumers and the media only encourages this ignorance. Media coverage chooses to highlight unsavory aspects of animal production, which in many instances, should be justly exposed, but this exposure only pushes consumers further from seeking dialogue with and understanding of producers. The public consumer turns to their veterinarian for answers, and often this veterinarian does not specialize in food animals.³⁴

When a veterinarian is unable to respond to client questions about the animal agriculture industry with unbiased, scientifically sound information, the veterinary profession becomes directly responsible for deepening the divide between the food animal industry and the rest of the public. This issue is worse now more than ever with the majority of veterinary students coming from suburban upbringings with at least three generations between themselves and farming. It is imperative that these students, who otherwise have no exposure to the food animal industry, be taught the basics of animal production and welfare assessments.^{28,34}

Educated advocacy for the animal welfare is needed for all groups of animals, not just the animals we breed, raise, and use for food. Wildlife, laboratory animal, and even companion animal industries face a deluge of media reports that expose truths and untruths about how animals within their industries are bred, raised, and discarded. The animal welfare issues associated with these industries are complex but the public tends to view them as black and

white. The veterinarian must reveal these complexities to the general public to encourage understanding. When the public is able to understand the policies and practices behind an animal industry in terms of economics, environmental protection, and public safety, they can begin to either accept the industry more readily or clarify the aspects they wish to see changed.

However, the veterinary profession itself has been criticized for viewing issues facing animal industries and the topic of animal welfare too narrowly with a primary focus on animal health and physical harm.³⁵ The welfare issues facing all animal industries encapsulate all violations of animal well-being and too few veterinarians have shown leadership in pushing to correct them. As Dr. Caroline Hewson writes, “Who amongst us can put our hand on our hearts and say that we really have been outspoken enough about the transport of live animals... or the keeping of exotic species as pet animals; or to turn a blind eye to inappropriate breeding practices whilst at the same time carrying out expensive surgery to correct inherited defects?”³⁵ Veterinarians occupy a unique space in society where they are not only obligated to gather and impart knowledge, but they are provided a platform from which to disseminate it in a powerful and convincing way. This responsibility requires veterinarians of all ages to stay relevant with up-to-date information and be effective by remaining visible and proactive in their communities.³⁶

The failure of veterinarians to maintain their commitments to this crucial role in society is a result of institutional shortcomings, muddled animal welfare standards, and the frustratingly wide range of veterinary attitudes towards animals.^{35,37} Conflict between earning a paycheck and angering clients (who provided financial livelihood) also contributes to veterinarians finding difficulty in making choices and decisions that fulfill their moral obligations to animals and society. They may also have the knowledge and awareness of their duties but they simply may

not care enough to act.³⁵ There may be a large difference between the innate concern different veterinary practitioners have for animals. Progression through the years of practice may also be a strong influence on the care a veterinarian has for their work and for animals in general. A powerful apathy may develop in practitioners who have been exhausted by disappointment and frustration in their profession when they too often have faced moral and ethical conflicts in the treatment of animals by their clients and their own colleagues. How do we as a society and the veterinary profession motivate change in all these areas that seem intractable?

The AVMA emphasizes that in order to make real, long-lasting changes to the veterinary community's dedication to animal welfare, the veterinarians must accept the study of animal welfare as a legitimate science that is constantly evolving, self-correcting, and in need of proactive tutelage.³³ There must be respect for animal welfare science and for those outside the veterinary profession who hope to work together with veterinarians to educate clients and improve their treatment of animals. Once that shared respect exists, the challenge of educating the public of how to better their own and other animals' welfare can be more efficiently accomplished. Commitment by all parties---veterinarian, animal scientist, animal owner, the public---is the key to sustaining real change in how we breed, raise, treat, and kill animals. For veterinarians to be successful in helping to educate and collaborate with others, they must be effective communicators and motivators. The tendency for veterinarians to fail at convincing an animal owner to change their husbandry practices for the benefit of the animal may be related to many individual factors, but it is likely these veterinarians were not provided sufficient training in methods of problem-solving, influence, and persuasion.^{31,37}

The AVMA admits a "noticeable gap" between the goal of veterinary school education to prepare students to be proactive and effective advocates for animal welfare in their communities

and the reality of that achievement.³³ Veterinary students are graduating and moving into their careers with narrow focuses on their medical specialty, their daily routines, the desires of the clients that provide their paychecks, and a general obliviousness towards what other injustices may be happening around them. As veterinary school debt increases and veterinary income stays stagnant, graduates are under pressure to work with what they know, keep their heads down, minimize upset, and pay back their debt.³⁸ Veterinary students' education should include extensive instruction on their unique role as animal experts in society, the power associated with that role, and the limitations of what a four-year education can provide.³¹ They must enter the profession aware of the need for continuing education to broaden their knowledge of numerous topics and that graduation does not represent the end of learning.

Veterinary faculty make a lot of assumptions about what each student, at graduation day, has learned about animal welfare issues and assessments.³⁰ There is the assumption that in four years of animal medicine education, every student has been exposed to a multitude of welfare issues and that at different moments, they have been instructed on the ethical reasoning to find a resolution, proper corrective action, reporting, follow-up resolution, and public education. Veterinary students and faculty may assume that individuals who were enrolled in a medical education program would have been provided animal welfare education at some point throughout the four years. There also may be a frequent assumption that by nature, veterinary students care about animals, and that care must indicate they also are fully knowledgeable about the welfare of animals. The ability to care for an animal and the ability to understand animal welfare and identify its violations are not synonymous abilities. The faculty and the public can never be sure of what veterinary students are actually learning when a benchmark, such as a specific course, does not exist by which to measure student knowledge.³⁰ Unfortunately, the complexity of

adding such a course to the veterinary curriculum is exacerbated by noise from critics who argue that animal welfare is a highly subjective topic—what one individual may judge to be an ideal welfare state for an animal may be perceived by someone else as less than ideal. These critics incorrectly argue that welfare assessments cannot be taught.^{5,19} Yet, this criticism further demonstrates that it is even more imperative that specific instruction be given on animal welfare issues and assessments to minimize disagreements between veterinarian observers of compromised welfare and encourage cooperation to make changes in an animal's life.

A majority of curriculums lack a required animal welfare course that would, at the very least, provide a standard benchmark by which we can measure veterinary knowledge of animal welfare issues and how they have been taught to manage these issues in their professions.^{37,39-41} The United States lags behind the United Kingdom, Latin America, and Australia in emphasizing the importance of animal welfare education for veterinary students.^{40,41} Entire institutes of animal welfare exist in association with veterinary schools in many of these countries, including Chile, Germany, and Canada.⁴⁰ Support for the creation and inclusion of animal welfare courses in veterinary curriculums nationwide has only just begun to be effective. In 2004, only five veterinary schools in the United States had a course on animal welfare and the AVMA only included animal welfare in the veterinary oath in 2010.⁴¹ As of 2018, the author of this paper has found nine mainland AVMA accredited US veterinary schools have a course on animal welfare, specifically. The struggle to reorganize existing curriculums to accommodate such a course and to convince faculty that it is, in fact, needed has proved to be difficult.³⁰ As Lord and Walker (2009) write, there is a shortage of faculty nationwide who are skilled in animal welfare instruction, veterinary curriculums are already overfilled with coursework, and selecting the

appropriate year to include such a course is challenging. These challenges will need to be navigated nationwide and resolved through cooperation, understanding, and investment.

The Integration of an Animal Welfare-Specific Course in Veterinary Curriculums in the United States: Challenges Faced and Recent Progress

The welfare of animals is assumed to be the cornerstone of a veterinarian's education and their career. Ideally, animal welfare principals make up the moral groundwork on which veterinarians operate every day. Animal welfare is hardly a new subject in veterinary education but it is a subject that has not had specificity in its instruction. Rather, animal welfare is a topic has been assumed to be sufficiently covered by coursework, rotation, and externship experiences throughout the four years of school. Caring for animals' well-being, being knowledgeable about how to educate others about such optimal care, and wanting to educate others and correct injustices would be obvious positions for any individual with aspirations of becoming a veterinarian. Yet, dangerous assumptions are made about individual veterinary students' moral codes, instincts, and methods to achieve their goals. Subsequently, further assumptions are made about what is truly being taught in veterinary coursework with respect to animal welfare. When these assumptions are combined, it is not only likely but probable that graduating veterinary students have vastly different concepts of not only what animal welfare is but their own responsibilities for its advocacy^{30,42}

The concepts of animal welfare apply in all veterinary course topics. Animal welfare has often been equated with physical health and little emphasis has been placed on the other topics encapsulated by the term. Topics such as an animal's psychological state, their capacity to suffering both physically and emotionally, and the resulting behaviors associated with altered psychological well-being have not been extensively covered in the traditional curriculum.³⁰ With

this narrow definition of welfare that focuses on physical health factors as the sole indicators of bad welfare, it would make sense that there would appear to be no need for additional education in a curriculum heavy-loaded with instruction on animal physiology. Thus, a specific course intended to define, support, broaden, and extend the subject of animal welfare has not been a traditional part of the curriculum nationwide.^{30,37,39,40} Yet, in the past few decades, there has been increased demand for veterinary school graduates to be able to respond to the public's animal welfare concerns that reach beyond the physical health of the animal. Public awareness of an animal's psychological capabilities has, amongst other catalysts, brought increased scrutiny to how we, as a society, raise animals for pets, food, and research and how we treat those that share our environment.³⁹

As early as 1991, the World Veterinary Association published animal welfare and ethology policies that stated that “in order to establish an informed position on animal welfare...it is essential to include the subject in basic...education.”⁴⁰ As Estol writes, the association called for animal welfare to be a subject in its own right, taught apart from other coursework as a unique subject, and taught both at the pre-clinical and clinical levels.⁴⁰ It must include topics such as bioethics, animal suffering, and animal pain. Broom (2005) argues that an animal welfare course in veterinary education should cover the concepts behind welfare science, ethics, animal welfare assessment strategies, animal handling, transport, slaughter, and comprehensive instruction on physiological and behavioral measures of welfare. Broom states that veterinary degrees should not be awarded to graduates unless they have completed a complete course on animal welfare science, the ethics of animal care and use, and animal law.

The implementation of animal welfare courses in veterinary curriculums in the United States has lagged behind efforts by Europe and Latin America.⁴⁰ Estol explains that several

veterinary colleges in Chile and Brazil place more emphasis on animal welfare as its own science than US schools have traditionally. In Europe, Germany developed the Institute of Animal Hygiene and Welfare within the School of Veterinary Medicine in Westfalenhof, Hanover, Germany. In 2000, Canada developed the Sir James Dunn Animal Welfare Centre at the Atlantic Veterinary College on Prince Edward Island. In the UK, the University of Bristol requires lectures and group discussions on animal welfare in both year one and year three of veterinary school.³⁷ Tufts Veterinary School in Massachusetts paved the way in 1983 requiring students to enroll in courses throughout the four years that teach topics related to animal welfare and ethics. Washington State Center for Animal Well-being was established in 1993 to integrate topics of welfare and well-being with the veterinary school on campus. Cornell University established an Institute for Animal Welfare in 1997, although this is not a required element of the veterinary education obtained at Cornell's veterinary school.⁴⁰

Despite these developments by a few schools across the United States, the creation and integration of animal welfare courses in veterinary schools has been extremely slow. The findings by the author of this paper have revealed that as of spring 2018, only 9 out of the 30 veterinary colleges accredited by the AVMA in the mainland US have a specific animal welfare course, as either required or elective, as part of their curriculum. This is despite the 2010 amendment to the veterinary oath by the American Veterinary Medical Association (AVMA) to include animal welfare, specifically.⁴³ In 2011, the AVMA Committee on Education instructed all veterinary schools to require a course on ethics and a committee was established to create a model curriculum on animal welfare.⁴¹ Failure to implement such a course is detrimental to the ability of students to fulfill the moral promises stated in the veterinary oath. In order for veterinary students to assume the responsibility of protecting and promoting animal welfare, they

must have a thorough education on the topic. Specifically, education on the perceptive and overall cognitive abilities of a multitude of species rather than the traditional focus given to companion animal mentation and emotion is needed. In a study done by Levine et al. (2005), veterinary students were more willing to acknowledge the cognitive abilities of small companion animals than food animals, which indicates their education on the topic of animal awareness and complex thought is insufficient.⁴² This study also illuminated differences between the perception of humaneness of certain procedures between those students interested in food animal medicine and those interested in small animal medicine.

The aim of an animal welfare course in the standard veterinary curriculum is not to teach students what to think but rather how to use the scientific information they have been provided to evaluate all sides of an issue pertaining to how an animal is cared for and raised. Through readings, debates, interactions, and discussions, students cannot avoid being exposed to animal well-being topics and differing perspectives that they would otherwise never encounter in a traditional veterinary curriculum. An ideal course would provide instruction on how to research topics brought up by clients or in a public debate. Post-graduation, this research skill can provide veterinarians a backbone with which to feel confident in taking an issue, finding a solution, and educating others with unemotional, unbiased information. Saddled with this kind of training, veterinary students will graduate knowing they were provided the necessary resources to begin to tackle moral and ethical issues that will inevitably arise on day one of their practice. They will have the basic training to be able to listen to others, acknowledge when they may be wrong, when animal care can be improved, or when they desperately want to correct an injustice in their community. Dr. David Main, a professor at the University of Bristol, asks the question “Are new graduates sufficiently prepared to handle the difficult ethical and moral dilemmas that welfare

issues can present?”³⁷ At present, the likely answer for most graduates is no. Courses in veterinary ethics are prevalent in US veterinary curriculums but these courses fall short in educating students about assessing welfare, acting to correct poor welfare, being exposed to topics of animal care that may not be in their specific focus, and learning to view issues of animal care from multiple angles. Without this training, veterinary graduates will tend to approach these ethical and moral dilemmas from the one perspective with which they are most comfortable and confident—the perspective they likely had from their own community upbringing, before they even entered veterinary school.

In 2018, Kipperman et al. performed a survey on the ethical dilemmas encountered by small animal practitioners.⁴⁴ The survey results suggest that the veterinary ethics courses currently provided in veterinary curriculums are insufficient. In this survey, the ethical dilemmas caused by client financial concerns were common causes of conflict. Often, these financial concerns place a veterinarian in the position of witnessing and participating in compromised animal welfare. This is a prominent stressor in daily veterinary work. Only 20% of respondents stated that other veterinarians in their practices prioritized the patient’s, or the animal’s, interests and only 50% of respondents stated that they themselves prioritized patient interests.⁴⁴ The results showed that the trainings provided by traditional veterinary ethics courses are insufficient. More training should be provided in ethical theory and the marriage of upholding personal and social ethics and implementing good welfare. Graduates need to be provided tools to correct welfare injustices and when they fail to do so, have better methods of coping with moral and ethical stress.

A few surveys have been conducted in the last twenty years to better understand veterinary students’ capacity for empathy towards animal suffering, pain, and overall

compromised well-being, their knowledge of welfare issues, and their attitudes towards animal welfare education. Paul and Podberscek (2000) conducted one of the first surveys in the U.K. to look at the evolution of veterinary student empathy through the four years of school.⁴⁵ The study found a significant interaction between sex and year of study. Female veterinary students maintained higher empathy towards animals throughout veterinary school while male students' capacities for empathy declined as school progressed. Students also were found to rate animals as having lower levels of sentience in their later years of study.⁴⁵ This study is concerning as one might expect and hope that as students progressed through their education of animal medicine, they would graduate to begin their careers with the highest levels of compassion and reverence for animal well-being and their ability to suffer. The hardening of attitudes illuminated by this survey indicates a great need for veterinary students to be mandated to complete animal welfare training during veterinary school, even in the latter two years.

A survey completed more recently in Australia⁴⁶ produced data that seemingly opposed the findings of Paul and Podberscek (2000). Both first and last year veterinary students were found to be compassionate towards animal issues and ethical violations. Yet, students admitted to feeling underprepared and inexperienced in taking action to correct compromised welfare and injustice.⁴⁶ Preparing students to be feel confident in their abilities to take such action must begin with comprehensive education in animal welfare assessments, communication with animal owners and the public, and the proper protocols for correcting welfare violations. The efficacy of such courses on students' overall attitudes towards animal well-being and students' preparedness to act as animal welfare advocates have begun to be studied. Following the implementation of a mandatory animal welfare course at Michigan State University, student respondents indicated that the course had effectively challenged them and improved their ability to identify

compromised welfare and ethics and discuss solutions.⁴¹ A welfare and ethics course was also introduced at the School of Veterinary and Animal Sciences at the University of Adelaide in Australia.⁴⁷ A survey was created by Hazel et al. (2011) to examine the effect the course had on students' attitudes towards animals and their well-being. Students indicated significantly increased concern for the treatment of pest and profit animals. Women rated higher in concern for animals in all categories of animals, which had been similarly found in the study done by Paul and Podberscek (2000). Hazel et al. (2011) found that overall, students wanting to work with livestock maintained lower attitude scores for both pests and profit animals. This finding indicates that such a course did not have a significant effect on some potentially pre-existing attitudes towards and beliefs about animals that are produced for labor and food.

A survey was conducted at Cornell University's College of Veterinary Medicine to examine a similar relationship between lower levels of concern for livestock animals and those students wanting to practice in food animal industries.⁴² The survey also attempted to discover a difference between veterinary students' beliefs about the cognitive and emotional abilities of different species, specifically small animal companions compared to livestock animals. Cornell University did not offer a specific animal welfare course at the time this survey was administered. Questions regarding the humaneness of procedures for farm and companion animals and the cognitive abilities of these two groups of animals were asked to respondents, of which 10.5% were interested in food animal medicine and 49% were interested in small animal medicine. 15% of students interested in small animal medicine rated procedures such as band and castration of animals less than one week of age as humane compared to 56% of students aspiring to work with food animals. Overall, students interested in small animal practice rated procedures on farm and companion animals as less humane and those students who intended to

focus on livestock medicine. In addition, Levine et al. (2005) found that less than 90% of students believed that farm animals had cognitive abilities. Respondents also were less likely to believe that poultry and ruminants had emotional abilities compared to dogs and cats. The study by Levine et al. (2005) indicates some powerful inconsistencies between veterinary students in their perception of animal pain, acceptable welfare practices, and cognitive abilities of different animal species. The conclusions of the study stress the need for further reiterative investigation and analysis of North American veterinary students' attitudes and the need for the science of animal welfare to be developed further in the veterinary curriculum.

In 2010, results from a survey by Lord et al. were published which further investigated veterinary student attitudes towards and competencies of animal welfare.⁴⁸ This survey centered around a new elective animal welfare course in the veterinary school curriculum at The Ohio State University. The 46 enrolled students were surveyed after completing the elective course while a control group of matched students who had not taken the course were surveyed. The authors acknowledged that some bias may exist in survey responses given that a smaller percentage of students enrolled in the course were from rural areas and were interested in large animal practice than those not enrolled in the course. It is the opinion of the author of this paper that additional bias may exist in the data given that students who elected to take the welfare course were likely already interested in the topic of animal welfare. In addition, those enrolled in the course were only surveyed after completing the course, rather than comparing their knowledge before and after course completion to analyze a true effect of the course. It may not have been sufficient to compare survey responses of those who had never taken the course and were from a different sub-population of students to a different group of students who had completed the course. That being said, the findings of Lord et al. (2010) demonstrated the

benefits of an animal welfare course on students' opinions towards the inclusion of such a course in the required curriculum, student knowledge of welfare evaluation factors and strategies, the potential impact different groups of individuals can have on improving animal welfare, and student confidence in being able to educate themselves about animal welfare topics. Of those students who completed the course, 93.4% believed it should be a core offering in the veterinary curriculum compared to 77.7% of students not enrolled in the course. When asked about their confidence in researching an animal welfare topic with which they were unfamiliar, 91.3% of enrolled students strongly agreed they felt confident while 71.1% of those not enrolled shared this sentiment. Overall, for three animal welfare scenarios presented, course participants felt more confident in their abilities to educate themselves about the issues observed than non-course participants.⁴⁸

The study done by Lord et al. (2010) also asked respondents about their perceptions of the importance of other community members or groups in making animal welfare decisions. Interestingly, 76.1% of course participants ranked veterinarians as very important in these decisions compared to 93.3% of non-course participants. Animal scientists were similarly ranked higher by non-course participants with 39.1% of course participants ranking animal scientists as very important compared to 66.7% of non-course participants. The authors posited that perhaps, during the study of the course material, course participants concluded that change in practices and policies within a community is often not driven by its scientific and medical leaders but rather by public sentiment and ultimate demands. The authors also suggested that course participants may have concluded that scientists, such as veterinarians and animal scientists, are often unable to find scientific solutions to issues of animal welfare and must look to other individuals within a community for ethical guidance.⁴⁸

In each of these studies mentioned in this paper, results have demonstrated that veterinary students, worldwide, have a lack of knowledge of animal welfare issues, methods by which to educate themselves on welfare topics in order to educate others, and a lack of confidence in their roles as animal welfare leaders in their personal and professional communities. When animal welfare courses have been incorporated into veterinary curriculums, survey results have indicated that students have benefited from the instruction provided by specific animal welfare courses.^{41,42,47,48} Of the surveys that the author of this paper is aware, there has not been one that directly asks veterinary students if they believe they are obligated to be advocates for all animals in their community. Questions have also not been asked about veterinary students' inclinations to use pain management both before and after certain procedures with animals, such as bull castration, cattle dehorning, or declawing. These three procedures are controversial in the world of veterinary medicine and ones that, at least anecdotally, veterinarians may object to performing, depending on their species focus. By asking veterinary students their opinions of such pain management use, it would be possible to infer what may be lacking in their education with respect to such topics of pain management, livestock husbandry, and procedures of convenience, such as tail docking and declawing. In addition, the author of this paper has not found surveys administered to veterinary students which ask specific questions regarding the use of stunning in the slaughter of various species. By asking such questions, it may be possible to investigate if a veterinary curriculum is providing all students, regardless of their future interests, with education in multi-industry practices of humane euthanasia and slaughter.

Animal Pain

The ability of an animal to feel pain has been a topic of scientific research and debate for decades. While there are countless definitions of pain, the most relevant to this discussion

identifies pain as a sensory stimulus that causes a cascade of negative experiences for the stimulus receiver.⁴⁹ Pain can be divided into a two-part progression, as described by Anil. et al. (2002): 1) the activation of peripheral nerves in damaged tissue that carry signals activating the autonomic nervous system, arousing the whole physiological system, and 2) the resulting cerebral emotions or feelings from that nociception. The neural activation experienced by the central nervous system communicates feelings of enduring stress, strain, and overall suffering. It is that conscious experience of suffering that we, as humans, call pain. Pain can be further identified when a dose of analgesia calms or even eliminates that suffering.^{49,50} The above description is a general definition of acute pain. Chronic pain, as described by Hudson et al. (2008), is pain which has “persisted beyond normal tissue healing time” and leads to a constant firing of nerve fibers in the spinal cord. This ultimately lowers the individual’s tolerance of pain (hyperalgesia). Long-term chronic pain can cause allodynia, where normal stimuli, like gentle touch, are painful.⁵⁰

Pain in humans and animals has multiple purposes: learned avoidance, protection of body parts, the assistance of healing from traumatic injury, and responses that signal for help or prevent further injury.^{4,51} Without responses to pain, living things would be exterminated almost as quickly as they were created. Yet, a sharp division still remains in the scientific and medical community between those that willingly acknowledge animal and human pain as similar experiences of suffering, with almost identical physiological pathways, and those that continue to doubt the mere ability of animals to feel pain in a way that causes suffering. A multitude of research has attempted to show that, within the animal kingdom, there is a division between those animals that can experience pain as suffering and those that cannot. These conclusions are based on the assumption that suffering is a result of neurological complexity---animals with

simple nerve nets may not be capable of connecting nociception with a conscious negative experience while animals with more complex brains are fully capable of this.^{2,20} Grandin and Deesing (2002) state that a common method of analyzing whether or not an animal species can experience painful suffering is whether or not they actively look for relief from that pain. The separation of suffering from pain or from fear is also a distinction that must be made. It may be likely that suffering from pain is more negative of an experience than suffering from fear and that painful suffering requires higher levels of cognition.²⁰ Invertebrate animals may be capable of suffering from fear but lack the nociceptive-cognitive circuits to suffer from pain alone.^{2,20}

Research demonstrating the similarities in neural pathways connecting nociceptive and cognitive centers in animals and humans, pathways that cause the experience of pain, is not sufficient to prove that animals can suffer from this pain. Research was performed to identify an animal's ability to psychologically suffer from a heightened awareness of physical pain. The purpose of this study was to demonstrate that an animal's visible physical reaction to pain was not a simple reflex to correct a noxious stimulus.⁵² A pain-inducing substance was injected into the leg of chickens and it was posited that if the chicken experienced the pain as a negative cognitive experience, distracting the bird would reduce its physical indicators of pain, as demonstrated with humans. When the chicken's attention was directed away from the injected stimulus, researchers found that the bird's display of pain was significantly reduced. Gentle's (2001) research indicated that an animal's reaction to physical pain, such as limping or vocalizing, is not likely to be a mere automatic unconscious adjustment to nociception. The chicken's physical reaction to a noxious stimulus was modified by diverting its consciousness.⁵² While one study cannot definitively prove anything, Gentle's (2001) findings join a larger body

of work attempting to prove the psychological awareness of vertebrate animals to painful experiences and the similarities of those experiences to human suffering.^{4,51,53,54}

In the past few decades, an increasing public concern for animal welfare has forced the scientific community to examine their practices with animal subjects.¹⁰ Yet, as Rollin argues, once the physiological ability of animals to feel pain was generally accepted, the resistance to implementing sufficient pain control and eliminating animal subjects all together was based on new claims. Scientists claimed that animal pain was momentary, reflexive, and even insignificant because animals lacked the ability to remember. If animals cannot anticipate and they cannot remember painful experiences, then controlling that pain has no long-term benefit given that nociceptive experiences have no psychological connection.¹⁰ It was suggested that animals experience pain in a similar way that a lobotomized brain would experience pain, incapable of internalizing the pain and translating it into an emotional response.⁵⁵ Yet, animals learn and anticipate, as is evidenced by fast mapping and the strong associations dogs demonstrate between certain stimuli and fear responses, even weeks after they first encountered that stimulus.⁵⁶ If the flawed logic is followed that animals truly cannot remember or anticipate, then the momentary pain may be even more significant than pain experienced by something that can anticipate.¹⁰ Rollin argues that an animal that cannot anticipate or know that there will be an end of that pain. Its momentary experience is an ultimately horrible one with no hope of relief. It is likely that animals cannot fully understand any reasoning behind inflicted pain, whereas human reasoning can provide a tempering effect of the pain's severity. But if animals cannot understand the reason for their suffering, that suffering is potentially more severe.¹⁰

Moving Beyond Animal Pain to Animal Pleasure

The prevention of animal pain and suffering is only half of what constitutes providing an animal with a decent life. Assuring that an animal does not suffer undue disturbances to its internal or external self only provides that animal with a net-zero, or neutral welfare state.⁶ The subject of animal welfare and animal pain has traditionally been focused on preventing suffering but has little to no focus on encouraging an animal's "positive matterings."⁵⁷ Allowing animals to experience positive elements of life by permitting them to explore their innate urges and preferences, or "pangs of pleasure," and to encourage an animal's natural way of being, or telos, provides a net-positive welfare state.^{6,57} Rollin (2011) argues that preventing an animal from pursuing its natural desires may be more detrimental to that animal than preventing some types of physical pain. This is evidenced countless times in nature, with the dog who breaks through the glass door to chase a rabbit, deeply lacerating its front leg, but despite its injuries it catches the rabbit and has a delicious lunch.

Detecting and Controlling Animal Pain and Suffering

Unnecessary pain occurs when the intensity of the pain experienced by an animal is greater than the physical damage or alteration. Unnecessary pain occurs when there is no benefit to an animal for enduring such pain.⁵¹ Molony and Kent (1997) state that unnecessary pain is also inflicted on animals when there is no benefit to that animal for enduring the temporary discomfort. There is no evidence to support the concept that animals have the cognitive abilities to predict future benefits of certain experiences which would allow them to tolerate temporary discomfort.³ Rollin (2011) states that it is likely animals have senses of time and place and cause and effect but not of long term consequences preventing animals from being able to temper pain with the knowledge that it will end soon. When deciding whether or not pain control should be

used during painful procedures or when observing an animal in a painful condition, overestimation of that pain is necessary.⁵¹ Molony and Kent (1997) argue that by choosing to believe that an animal is in pain, it will be very difficult to mistakenly not treat an animal that is suffering. This is acceptable at the expense of treating a few animals that may not be severely suffering.

In research performed by Sneddon et al. (2014), empirical measurement criteria were evaluated to attempt to provide a way to determine if different species of animals felt pain. These researchers wanted to further prove to the scientific community that animals of multiple vertebrate and invertebrate species were capable of physiologically and psychologically experiencing pain. They discovered some basic criteria with which to begin observing pain responses. Painful stimuli will affect an animal in a psychologically and physiologically different way than harmless stimuli. The exhibition of avoidance and protective behavior by an animal may be one of the first indicators of an animal experiencing pain. After a painful event, an animal will show a change in motivation towards the place or activity that caused pain. The animal may also seek out pain relief at a cost.⁴ Specific behaviors indicating pain and suffering are relative to the given species and some species, such as prey animals and predator species, will exhibit contradictory pain responses, making the detection of pain in different species an even more nuanced art-form.⁴

Painful Procedures and Conditions in Dairy and Beef Cattle

Cattle are prey animals who are stoic by nature.^{58,59} As a prey species, they have evolved to have strong constitutions that give away little evidence of pain and suffering. This behavior maintains their place in the herd and helps them avoid being picked off by predators. Visually identifying pain in these animals is generally difficult until the pain is advanced and potentially

chronic.^{2,59} Traditionally, pain assessment has been performed using physiological measures including changes in heart rate, respiratory rate, and concentrations of hormones, such as cortisol, released by the hypothalamic-pituitary-adrenocortical system.² But, as Weary et al. (2006) note, these measurements are difficult on-farm with herds of animals that are stressed by handling and separation from the herd.

Assessment of pain by behavioral observation is ideal for production animals and is potentially a more accurate measure of pain than physiological measures.⁴⁹ Yet, as Anil et al. (2002) points out, the subjective nature of these assessments may cast doubt on their legitimacy. Overall, the study of pain management in livestock has been slow to progress due to ethical and scientific issues with experimental design.⁵⁵ Flecknell (2008) argues that before dosing animal patients with analgesia, experimental data is needed to help determine drug efficacy and appropriate dosage. To obtain this experimental data, appropriate animal control groups are needed to study the effect of these pain control drugs in animals. Yet, having control groups of animals that are in pain and are not provided pain medication creates grave ethical concerns. Confounding factors and the subjective nature of the assessment criteria has further slowed progress in pain mitigation research for animals.^{2,55}

A study done by Gleeup et al. (2015) attempted to create a pain scoring tool for cattle based on behavioral changes. A similar scoring tool had been created for horses, which detailed subtle behavior changes observed in horse facial muscles during castration.⁶⁰ Pain specific behavior in dairy cattle was investigated that was thought to be associated with known painful conditions such as limb fractures or other sources of lameness, peritonitis, and acute toxic mastitis.⁵⁹ Documented behaviors indicating pain include, but are not limited to, altered attention towards surroundings, altered stance, vocalization, ear position, head position, response

to approach, and back position.⁵⁸ Gleerup et al. (2015) found that the facial expressions controlled by the tension of muscles controlling mimic and chewing, dilation of nostrils, and the tension stare were different between non-painful and painful cattle. Significant pain associated with lameness and mastitis in cattle has been found in a multitude of other studies as well by using behavioral indicators accompanied by physiological indicators.^{59,61-63} The research done by Gleerup et al. (2015) revealed that cows show pain specific behaviors and that these pain behaviors are altered by analgesia.

Behavioral and physiological indicators of acute and chronic pain have been specifically observed during and after several management procedures, such as tail docking, castration, and dehorning of cattle.⁶⁴⁻⁷⁷ A series of experiments has demonstrated that tail docking causes indicators of chronic pain.^{64,65} Castration of young cattle also has been shown to cause significant increases in pain behavior, such as immobility, abnormal posture, increased laying time, and stiffness, and physiological measurements of pain including increases in blood plasma cortisol and substance P.^{67,68} Chronic pain indicators lasting at least 42 days have been documented following rubber ring methods of castration.⁶⁷ Additionally, disbudding of calves has been shown to cause acute pain as measured by spikes in plasma cortisol concentrations,^{70,71} changes in heart rate, eye temperature, electroencephalogram data, and behavior such as head shaking and rubbing, falling down, ear and tail flicking, and rearing.⁷²⁻⁷⁶ Amputation dehorning has been shown to cause a greater cortisol increase in blood plasma sampling than cautery dehorning.⁷⁰ When anesthesia was administered in the form of a cornual nerve block, behavioral changes and plasma cortisol levels were minimized, if not eliminated, further suggesting that the cortisol spikes are pain related.^{70,74,77}

The few clinical conditions and husbandry practices mentioned so far that have been extensively studied. These studies have demonstrated clear behavioral and physiological indicators of pain in animals. The experience of that pain interferes with the Five Freedoms framework as discussed earlier in this paper.⁹ Methods should be adopted whenever possible by veterinarians, animal owners, and animal caretakers to detect pain and suffering and make husbandry corrections to minimize or eliminate that pain.

Current Use of Pain Mitigation Drugs in Dairy and Beef Cattle

The prevention of pain in cattle is necessary given the husbandry procedures they must endure and their susceptibility to painful diseases. In the past 20 years, there has been progress in the ability of veterinarians and cattle producers around the world to recognize pain in animals and to be willing to use pain management drugs.⁷⁸⁻⁸¹ Local anesthetic use with nerve blocks are widely used to control pain during procedures such as dehorning but there exists a lack of use of drugs to control preoperative and postoperative pain and painful conditions in cattle.⁵⁵ The most commonly used pain control drugs are NSAIDs (nonsteroidal anti-inflammatory drugs), $\alpha 2$ -agonists such as Xylazine, and local anesthetics such as lidocaine.^{78,80}

Local anesthetics, such as lignocaine, numb tissue in a specific area by preventing the transmission of nerve signals to the brain.^{50,82} Procaine, a local anesthetic, is approved for use in the UK but not approved for use in the United States in cattle.⁵⁰ AMDUCA, or the Animal Medicinal Drug Use Clarification Act⁸³, allows for some pain mitigation drugs to be used extra-label under certain provisions.⁸⁰ This allows for veterinarians in the United States to prescribe analgesia like lidocaine or the NSAID meloxicam for use in cattle.⁸⁴ Lidocaine and bupivacaine have been shown to be effective in reducing behavioral and physiological responses to pain caused by dehorning of calves, and tail docking and castration of lambs.⁸⁵⁻⁸⁷ but these local

blocks are short-lived solutions. After the local anesthetic has cleared the area of the damaged tissue, blood plasma cortisol levels increase and pain behaviors resume, including ear flicking and head shaking.⁷¹

NSAID drugs work to control pain experienced by the animal by reducing the production of prostaglandins associated with inflammation due to tissue damage or injury.⁷⁴⁻⁷⁶ Commonly used NSAID drugs in cattle are ketoprofen, flunixin meglumine, and meloxicam. Ketoprofen only lasts two to four hours and has not been shown to reduce pain due to dehorning past that short time.^{71,88} Meloxicam is less commonly used but has been found to be longer lasting than flunixin meglumine.^{89,90} Currently, flunixin meglumine is the only NSAID approved in the United States for use in cattle and its topical formula is approved for managing pain associated with fever and endotoxemia.^{80,84} However, in the United Kingdom, a number of NSAIDs are approved for use.⁵⁰ When combined with a local block, the use of an NSAID like meloxicam has been shown to reduce pain to the greatest degree following dehorning, as measured by physiological responses including cortisol concentration, eye temperatures, and heart rate.^{91,92} The combination of the local anesthetic and NSAID drug was even able to reduce pain behavior so significantly that the behavior between control calves, who had not been dehorned, and the dehorned calves, was similar.⁷⁴ When local anesthetics were combined with the NSAID ketoprofen during calf castration, the increase in cortisol concentration, indicating pain and stress, was reduced to control levels.⁹³

Production parameters have also been shown to benefit from the use of systemic analgesia. When the experience of pain is reduced, stress is reduced in animals, and, as it would in humans, appetite increases, activity increases, and some production parameters increase.⁷⁶ Faulkner and Weary observed that the use of the NSAID meloxicam, when combined with a

local nerve block agent, significantly increased normal calf behavior and performance, including feed and water intakes and growth rates. It must also be noted that studies using systemic analgesia in cases of clinical mastitis showed increases in milk yield.⁹⁴⁻⁹⁶

α 2-agonist drugs, such as Xylazine, target the central and peripheral autonomic nervous system and slow the release of adrenaline, causing a sedative and analgesic effect.⁵⁰ Due to this sedative effect, α 2-agonists are not used for routine pain management, according to Hudson et al. (2008). The drug Xylazine has been shown to reduce the pain associated with caustic paste dehorning with one injection as well as the pain of tail docking in lambs.^{2,97} Xylazine is not approved for use in cattle in the United States, but is approved for use in the UK.^{50,80}

Clinician Attitudes Towards Use of Pain Mitigation in Cattle and Current Practices

A collection of survey instruments have been used over the past 20 years to investigate current veterinary practices of pain management in multiple countries around the world. One of the most cited papers by Huxley and Whey (2006) surveyed veterinarians in Great Britain and Northern Ireland who were members of the Boehringer Ingelheim mailing list. Questions were asked about respondent demographics, the pain scores respondents would attribute to different procedures and conditions in cattle, and frequency of pain mitigation drug use. Significant differences between male and female practitioner responses to pain scores were noted, with females attributing higher pain scores. More recent graduates of veterinary schools also indicated higher pain scores,⁷⁸ a finding found in surveys performed in recent years as well.^{80,81} Surveys performed in New Zealand and Scandinavia also found that younger veterinarians were more concerned about cattle pain but differed in their conclusions regarding the differences between female and male veterinarians' responses to pain statements.^{98,99} Both associations indicate that

veterinarians who are more recently educated have a stronger perception of animal pain and possibly a greater concern for unnecessary animal pain.

Associations were found between lower pain scores for cattle and United States' veterinarians who were raised on farms, participated in FFA or 4-H, graduated from a rural high school, or were politically conservative.⁸⁰ In the same study by Fajt et al. (2011), more recent veterinary school graduates administered analgesia to a larger percentage of beef and dairy cattle for lameness conditions. United States veterinarians who participated in FFA or 4-H administered analgesia to less dairy and beef calves for dehorning and castration.⁸⁰ In the UK survey by Huxley and Whey (2006), there was also a significant association between practitioners that attributed lower pain scores to painful conditions and did not use pain mitigation with cattle.

Non-steroidal anti-inflammatory drug use by veterinarians in food animal treatment has been historically low and only recently have veterinarians begun to focus on post-operative or chronic condition pain management in food animals.^{55,78,81} Of all respondents in the UK survey by Huxley and Whey (2006), 61%, 68%, and 60% indicated they used NSAID pain control after claw amputation, cesarean section, and umbilical hernia repair, respectively. For surgical castration of calves, NSAIDs were used by only 4.6% of respondents and for disbudding only 1.7% used NSAIDs. For dehorning cattle more than 12 mo., 2.6% reported using NSAIDs, such as flunixin, meloxicam, and ketoprofen, while 99% reported using local anesthesia. The most concerning finding in this survey was that a small number of respondents indicated they did not use local anesthetic in any cases.⁷⁸

Despite the minimal use of NSAIDs in painful procedures in cattle, over 90% of respondents indicated that they believed cattle did benefit from analgesia use, local and/or

systemic, but indicated that cost associated with analgesia was an issue for the farmers.⁷⁸ While this survey illustrated a large majority of veterinarians regularly use local anesthetics, the use of analgesia for the treatment of post-procedural pain or longer term pain from disease is relatively low. In the survey by Remnant et al. (2017), disbudding and castrating calves involved significantly less NSAID treatment by veterinarians despite the acknowledgement of the pain associated with these procedures. In addition, the fact that the clinicians surveyed by Huxley and Whey (2006) did not use analgesia and also provided lower pain ratings for procedures and conditions indicates that those clinicians that believe an animal is truly suffering are more likely to act to minimize that suffering. These two surveys provided some evidence of a lack of appreciation for the pain caused by husbandry practices and disease by veterinarians in the UK.

A similar survey conducted in 2007 in Canada found that those veterinarians working in the dairy industry were more likely to use analgesia with cattle overall.⁷⁹ Analgesia use could involve either local anesthesia or systemic analgesics. Another study by Hewson et al. (2007b) found that more than 80% of respondents did not use analgesia when castrating both beef and dairy calves less than six months of age while more than 50% of respondents did not use analgesia when castrating calves older than six months.⁶² Another survey performed in 2010 found that one in five veterinarians report using analgesia, local or systemic, during castration of calves¹⁰⁰ while a survey performed in the US in 2011 indicated that less than 40% of respondents used analgesia when castrating beef calves at any age.⁸⁰ A recent survey in the UK reported that 67% of veterinarian respondents used local anesthesia for calf castration, indicating that some improvements in use of analgesics with castration have been made.⁸¹

The study done by Hewson et al. (2007a) also showed that there was a greater percentage of Canadian veterinarians (85%) that regularly used some analgesia when dehorning dairy calves

at any age compared to the number found in a similar US survey. Fajt et al. (2011) found that 63% of veterinarians in the United States indicated using analgesia for dehorning dairy calves less than six months of age and 74% indicated using analgesia for dairy calves older than six months. Remnant et al. (2017) reported that 90-95% of respondents used local anesthesia for calf disbudding. In general, analgesia use for dehorning and disbudding is more common than for castration, yet both procedures cause significant pain. Fajt et al. (2011) notes that the differences between US, Canadian, and British veterinary pain management practices may be attributed to the different drug approval statuses of drugs, different costs for drugs in the different countries, or the different educational focus in veterinary college systems.

Future Considerations: How Do We Improve?

Unnecessary pain in animals is unacceptable, particularly when caused by humans that control their environment, their nutrition, their social interactions, and their ability to express their wants and fears. The pain of castration and dehorning, common and widely utilized husbandry procedures, can be controlled with sedatives, local anesthetic nerve blocks, and NSAID drugs to control pain during and after the procedure. However, both producers and veterinarians face obstacles to the implementation of this pain management, both for economic and sociological reasons. There is a common belief that providing pain management is expensive, elaborate, and requires more time spent on an individual animal, thereby increasing veterinary fees and labor. However, the cost of pain management for dehorning, for example, is relatively inexpensive^{50,79} and this method could be applied to other husbandry practices.

Remnant et al. (2017), reported that the percent of respondents who agreed to the statement that “farmers are happy to pay the costs involved with giving analgesics to cattle” increased from a previous 36 percent⁷⁸ to 52 percent. A survey performed in Ontario, Canada

demonstrated that veterinarians were in fact more likely than farmers to cite cost as the reason for not using NSAIDs for disbudding.¹⁰¹ Perhaps for some veterinarians, there is a misconception that farmers are unwilling to use analgesia due to costs when in fact farmers may be interested in paying those fees. There may exist a lack of dialogue between veterinarian and producer regarding progress of pain management methods for cattle and the availability of new drug products. It is the responsibility of the veterinarian to be an advocate for increased use of pain management in dairy and beef cattle whenever possible and to provide producers with affordable options. Finding methods that are cost-effective and easily applicable is crucial.²

Encouragingly, Remnant et al. (2017) reported that two-thirds of veterinarian respondents stated their use of analgesia has increased in the last ten years due to changes in producer attitudes, perception of pain in cattle, and reduction in cost of medications. This survey was not performed in the US and it is difficult to make comparisons between different countries. Further research must be performed to identify similar potential changes in attitudes of producer and veterinarians in the United States towards pain management in cattle as Remnant et al. (2017) found. Research should also seek to quantify the amount of progress that must still be made in mitigating pain associated with standard husbandry procedures in cattle.

REFERENCES

1. Duncan IJH. Animal Rights – Animal Welfare: A Scientist's Assessment1. *Poultry Science* 1981;60:489-499.
2. Weary DM, Niel L, Flower FC, et al. Identifying and preventing pain in animals. *Applied Animal Behaviour Science* 2006;100:64-76.
3. Rollin BE. Animal Pain: What It is and Why It Matters. *The Journal of Ethics* 2011;15:425.
4. Sneddon LU, Elwood RW, Adamo SA, et al. Defining and assessing animal pain. *Animal Behaviour* 2014;97:201-212.
5. Dawkins MS. From an animal's point of view: Motivation, fitness, and animal welfare. *Behavioral and Brain Sciences* 1990;13:1-9.
6. Mellor DJ. Animal emotions, behaviour and the promotion of positive welfare states. *New Zealand Veterinary Journal* 2011;60:1-8.
7. Rollin B. Animal Welfare, Animal Rights, and Agriculture. *Journal of Animal Science* 1990;68:3456-3461.
8. Britain G, Brambell FWR. *Report of the Technical Committee to Enquire Into the Welfare of Animals Kept Under Intensive Livestock Husbandry Systems, Etc.*[Chairman, Professor FW Rogers Brambell.], 1965.
9. FAWC FAWC. First Press Notice, 5/12. *MAFF, London* 1979.
10. Rollin BE. Animal pain. *Advances in Animal Welfare Science* 1985: Springer, 1985;91-106.
11. Mellor DJ, Webster JR. Development of animal welfare understanding drives change in minimum welfare standards. *Revue scientifique et technique (International Office of Epizootics)* 2014;33:121-130.
12. Animal Welfare Act. 1989. Fed. Register (ed.) 9 CFR Parts 1 and 2. No. Vol. 54. p 36112-36163.
13. Fraser D, Duncan IJH, Edwards SA, et al. General Principles for the welfare of animals in production systems: The underlying science and its application. *The Veterinary Journal* 2013;198:19-27.
14. McCulloch SP. A Critique of FAWC's Five Freedoms as a Framework for the Analysis of Animal Welfare. *Journal of Agricultural and Environmental Ethics* 2013;26:959-975.
15. Fraser D. Animal ethics and animal welfare science: bridging the two cultures¹. *Applied Animal Behaviour Science* 1999;65:171-189.
16. Fisher MW. Defining animal welfare — does consistency matter? *New Zealand Veterinary Journal* 2009;57:71-73.
17. Broom DM. Indicators of poor welfare. *British Veterinary Journal* 1986;142:524-526.
18. Grandin T, Hauser M. Animals are not things: A view on animal welfare based on neurological complexity. *a discussion on whether or not animals should be property, with Marc Hauser, Dept of Psychology, Harvard University* 2002.
19. Gregory NG, Grandin T. *Animal welfare and meat science*: CABI Pub., 1998.
20. Grandin T, Deesing M. Distress in animals: is it fear, pain or physical stress. Manhattan Beach (CA): American Board of Veterinary Practitioners Symposium 2002.
21. Rollin BE. *Telos. Veterinary & Animal Ethics*: Blackwell Publishing Ltd, 2012;75-83.
22. Green TC, Mellor DJ. Extending ideas about animal welfare assessment to include 'quality of life' and related concepts. *New Zealand Veterinary Journal* 2011;59:263-271.

23. Yeates JW, Main DCJ. Assessment of positive welfare: A review. *The Veterinary Journal* 2008;175:293-300.
24. Fraser D. A Scientific Conception of Animal Welfare that Reflects Ethical Concerns. *Journal of Animal Welfare* 1997;6.
25. Grandin T. *Improving animal welfare: a practical approach*: Cabi, 2015.
26. Rollin BE. The regulation of animal research and the emergence of animal ethics: a conceptual history. *Theoretical Medicine and Bioethics* 2006;27:285-304.
27. AVMA. Animal Welfare: What Is It? 2018; <https://www.avma.org/KB/Resources/Reference/AnimalWelfare/Pages/what-is-animal-welfare.aspx>. Accessed April 6 2018.
28. Edwards J. The role of the veterinarian in animal welfare: a global perspective. Global conference on animal welfare: an OIE initiative 2004;27-32.
29. AVMA. Veterinarian's Oath. 2018; <https://www.avma.org/KB/Policies/Pages/veterinarians-oath.aspx>. Accessed April 6 2018.
30. Lord LK, Walker JB. An approach to teaching animal welfare issues at the Ohio State University. *Journal of veterinary medical education* 2009;36:276-279.
31. Carbone L. Expertise and advocacy in animal-welfare decision making: Considerations for a veterinary curriculum in animal welfare. *Journal of veterinary medical education* 2010;37:36-39.
32. AVMA. Joint AVMA-FVE-CVMA Statement on the Roles of Veterinarians in Ensuring Good Animal Welfare. 2018; <https://www.avma.org/KB/Policies/Pages/Joint-Statement-Animal-Welfare.aspx>. Accessed April 6 2018, 2018.
33. AVMA/AAVMC. Animal Welfare in Veterinary Medical Education and Research. International Educational Symposium on Animal Welfare 2009.
34. Beaver BV. Introduction: Animal Welfare Education, a Critical Time in Veterinary Medicine. *Journal of Veterinary Medical Education* 2005;32:419-421.
35. Hewson CJ. Focus on animal welfare. *The Canadian Veterinary Journal* 2003;44:335-336.
36. Berry J. Animal welfare....What is the veterinarian's role? *The Canadian Veterinary Journal* 2014;55:203-206.
37. Main DC. Evolution of animal-welfare education for veterinary students. *Journal of Veterinary Medical Education* 2010;37:30-35.
38. AAVMC A. The 2017 AVMA and AAVMC Report on Veterinary Markets, 2017.
39. Broom DM. Animal welfare education: development and prospects. *Journal of Veterinary Medical Education* 2005;32:438-441.
40. Estol LR. Animal Welfare in the Veterinary Curriculum. *Global Conference on Animal Welfare: An OIE Initiative*. Paris: European Communities, 2004;33-45.
41. Aboud SK, Siegford JM. Student Perceptions of an Animal-Welfare and Ethics Course Taught Early in the Veterinary Curriculum. *Journal of Veterinary Medical Education* 2012;39:136-141.
42. Levine ED, Mills DS, Houpt KA. Attitudes of Veterinary Students at One US College toward Factors Relating to Farm Animal Welfare. *Journal of Veterinary Medical Education* 2005;32:481-490.
43. Nolen RS. Veterinarian's Oath revised to emphasize animal welfare commitment. AVMA.org: JAVMA News, 2010.
44. Kipperman B, Morris P, Rollin B. Ethical dilemmas encountered by small animal veterinarians: characterisation, responses, consequences and beliefs regarding euthanasia. *The Veterinary record* 2018.

45. Paul ES, Podberscek AL. Veterinary education and students' attitudes towards animal welfare. *The Veterinary record* 2000;146:269-272.
46. Verrinder JM, Phillips CJ. Assessing veterinary and animal science students' moral judgment development on animal ethics issues. *Journal of veterinary medical education* 2015;42:206-216.
47. Hazel SJ, Signal TD, Taylor N. Can teaching veterinary and animal-science students about animal welfare affect their attitude toward animals and human-related empathy? *Journal of Veterinary Medical Education* 2011;38:74-83.
48. Lord LK, Walker JB, Croney CC, et al. A comparison of veterinary students enrolled and not enrolled in an animal-welfare course. *Journal of veterinary medical education* 2010;37:40-48.
49. Anil SS, Anil L, Deen J. Challenges of pain assessment in domestic animals. *Journal of the American Veterinary Medical Association* 2002;220:313-319.
50. Hudson C, Whay H, Huxley J. Recognition and management of pain in cattle. *In Practice* 2008;30:126.
51. Molony V, Kent JE. Assessment of acute pain in farm animals using behavioral and physiological measurements2. *Journal of Animal Science* 1997;75:266-272.
52. Gentle M. Attentional shifts alter pain perception in the chicken. *Animal Welfare* 2001;10:187-194.
53. Duncan IJH. The changing concept of animal sentience. *Applied Animal Behaviour Science* 2006;100:11-19.
54. Rutherford K. Assessing pain in animals. *Animal Welfare* 2002;11:31-53.
55. Flecknell P. Analgesia from a veterinary perspective. *British Journal of Anaesthesia* 2008;101:121-124.
56. Kaminski J, Call J, Fischer J. Word Learning in a Domestic Dog: Evidence for "Fast Mapping". *Science* 2004;304:1682.
57. Rollin BE. Telos. Veterinary & Animal Ethics: Proceedings of the First International Conference on Veterinary and Animal Ethics, September 2011 2011;75-83.
58. Gleerup KB, Andersen PH, Munksgaard L, et al. Pain evaluation in dairy cattle. *Applied Animal Behaviour Science* 2015;171:25-32.
59. Leslie KE, Petersson-Wolfe CS. Assessment and Management of Pain in Dairy Cows with Clinical Mastitis. *Veterinary Clinics of North America: Food Animal Practice* 2012;28:289-305.
60. Dalla Costa E, Minero M, Lebelt D, et al. Development of the Horse Grimace Scale (HGS) as a Pain Assessment Tool in Horses Undergoing Routine Castration. *PLOS ONE* 2014;9:e92281.
61. Flower FC, Sedlbauer M, Carter E, et al. Analgesics Improve the Gait of Lamé Dairy Cattle. *Journal of Dairy Science* 2008;91:3010-3014.
62. Hewson CJ, Dohoo IR, Lemke KA, et al. Canadian veterinarians' use of analgesics in cattle, pigs, and horses in 2004 and 2005. *The Canadian Veterinary Journal* 2007b;48:155-164.
63. Whay HR. Lameness and pain in dairy cows: does it hurt and does it matter? *Proceedings of the first Regional Conference on Cow Comfort and Lameness (RCCCL)*. Tehran 2016.
64. Eicher SD, Morrow-Tesch JL, Albright JL, et al. Tail-docking alters fly numbers, fly-avoidance behaviors, and cleanliness, but not physiological measures. *J Dairy Sci* 2001;84:1822-1828.
65. Eicher SD, Cheng HW, Sorrells AD, et al. Short Communication: Behavioral and Physiological Indicators of Sensitivity or Chronic Pain Following Tail Docking1. *Journal of Dairy Science* 2006;89:3047-3051.

66. Coetzee JF, Gehring R, Tarus-Sang J, et al. Effect of sub-anesthetic xylazine and ketamine ('ketamine stun') administered to calves immediately prior to castration. *Veterinary Anaesthesia and Analgesia* 2010;37:566-578.
67. Molony V, Kent JE, Robertson IS. Assessment of acute and chronic pain after different methods of castration of calves. *Applied Animal Behaviour Science* 1995;46:33-48.
68. Coetzee JF, Lubbers BV, Toerber SE, et al. Plasma concentrations of substance P and cortisol in beef calves after castration or simulated castration. *American journal of veterinary research* 2008;69:751-762.
69. Molony V, Kent J, Robertson I. Behavioural responses of lambs of three ages in the first three hours after three methods of castration and tail docking. *Research in Veterinary Science* 1993b;55:236-245.
70. Petrie NJ, Mellor DJ, Stafford KJ, et al. Cortisol responses of calves to two methods of disbudding used with or without local anaesthetic. *New Zealand Veterinary Journal* 1996;44:9-14.
71. Sutherland MA, Mellor DJ, Stafford KJ, et al. Cortisol responses to dehorning of calves given a 5-h local anaesthetic regimen plus phenylbutazone, ketoprofen, or adrenocorticotrophic hormone prior to dehorning. *Research in Veterinary Science* 2002;73:115-123.
72. GrØNdahl-Nielsen C, Simonsen HB, Damkjær Lund J, et al. Behavioural, Endocrine and Cardiac Responses in Young Calves Undergoing Dehorning Without and With Use of Sedation and Analgesia. *The Veterinary Journal* 1999;158:14-20.
73. Stewart M, Stafford KJ, Dowling SK, et al. Eye temperature and heart rate variability of calves disbudded with or without local anaesthetic. *Physiology & Behavior* 2008;93:789-797.
74. McMeekan C, Stafford KJ, Mellor DJ, et al. Effects of a local anaesthetic and a non-steroidal anti-inflammatory analgesic on the behavioural responses of calves to dehorning. *New Zealand Veterinary Journal* 1999;47:92-96.
75. Heinrich A, Duffield TF, Lissemore KD, et al. The effect of meloxicam on behavior and pain sensitivity of dairy calves following cautery dehorning with a local anesthetic. *Journal of Dairy Science* 2010;93:2450-2457.
76. Faulkner PM, Weary DM. Reducing Pain After Dehorning in Dairy Calves. *Journal of Dairy Science* 2000;83:2037-2041.
77. Morisse JP, Cotte JP, Huonnic D. Effect of dehorning on behaviour and plasma cortisol responses in young calves. *Applied Animal Behaviour Science* 1995;43:239-247.
78. Huxley JN, Whay HR. Current attitudes of cattle practitioners to pain and the use of analgesics in cattle. *Veterinary Record* 2006;159:662.
79. Hewson CJ, Dohoo IR, Lemke KA, et al. Factors affecting Canadian veterinarians' use of analgesics when dehorning beef and dairy calves. *The Canadian Veterinary Journal* 2007a;48:1129-1136.
80. Fajt VR, Wagner SA, Norby B. Analgesic drug administration and attitudes about analgesia in cattle among bovine practitioners in the United States. *Journal of the American Veterinary Medical Association* 2011;238:755-767.
81. Remnant JG, Tremlett A, Huxley JN, et al. Clinician attitudes to pain and use of analgesia in cattle: where are we 10 years on? *Veterinary Record* 2017;181:400.
82. Benowitz NL, Meister W. Clinical pharmacokinetics of lignocaine. *Clinical pharmacokinetics* 1978;3:177-201.

83. US FDA. Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA). <https://www.fda.gov/animal-veterinary/acts-rules-regulations/animal-medicinal-drug-use-clarification-act-1994-amduca>. Accessed June 2019.
84. Extralabel drug use in animals; final rule, 21 CFR Part 530. *Federal Register* 1996;61:57731-57746.
85. Graf B, Senn M. Behavioural and physiological responses of calves to dehorning by heat cauterization with or without local anaesthesia. *Applied Animal Behaviour Science* 1999;62:153-171.
86. Wood GN. Recognition and assessment of pain in lambs. 1991.
87. Wood G, Molony V. Welfare aspects of castration and tail docking of lambs. *In Practice* 1992;14:2-7.
88. Landoni MF, Cunningham FM, Lees P. Pharmacokinetics and pharmacodynamics of ketoprofen in calves applying PK/PD modelling. *Journal of Veterinary Pharmacology and Therapeutics* 1995a;18:315-324.
89. Allen K, Coetzee J, Edwards-Callaway L, et al. The effect of timing of oral meloxicam administration on physiological responses in calves after cautery dehorning with local anesthesia. *Journal of dairy science* 2013;96:5194-5205.
90. Friton GM, Cajal C, Ramirez-Romero R. Long-term effects of meloxicam in the treatment of respiratory disease in fattening cattle. *Veterinary Record* 2005;156:809.
91. Stewart M, Stookey JM, Stafford KJ, et al. Effects of local anesthetic and a nonsteroidal antiinflammatory drug on pain responses of dairy calves to hot-iron dehorning. *Journal of Dairy Science* 2009;92:1512-1519.
92. Heinrich A, Duffield TF, Lissemore KD, et al. The impact of meloxicam on postsurgical stress associated with cautery dehorning. *Journal of Dairy Science* 2009;92:540-547.
93. Earley B, Crowe MA. Effects of ketoprofen alone or in combination with local anesthesia during the castration of bull calves on plasma cortisol, immunological, and inflammatory responses. *J Anim Sci* 2002;80:1044-1052.
94. Hernandez J, Shearer JK, Webb DW. Effect of lameness on milk yield in dairy cows. *J Am Vet Med Assoc* 2002;220:640-644.
95. Warnick LD, Janssen D, Guard CL, et al. The effect of lameness on milk production in dairy cows. *J Dairy Sci* 2001;84:1988-1997.
96. O'Callaghan-Lowe K, Downham D, Murray R, et al. Effect of lameness treatment on pain and milk production in dairy cattle. 13th International Symposium on Lameness in Ruminants, Slovenia 11th–15th February 2004 2004;237-238.
97. Molony V, Kent J, Fleetwood-Walker S, et al. Effects of xylazine and L659874 on behaviour of lambs after tail docking. Proceedings of the 7th IASP World Congress on Pain, Paris 1993a;80.
98. Laven RA, Huxley JN, Whay HR, et al. Results of a survey of attitudes of dairy veterinarians in New Zealand regarding painful procedures and conditions in cattle. *New Zealand Veterinary Journal* 2009;57:215-220.
99. Thomsen PT, Gidekull M, Herskin MS, et al. Scandinavian bovine practitioners' attitudes to the use of analgesics in cattle. *Veterinary Record* 2010;167:256.
100. Coetzee JF, Nutsch AL, Barbur LA, et al. A survey of castration methods and associated livestock management practices performed by bovine veterinarians in the United States. *BMC Veterinary Research* 2010;6:12.

101. Winder CB, LeBlanc SJ, Haley DB, et al. Practices for the disbudding and dehorning of dairy calves by veterinarians and dairy producers in Ontario, Canada. *J Dairy Sci* 2016;99:10161-10173.

CHAPTER II: KNOWLEDGE AND OPINIONS OF THIRD YEAR VETERINARY STUDENTS RELEVANT TO ANIMAL WELFARE BEFORE AND AFTER IMPLEMENTATION OF A CORE WELFARE COURSE

Introduction

Protecting the welfare of animals, whether they are animals produced for food, companions, or research subjects, is a human responsibility. While the obligation to care for animals is universally shared, veterinarians are often considered the primary advocates for animals and the ultimate champions of their well-being.¹⁻³ Upon graduating from training, veterinarians globally pledge not only to uphold, but to promote the principles of animal welfare for the benefit of animal well-being and society.⁴

In the past few decades, public demand for greater consideration of animal well-being across animal industries has strengthened the need for veterinarians to have current and broad knowledge of issues and trends in animal welfare, regardless of veterinary specialty.^{5,6} At the same time, leading organizations in animal health and welfare, such as the American Veterinary Medical Association (AVMA) and the American Association of Veterinary Medical Colleges (AAVMC), emphasize the necessity for veterinarians to be sufficiently knowledgeable about animal welfare science and issues in order to be effective change-makers; indeed, veterinarians must continually seek to enhance, improve and evolve their knowledge and opinions regarding animal health and welfare.^{7,8} To fulfill this obligation to protect animal welfare, as sworn in the Veterinarian's Oath upon graduation, proper training must be offered by veterinary programs in the scientific study of animal welfare.⁹

The AVMA identifies a “noticeable gap” between the goal of Doctor of Veterinary Medicine (DVM) education in preparing students to be proactive and effective advocates for animal welfare and the actuality of that occurring given the lack of animal welfare courses in veterinary schools nationwide.^{7,10} The AVMA Council on Education (COE) requires veterinary curriculums of veterinary colleges eligible for AVMA accreditation to provide “knowledge, skills, values, attitudes, aptitudes and behaviors necessary to address responsibly the health and well-being of animals in the context of ever-changing societal expectations” but any mention of training in animal welfare science is absent from these listed requirements.¹¹

The United States (US) lags behind Europe and Latin America in implementing welfare education in veterinary schools.² A 2016 study, in which a curricular review was performed across the 30 AVMA-accredited mainland US veterinary schools, found that only six offered a formal, 1 to 2 credit course that included the term animal welfare in the title with an inconsistent variety of species and topics covered.¹⁰ As of 2018, one author of this paper (ECSJ), in searching veterinary curriculums for courses with either “welfare” in the title or course descriptions containing central themes of welfare education, found that only nine of the 30 mainland AVMA-accredited US veterinary schools currently offer a formal course on animal welfare. Most courses indicated in the course descriptions that the instruction focused on general animal welfare without a particular emphasis on species. A required animal welfare course would, at the very least, establish a baseline from which veterinary knowledge and management of animal welfare issues can be measured as DVM students move from training to professional practice.^{3,10,12}

In the last 20 years, several surveys have been conducted to better understand veterinary students’ capacity for empathy towards animal suffering, pain, and overall compromised well-

being; their knowledge of welfare issues; and their attitudes towards animal welfare education.¹³⁻

¹⁸ Surveys analyzing responses by DVM students enrolled in animal welfare courses have generally found that the courses have effectively challenged students to improve their ability to identify compromised welfare, discuss solutions and encouraged ethical considerations.^{15,17} A 2010 study of DVM students revealed that an elective animal welfare course promoted favorable opinions towards the prospective inclusion of such a course in the required curriculum, improved knowledge of welfare evaluation criteria and strategies, and promoted confidence in self-educating about animal welfare topics.¹⁵

Only one of these studies, conducted in the US, focused on a required, versus elective, animal welfare course.¹⁷ The survey assessed student perception of such a course and was administered to first year DVM students following completion of the mandatory two-credit course. While the survey highlighted the positive reception of an animal welfare course by first year students, it did not evaluate possible changes in student knowledge of, and opinions towards, animal welfare and animal welfare advocacy as a result of completing the required course.

The purpose of this study was to examine the current opinions of third-year veterinary students, never exposed to a professional degree animal welfare course, towards the implementation of such a required course; to assess these veterinary students' opinions towards their roles within a community in making animal welfare decisions; to assess the confidence of these veterinary students in educating themselves about animal welfare issues; and to assess the effect of this new course on changing students' knowledge of and opinions towards their roles as animal welfare advocates.

Materials and Methods

The College of Veterinary Medicine and Biomedical Sciences (CVMBS) at CSU introduced an animal welfare course in the third-year veterinary curriculum in the spring of 2018. The course was approved by the University Curriculum Committee in the Fall of 2017 as a required element of the third-year, second semester DVM curriculum. The animal welfare course, which met twice weekly for a total of two hours, was designed to introduce students to the basic principles of animal welfare science through lectures, discussions, professional panels, and student assignments. The course was developed using guidance from the model curriculum put forth by the AVMA Model Animal Welfare Curriculum Planning Group.¹⁹

General

Survey questions regarding third-year DVM students' attitudes towards, and knowledge of, animal welfare topics, animal welfare education, and their responsibilities as animal welfare advocates were developed by individuals within the CSU Department of Animal Science and the CVMBS. The survey was tested by two graduate students within CSU's Animal Science department and two veterinarian mentors to one of the co-authors of this paper (ECSJ). This survey was examined by the Institutional Review Board at CSU and deemed exempt from full board review. A paper survey was developed and administered in-person to veterinary students (N=145) enrolled in the two-credit animal welfare course. A pre-course survey and an identical (except for demographic information) post-course survey was administered to the course registrants. On January 19, 2018, the paper pre-course survey was administered to students of the first day of the animal welfare course by one of the co-authors (ECSJ). Students were verbally informed of the voluntary nature of this survey and no incentives were provided. Students were informed that by returning the blank survey they could opt out of participation and their consent

to participate would be given by returning a completed survey. Each survey had an informed consent cover page attached in front of the survey questions that repeated these details and provided further information of informed consent and the appropriate individuals to contact with any concerns or questions. After being informed of the anonymous nature of the survey, respondents were asked to provide a “Survey ID code” which consisted of the last two letters of their mother’s maiden name and the first three numbers of their hometown zip code. This identifier was used to match pre- and post-course surveys and assess change in individual responses. Surveys were collected in person by one of the authors of this paper (ECSJ) following completion. A total of 131 students completed the survey.

On April 25, 2018, the same survey was administered to the students on the final day of class using an identical method of administration and informed consent as that of the first survey. As planned, the post-course survey was modified by removing the demographic questions. One additional question was removed from the post-course survey as pre-course responses indicated that students did not consistently answer the question in the manner intended (i.e. rating vs ranking). Respondents were asked to include the same Survey ID code on the post-course survey as was provided on the pre-course survey. The post-course survey was collected from voluntary respondents (n=125) by one of the authors of this paper (ECSJ) at the end of the last class session after completion.

The first section in the pre-course survey consisted of demographic questions of age, gender, race or ethnicity, home community, and dietary preference (Table 1). For each demographic question apart from age, respondents were given the choice of selecting “Not Defined” and a write-in option was provided if they did not identify with the categories listed. Table 1 also includes specialization and curriculum track responses (Q1 and Q2 on the survey).

Pre-course surveys that did not have ID codes provided were given a unique identifier and were included only in the pre-course data analysis for summary statistics (n=15).

The remainder of the survey consisted of 22 questions (pre-course) and 21 questions (post-course) consisting of both Likert scale, ranking and binary response questions. For the purposes of this paper, four questions were selected for analysis (Table 2). The focus of this paper is on attitudes towards animal welfare education and advocacy and therefore the questions related to those specific topics were chosen for inclusion. The additional questions from the survey not included here focused on specific welfare issues (e.g. pain mitigation), metrics used to assess welfare and their significance, and concern for the welfare of different categories of animals (e.g. food animal, exotics, companion, etc). Data from additional questions will be reviewed in subsequent papers.

Quantitative Analysis

Pre-course and post-course survey data was manually entered into Numbers software^a. Only completed surveys with all questions answered were included in both the pre- and post-course analysis. Demographic data was summarized by calculating percentages for all demographic categories using Numbers software^a. Data from the pre-course survey (n=131) questions and the post-course survey (n=125) questions with Likert scale and ranking responses were summarized. Mean Likert scale responses and mean ranking responses were summarized using R software^b. Percentages of responses greater than a Likert value of 3 (indicating agreement) were summarized using Numbers software^a. In this way, Likert scale responses were made binary by treating responses greater than 3 as “Yes/Agree” and responses 3 or less as “No/Disagree.” For the pre-course survey data analysis, Fisher Exact Tests were used to analyze

associations between demographic variables and Likert scale questions (converted to binary) using R software^b.

More than half of the survey ID codes written by respondents on the post-course surveys did not match the ID codes given by respondents on the pre-course surveys. The authors of this paper do not know what caused the discrepancies between ID codes and these errors are unfortunate in that they limited the statistical analysis that could be performed. Due to these errors, only 61 completed surveys could be paired by ID codes and used for comparative statistical testing. The total group of post-course survey respondents ($n = 125$) cannot be said to be the same group as the pre-course survey respondents ($n = 131$) and may contain a proportion of students that did not complete pre-course surveys, thereby making the total post-course sample a different combination of individuals from the pre-course sample. Therefore, statistical testing was not used to compare total pre-course and total post-course response data but summary statistics on these two populations are included for consideration.

For the paired ($n=61$) survey questions with Likert scale and ranking responses, the significant differences between the mean Likert scale responses or the mean ranking response for individual questions were tested by paired t-tests using R software^b. For the same paired survey questions with Likert responses, significant differences between the proportion of responses with Likert values greater than 3 (Likert scale converted to a binary response of agree/disagree) in the pre and post-course data were tested by McNemar's test using R software^b.

Statistical significance was designated a priori for all tests performed as p-values less than or equal to 0.05.

Qualitative analysis

Qualitative thematic analysis was performed on Question 3 (Q3) of both the pre-course and post-course survey. Question 3 asked respondents to respond to the statement “It is important to have an animal welfare and ethics course as part of the veterinary curriculum” using a Likert scale with a follow-up write-in response asking “Why or why not?” (Table 2). These write-in responses were transcribed into Numbers^a software for both the pre-course surveys and post-course surveys. Write-in responses paired by ID codes (n=30) were used to compare proportional changes in attitudes from pre-course and post-course. Summary statistics were also performed on the total write-in responses for the pre and post-course surveys (n=93 and n=79, respectively), with the acknowledgement that these responses would be treated as samples from distinctly separate populations of students. Thematic codes were created by a co-author based on preliminary review of all responses. Many different opinions were expressed in these written responses but there were common themes that became apparent when sorting through all the responses. The co-author created thematic categories based on these common themes as a means of organizing the written responses into groups that contained similar opinions and ideas that could then be statistically compared. Two graduate students, one being a co-author (ECSJ), coded the write-in responses to Q3 for both the completed pre-course surveys and post-course surveys. Biases were established verbally before coding to eliminate the tendency of either coder to code responses based on personal bias resulting from previous experience or knowledge. Both coders verbalized to one another any personal bias they were aware of that related to the research subject and the study participants in an in-person discussion before coding began. The average percent agreement between the two coders for all survey responses was 92.5%. This value was calculated by comparing the two codes assigned to each response (for the paired responses and

the the total pre and total post responses) one from each coder, and dividing the total responses (n=30, n=93, n=79) by the number of responses to which identical codes were assigned. The three percentages generated by these calculations were then averaged to give a final percent agreement value.

Results

The pre-course survey response rate was 90.3% (n=131). The post-course survey response rate was 86.2% (n=125). Only 61 pre- and post-course surveys were able to be paired (41.2% response rate) and used for statistical testing. Summary statistics for the unpaired pre- and post-course survey responses are provided in a selection of tables and generally indicate similar results to the paired responses.

Demographics

Of the 131 individuals who completed pre-course surveys, the majority of respondents (n=105; 80.2%) were between the ages of 20-29, 17.5% (n=23) of individuals were between 30-39 years old, and 2.3% (n=3) of individuals were over the age of 40 (Table 1). Eighty four percent (n=110) of respondents were female and 16.0% (n=21) of respondents were male. More than half (n=75; 57.3%) of respondents identified growing up in suburban communities while 22.9% (n=30) of respondents identified growing up in rural communities and 18.3% (n=24) identified growing up in urban communities. Regarding program track, 54.2% (n=71) of respondents had selected to track small animal medicine, 26.7% (n=35) had selected to track general medicine, and 19.1% (n=25) had selected to track large animal medicine. When asked about their future practice interests, with multiple selections allowed, 52.7% (n=69) of respondents expressed interest in companion animal practice, 26.0% (n=34) were interested in mixed practice, and 20.6% (n=27) were interested in research or academia. A smaller percentage

of respondents were interested in exotics or zoo medicine (n=17; 13.0%), equine (n=15; 11.5%), food animal (n=12; 9.2%), public health or policy (n=9; 6.9%), or wildlife (n=8; 6.1%). Practicing lab animal medicine was of least interest to respondents, of which only 2.3% (n=3) expressed interest.

Summary of Responses to Questions Containing Likert Scales or Ranking

Four questions containing either Likert scale responses or ranking responses were selected for analysis from both the pre-course and post-course surveys. These questions are described in Table 2. For the first question (Q3), which asked respondents to indicate their level of agreement with the inclusion of an animal welfare and ethics course in the veterinary curriculum, percentages of responses that contained a Likert value greater than 3, indicating agreement with the statement within the question, were calculated. For the paired response data (n=61), a significant increase in the percentage of respondents indicating they agreed with the inclusion of the course was seen in the post-course responses (p=0.009). Before completing the course, 54.1% (n=33) expressed agreement with the inclusion of a course while 75.4% (n=46) expressed agreement after completing the course (Table 3).

For Question 6, which asked respondents to indicate, using a Likert scale, their level of agreement with the statement “I feel confident that I know how to research an animal welfare topic, even one that I know very little about, in order to form an educated opinion that I can communicate to others”, a significant change in agreement was seen in the paired post-course survey data (p<0.001; Table 3); 60.7% (n=37) of respondents expressed agreement with the statement in Q6 before completing the course while 95.1% (n=58) expressed agreement after completing the course. No significant changes in agreement were seen between the paired pre-course and post-course data in Question 13 (p = 0.55), which presented respondents with the

statement “As an expert in a particular animal type, I am obligated to be an advocate for the welfare of all animals in my community.” The majority of pre- and post-course paired survey responses agreed with this statement (n=49; 80.3% and n=52; 85.2%, respectively).

Question 11 asked respondents to rank, in terms of influence, their responses to the question “How influential should the listed individuals be in making animal welfare decisions within a community?” Given that some respondents in each pool did not correctly rank the categories amongst the others, these responses were eliminated from this data set. For the pre-course respondents (n=110) and post-course respondents (n=114), and the paired respondent data (n=47), veterinarians were ranked as the most highly influential, with animal scientists ranked second most influential, animal industry members ranked third, the general public ranked fourth, animal rights activists or campaigners ranked fifth, and politicians were ranked as the least influential (Table 4). No significant differences in these rankings were seen between the paired pre-course and post-course data for other members of the community ($p \geq 0.11$).

Associations of Respondent Demographics to Pre-Course Likert Scale Response

Questions. Demographic data was collected only on the pre-course survey. Percentages of total respondents in demographic categories of gender, home community, and track that responded with Likert values greater than 3 (indicating agreement with the question’s statement) were calculated and the paired response data were tested for significant differences by the Fisher Exact method (Table 5). There were no significant differences between responses of different genders, home communities, or track selections to questions relating to the inclusion of the welfare course in the veterinary curriculum, respondent confidence in researching welfare issues, or respondent obligation to animal welfare advocacy ($p > 0.05$).

Qualitative Analysis

Five themes were used to code the write-in responses: knowledge and confidence, a sense of duty or responsibility, anger or resentment, seeking change, and undecided. A majority of write-in responses in both the total pre-(62.4%) and total post-course (64.5%) surveys reflected overall positivity towards the new course. Of the five themes used to code the write-in responses to the statement: “It is important to have an animal welfare and ethics course as part of the veterinary curriculum”, the theme that occurred in the greatest proportion of paired pre-course and post-course responses was a “Sense of Duty or Responsibility” (43.3% pre-course and 50.0% post-course; Table 5). This theme primarily included write-in responses that reflected a strong sense of moral and professional responsibility towards society as a whole (“Veterinarians are expected to have an opinion on animal welfare”; “Veterinarians pass on education to the public”; “Veterinarians are publically held accountable as stewards of animal welfare”). Responses discussed the necessity of integrity, intelligence, and honesty in a culture that places high value in transparency and dependability. For the paired pre-course responses, the theme of “Anger or Resentment” was the second most common with 40.0% (n=12) prevalence. This theme included write-in responses that reflected negative feelings towards the new course itself, with comments that reflected a general fear of the potential increase in workload (“waste of time.... [third-year students] have too much to learn already.”), disinterest in instruction on a topic they believed to be subjective (“[we can] figure this out on [their] own” and “we are becoming vets so we already care about welfare...I don’t need someone telling me how best to do that”), and a perceived redundancy in the curriculum (“[we] get welfare throughout”). The proportion of responses with the “Anger or Resentment” theme was reduced by half in the post-course paired responses (n=6; 20.0%). The proportion of paired responses with the theme of

“Knowledge and Confidence” did not change considerably from pre-course to post-course (n=5; 16.7% and n=6; 20.0%, respectively). This theme included responses that reflected an overall appreciation for the information that can be gained from the welfare course and responses that discussed the course material’s applicability to the veterinary profession. The least common themes for the pre-course responses were “Undecided” (n=2; 6.7%), a theme that included responses that indicated the respondent was “not sure how this class will go”, and “Seeking Change” (n=0; 0.0%). The theme of “Seeking Change” included responses in which the respondent made suggestions for how the course or the instruction on welfare could be changed (“An important topic but probably doesn’t need a full course”; “[This topic] should be input throughout the curriculum instead”). The theme of “Seeking Change” increased in the post-course paired responses to 16.2% (n=5).

Any differences, or changes, in theme proportions between the total pre-course and post-course response groups cannot accurately be discussed given that more than half of the post-course responses could not be matched with pre-course survey ID codes. However, similar proportions were seen in the total pre-course and post-course data as were seen in the paired response data for the themes of “Undecided”, “Sense of Duty or Responsibility”, and “Anger or Resentment” (Table 6).

Discussion and Conclusion

The intent of this survey was four-fold: (1) to examine the current opinions of third-year veterinary students, never before exposed to a professional degree animal welfare course, towards the implementation of such a required course; (2) to assess these veterinary students’ opinions towards their roles within a community in making animal welfare decisions; (3) to assess the confidences of these veterinary students in educating themselves about animal welfare

issues; 4) to assess the effect of this new course on changing students' knowledge of and opinions towards their roles as animal welfare advocates. Amidst the growing concern in the veterinary and academic communities regarding the lack of adherence to animal welfare standards and practices by veterinarians,^{1,12} it is important to assess what may be missing in veterinary education that could be causing veterinarians to either overlook or not fully understand welfare violations. Veterinarians are not only expected, but obligated to protect, improve, and advocate for animal welfare, regardless of their species specialty. A joint statement by the AVMA, the Federation of Veterinarians of Europe, and the Canadian Veterinary Medical Association states that veterinarians,

“as knowledgeable and accountable professionals—have an opportunity and an obligation to help animal owners, caretakers, handlers, and policy makers protect and improve animals’ welfare...veterinarians are, and must continually strive to be, the leading advocates for the good welfare of animals in a continually evolving society.”⁸

As society changes and relationships with animals change, veterinarians must remain the constant advocate for animal welfare over the course of animals’ lives and for the proper humane treatment at the end of animals’ lives.

This study’s gender representation is similar to that of the gender composition of veterinary schools nationwide. The 2017-2018 Internal Association of American Veterinary Medical Colleges (AAVMC) Annual Data Report cites that nationwide, approximately 19% of veterinary students are male and, according to the Internal Data Report, approximately 16% of Colorado State University veterinary students are male.²⁰ In terms of home community, the

2017-2018 Internal AAVMC report cites that, nationwide, approximately 55% of applicants identify their home communities as suburban, which is similar to the home community representation in this study.²⁰ Additionally, the demographics of this study were similar to that of other study populations that administered surveys focused on veterinary animal welfare knowledge and education.^{14,15}

To the authors' knowledge, there have not been any papers published with data reflecting the relationships of the demographic categories to respondent attitudes towards an animal welfare course. In past survey studies,^{13,16} male respondents rated lower than females in their empathy and general attitudes towards animals. In addition, another study found that veterinary students interested in working with small animals rated procedures such as banding castration and castration before one week of age as more inhumane than students interested in working with food animals.¹⁴ In the current study, there was no significant difference in opinion towards the inclusion of the welfare course between large, small, and general animal track respondents or different genders.

The results of this survey indicate that the course had a positive effect on respondents' opinions towards the inclusion of an animal welfare course in the veterinary curriculum. These results are similar to the post-course sentiments of students at other veterinary schools who agreed that an animal welfare course was "challenging and effective¹⁷" and should be a vital element of the veterinary curriculum.^{15,17} The material presented in the course at CSU may have been more intellectually and emotionally engaging than students had expected. Some respondents may have begun the course wanting to be convinced of its worth before deciding whether or not they agreed that such a course was necessary, and in the end, were adequately convinced.

Additionally, respondents were asked to provide reasons for their agreement or disagreement with the inclusion of an animal welfare course in the veterinary curriculum. A majority of write-in responses in both the total pre- (62.4%) and total post-course (64.5%) surveys reflected overall positivity towards the new course. Students expressed interest in, and passion for, the topic of animal welfare given their commitment to the professional oath and expectations of the veterinary profession, welfare advocacy in their communities, and their clients and patients. Several of the respondents wrote statements similar to “Veterinarians are publicly held accountable as stewards of animal welfare and we should be knowledgeable on the topic.” Through their written comments students conveyed the necessity of understanding animal welfare beyond animal health, and the importance of effectively communicating this knowledge to non-scientific members of their communities.

When considering the post-course percentage of students who agreed that a welfare course should be part of the veterinary curriculum, approximately a quarter of the student respondents did not believe a welfare course should be included in veterinary programs. The question did not specify that the welfare course would be required or elective, simply that a course centered on the topic would be part of the general curriculum. Yet, it is possible that students assumed this question referred to a required curricular element given that they themselves were enrolled in a required course.

Before respondents had taken the course, the proportion of paired write-in responses that reflected anger or resentment about the course was almost equal to the proportion of paired responses that reflected positive sentiments. Within this theme of anger and resentment were responses that discussed the existing heavy third-year course load and that the welfare course would be a “waste of time.... [third-year students] have too much to learn already.” Comments

such as these reflecting student fears of an increased workload and unmanageable stress create concerns for those constructing veterinary curricula nationwide.^{10,13,21} When introducing a new course into an already full, challenging, and fairly stable veterinary curriculum, finding space in which to fit this new course without sacrificing the time spent in other courses is a real challenge. In this case, students may have felt overwhelmed with the prospect of another course added as they approached their final year.

Another common response within the theme of anger and resentment was that respondents felt they could “figure this out on [their] own.” It may be a common response by members of the veterinary community to treat animal welfare as a basic concept that should be second nature to everyone. To be sure, animal welfare should be recognizable to everyone, in particular animal care professionals, yet there often exists a lack of appreciation for some basic welfare principles.^{1,12} In a survey completed in the UK in 2000, a proportion of male veterinary students were found to disagree with the notion that cattle and cats can feel pain while also exhibiting a significant decline in empathy towards animals as they progressed through veterinary school.¹³ In addition, fewer than 90% of veterinary students surveyed in 2005 believed in the cognitive abilities of farm animals whereas over 90% believed dogs and cats were cognitive beings.¹⁴ To have knowledge of animal welfare issues demands continuous education and awareness of contemporary issues, such as the recognition and treatment of animal pain, in addition to one’s own ideologies. The intent of the course was to provide basic knowledge of welfare issues for all students entering their final year of training and to encourage them to continue their education and consideration of animal welfare issues beyond graduation.

Another common survey response to the inclusion of the welfare course was that respondents “get welfare throughout” the veterinary curriculum. These survey responses indicate

that students unhappy with the inclusion of the new welfare course felt confident in their knowledge of animal welfare from exposure to the subject in previous semesters. While it is encouraging that other courses incorporate welfare training, this training was not comprehensive. Ideally, these individuals, upon completion of the course, acknowledged learning new information while having sharpened their existing skills. Additionally, a few respondents wrote sentiments similar to “we are becoming vets so we already care about welfare...I don’t need someone telling me how best to do that.” This statement makes an incorrect assumption that those interested in animal health and medicine are also proficient in recognizing and addressing poor welfare situations that may not immediately present a physically sick animal. The science of animal welfare includes more than just the assessment of physical aspects of an animal’s welfare (i.e. health) and includes non-physical components. When welfare is approached from a purely health perspective, there is a risk that poor welfare may be overlooked. Animal welfare science takes the idea of an animal’s well-being beyond humanity’s anthropomorphic ideals of what animal happiness and comfort look like and broadens the definition of welfare to a state of existence that is more than just the absence of suffering.^{22,23} Despite some of the negative comments, it is encouraging that the prevalence of the theme of “anger and resentment” was reduced by 50% post-course. This indicates that overall, students found the course to be more useful and important than they had previously stated.

The theme of “knowledge and confidence” was less prevalent than expected but the responses helped illustrate that some students felt their welfare education had been insufficient up until the introduction of this course. One respondent wrote “We have not been taught about animal welfare so far and I think it is something that should be part of our curriculum.” Although some students had indicated they receive welfare training throughout the curriculum this contrary

comment may indicate that not all students have the same perception of what adequate training should include and would like to see more specific inclusion of animal welfare topics. In addition, a few responses indicated that they were concerned with the lack of mutual understanding of the topic of animal welfare amongst their peers, writing that “animal welfare may not be obvious to everyone...it helps small animal people learn about large animal welfare” and vice versa. Some proponents of adding specific welfare courses to veterinary curricula have suggested that without a specific course in animal welfare, it is impossible to know that every veterinary graduate has a common understanding and respect for animal welfare issues.^{12,21}

Finally, the theme of “seeking change” was not seen in pre-course responses but was seen in post-course responses. Perhaps those that felt undecided about the inclusion of this course concluded that they supported the general principles presented but that the method of instruction or the placement within the third-year curriculum could be improved. The main sentiment reflected in responses identified with this theme was that the placement of this welfare course in the second semester of the third year was not ideal. Some respondents suggested the course should be included earlier in the veterinary curriculum, when some necessary foundations of veterinary medicine, like animal welfare, should begin to be established. These sentiments were considered and after internal curricular review it was decided to offer the CSU animal welfare in the first semester of the second year beginning in the 2018-2019 academic year.

The results of this study found a significant improvement in respondents’ abilities to research an animal welfare topic with which they were previously unfamiliar. A previous paper discussed a similar finding which highlighted the ability of limited exposure to animal welfare assessment to make an impact on veterinary students’ abilities to educate themselves.¹⁵ The course likely exposed students to welfare topics they had not explored before and possibly

peaked their interest, encouraging them to investigate topics further outside of class and expanding their research skills. By having the ability and confidence to find reliable and unbiased information on animal welfare issues, students are more likely to become veterinarians who will educate their clients and the public in efforts to provide accurate information, and reduce the spread of false information, relating to animal well-being.^{1,15,24}

Interestingly, the course did not have a significant effect on the commitment of veterinary students to advocate for the welfare of all animals in their communities. Both before and after the course, more than 80% of respondents agreed with the obligation, as veterinarians, to act as advocates for all animals' welfare. However, the remaining 15-20% of respondents did not agree with this obligation. It is possible that respondents may have been hesitant to agree with a statement regarding commitment to welfare advocacy that was as bold as to include "*all* animals in [the respondent's] community". This survey statement may have been written too boldly and may have benefited from eliminating the word "all". The intention of this question's statement was to emphasize the all-encompassing, unbiased, and nonspecific nature of a veterinarians obligation towards animal welfare. The AVMA states that "veterinarians are obligated morally, ethically, and philosophically to promote the welfare of animals"^{14,25} This statement does not suggest that veterinarians are only obligated to care for the welfare of some animals and disregard that of others. There is concern that veterinary students and practicing veterinarians do not fully understand or appreciate the extent of their roles as animal welfare advocates within their own communities.^{1,12,24} Given the acknowledgement by the authors of this paper that this question's wording may have been too bold and therefore caused unintended effects on the responses, conclusions must be made carefully. However, responses to this question do suggest that there exists a proportion of veterinary students, nearing graduation, that do not believe they

are obligated to advocate for all animal well-being. It was not possible with this study to delve deeper into what motivated these responses but would be interesting to include in future work.

When asked to rank members of society in terms of how influential they should be in animal welfare decisions within a community, all respondents ranked veterinarians as ideally having the most influence. Veterinarians hold a special role in society as animal experts with an obligation to both human and animal.^{1,12,24} Veterinarians have a “certified expertise” that comes from both their education and their professional mandate²⁴ and society expects them to wield this professional status to answer questions, find solutions, and prevent future problems between animals and humans (and at times, animals and animals). After completing the welfare course, respondent opinion towards the role of veterinarians in society did not change significantly. These findings are in contrast to another study which found that a lower percentage of course participants, after completing the course, ranked veterinarians and members of the AVMA as important in animal-welfare decision making, compared to non-course participants.¹⁵ Lord et al. (2010) suggested that, after completing the course, respondents realized the importance of the public and the constraints of science in influencing animal welfare decisions within the community and within animal industries. In the current study, respondent opinion towards the importance of the general public in influencing animal welfare decisions was not changed post-course. It is possible that the focus of this specific course was more encouraging of the veterinarian as a major influence within society as a means of encouraging the students to become engaged in the topic of animal welfare.

The introduction of an animal welfare course in the third-year veterinary curriculum at CSU demonstrated improvements in student understanding of the value of animal welfare science education and in their ability to conduct research and self-educate. Specific sentiments

regarding the introduction of an animal welfare course into the veterinary curriculum were highlighted in a qualitative analysis that exposed and quantified both positive and negative attitudes towards focused welfare education. The value students placed on the influential role of veterinarians with respect to animal welfare issues in their communities was held high.

Future research should be performed on a national scale investigating the potential gaps in veterinary education pertaining to animal welfare that may exist in order to further encourage the development of mandatory animal welfare science courses in veterinary curriculums nationwide. Research should also be conducted to better understand veterinary students' opinions of how their roles as animal welfare advocates could be better supported in their education and how this advocacy could be better executed within their communities.

TABLES

Table 2.1 Summary of survey respondent demographics collected from the pre-course survey (% of total respondents (n); N = 131¹).

Demographic	% of respondents (n) ¹	Demographic	% of respondents (n) ¹
Age		Gender	
20-24	26.0% (34)	Female	84.0% (110)
25-29	54.2% (71)	Male	16.0% (21)
30-34	16.0% (21)	Race/Ethnicity	
35-39	1.5% (2)	Caucasian	84.7% (111)
40-44	1.5% (2)	Asian	8.4% (11)
45-49	0.0% (0)	Not Defined	3.8% (5)
50+	0.8% (1)	Hispanic	3.0% (4)
Home Community		Haw/Pac.Islander	0.8% (1)
		Practice Interest	
Suburban	57.3% (75)	Companion Animal	52.7% (69)
Rural	22.9% (30)	Mixed	26.0% (34)
Urban	18.3% (24)	Research/Academia	20.6% (27)
Not Defined	1.5% (2)	Exotics/Zoo Med	13.0% (17)
Track		Equine	11.5% (15)
Small Animal	54.2% (71)	Food Animal	9.2% (12)
General	26.7% (35)	Public Health/Policy	6.9% (9)
Large Animal	19.1% (25)	Wildlife	6.1% (8)
		Lab Animal	2.3% (3)

¹ Total pre-course responses (n=131), ID code pairing was not considered in demographic summary

Table 2.2. Selected survey questions used for analysis focusing on veterinary student attitudes towards animal welfare education and advocacy.

Survey Question ID	Question	Response Type
Q3	It is important to have an animal welfare and ethics course aspart of the veterinary curriculum.	Likert scale (1 = strongly disagree; 5 = strongly agree) Place for written comments
Q6	I feel confident that I know how to research an animal welfare topic, even one that I know very little about, in order to form an educated opinion that I can communicate to others.	Likert scale (1 = strongly disagree; 5 = strongly agree)
Q11	How influential should the listed individuals be in making animal welfare decisions within a community? Animal rights organizations/campaigners Politicians Animal Scientists General Public Animal Industry Members Veterinarians	Ranking for each option (1 = highly influential; 5 = minimally or not at all influential)
Q13	As an expert in a particular animal type, I am obligated to be an advocate for the welfare of all animals in my community.	Likert scale (1 = strongly disagree; 5 = strongly agree)

Table 2.3. Total pre-course¹, total post-course², and paired³ (by matched ID codes) survey responses to questions containing Likert Scale responses

Survey Question	Overall Mean Likert* Response ($\pm$ SEM)					Proportion of Respondents with Likert values >3 (#)				
	Pre-Course (N=131)	Post-Course (N=125)	Paired N=61			Pre-Course (N=131)	Post-Course (N=125)	Paired (N=61)		
			Pre-Course	Post-Course	$p^{\dagger}$			Pre-Course	Post-Course	$p^{\ddagger}$
Q3 ⁴	3.48 (± 0.09)	3.91 (± 0.09)	3.46 (± 0.13)	3.90 (± 0.12)	0.001	51.9% (68)	76.0% (95)	54.1% (33)	75.4% (46)	0.009
Q6 ⁵	3.58 (± 0.09)	4.16 (± 0.07)	3.66 (± 0.12)	4.33 (± 0.07)	<0.001	59.5% (78)	92.0% (115)	60.7% (37)	95.1% (58)	<0.001
Q13 ⁶	4.02 (± 0.10)	4.06 (± 0.11)	3.92 (± 0.15)	4.26 (± 0.14)	0.041	82.4% (108)	82.4% (103)	80.3% (49)	85.2% (52)	0.55

1 Total pre-course responses (n=131) ignoring ID code pairing

2 Total post-course responses (n=125) ignoring ID code pairing

3 All pre and post-course responses that were able to be paired by ID codes written by respondents on both pre-course and post-course surveys (n=61)

4 It is important to have an animal welfare and ethics course as part of the veterinary curriculum.

5 I feel confident that I know how to research an animal welfare topic, even one that I know very little about, in order to form an educated opinion that I can communicate to others.

6 As an expert in a particular animal type, I am obligated to be an advocate for the welfare of all animals in my community.

* 1 = Strongly Disagree ; 5 = Strongly Agree

$\dagger$ Paired t-test

$\ddagger$ McNemar's Test

Table 2.4. Pre-course¹, post-course² and paired survey³ responses to the following question: Q11: How influential should the listed individuals be in making animal welfare decisions within a community?

Overall Mean Rank Value* (± SEM)														
<u>Veterinarians</u>					<u>Animal Scientists</u>					<u>Animal Industry Members</u>				
Pre-Course N=110	Post-Course N=114	Paired N=47			Pre-Course N=110	Post-Course N=114	Paired N=47			Pre-Course N=110	Post-Course N=114	Paired N=47		
		Pre-Course	Post-Course	p [†]			Pre-Course	Post-Course	p [†]			Pre-Course	Post-Course	p [†]
1.31 (±0.06)	1.45 (±0.07)	1.55 (±0.13)	1.28 (±0.08)	0.06	2.04 (±0.07)	1.99 (±0.09)	1.87 (±0.12)	2.02 (±0.12)	0.34	3.29 (±0.10)	3.06 (±0.09)	3.32 (±0.17)	3.17 (±0.12)	0.38
<u>General Public</u>					<u>Animal Rights Activists/Campaigners</u>					<u>Politicians</u>				
Pre-Course N=110	Post-Course N=114	Paired N=47			Pre-Course N=110	Post-Course N=114	Paired N=47			Pre-Course N=110	Post-Course N=114	Paired N=47		
		Pre-Course	Post-Course	p [†]			Pre-Course	Post-Course	p [†]			Pre-Course	Post-Course	p [†]
4.33 (±0.10)	4.37 (±0.10)	4.40 (±0.17)	4.29 (±0.16)	0.63	4.75 (±0.09)	4.75 (±0.09)	4.66 (±0.12)	4.74 (±0.14)	0.51	5.29 (±0.09)	5.38 (±0.07)	5.19 (±0.16)	5.49 (±0.09)	0.11

1 Total pre-course responses (n=131) ignoring ID code pairing

2 Total post-course responses (n=125) ignoring ID code pairing

3 All pre and post-course responses that were able to be paired by ID codes written by respondents on both pre-course and post-course surveys (n=61)

*1 = Highly Influential; 5 = Minimally or not at all influential

†Paired T-test

Table 2.5. Associations of respondent gender, home community, and track selection with pre-course survey responses¹ to questions containing Likert scale responses.

	Q3: It is important to have an animal welfare and ethics course as part of the veterinary curriculum.		Q6: I feel confident that I know how to research an animal welfare topic, even one that I know very little about, in order to form an educated opinion that I can communicate to others.		Q13: As an expert in a particular animal type, I am obligated to be an advocate for the welfare of all animals in my community.	
	Proportion of Respondents With Likert values > 3 (#)	<i>p</i> [*]	Proportion of Respondents With Likert values > 3 (#)	<i>p</i> [*]	Proportion of Respondents With Likert values > 3 (#)	<i>p</i> [*]
Gender						
Male (n=21)	57.1% (12)	0.64	47.6% (10)	0.27	81.0% (17)	0.76
Female (n=110)	50.9% (56)		61.8% (68)		82.7% (91)	
Home Community						
Rural (n=30)	46.7% (14)	0.54	66.7% (20)	0.4	70.0% (21)	0.06
Non-Rural (n=101)	53.5% (54)		57.4% (58)		86.1% (87)	
Track						
Small Animal (n=71)	49.3% (35)		62.0% (44)		80.3% (57)	
Large Animal (n=25)	48.0% (12)	0.53	68.0% (17)	0.27	76.0% (19)	0.21
General (n=35)	60.0% (21)		48.6% (17)		91.4% (32)	

¹ Total pre-course responses (n=131) ignoring ID code pairing

* Fisher Exact Test

Table 2.6. Qualitative thematic proportions of responses for write-in survey data

Theme	Example Response from Data	Average Proportion of Paired Responses Pre-Course* (#) (n=30)	Average Proportion of Paired Responses Post-Course* (#) (n=30)	Average Proportion of Total Pre-Course Responses* (#) (n=93)	Average Proportion of Total Post-Course Responses* (#) (n=79)
Sense of Duty or Responsibility	“Much of our oath necessitates the commitment to animal welfare and it is a part of our duty to study it.”	43.3% (13)	50.0% (15)	47.3% (44)	50.5% (47)
Anger or Resentment	“I don’t need someone telling me how best to help animals.”; “Adding to our course-load is not appreciated.”	40.0% (12)	20.0% (6)	34.4% (32)	15.1% (14)
Knowledge and Confidence	“Animal welfare and ethics may not be obvious to everyone.”; “It helps small animal people learn about large animal welfare and vice versa.”	16.7% (5)	20.0% (6)	15.1% (14)	14.0% (13)
Undecided	“Not sure what the value of the course will be.”; “We’ll see.”	6.7% (2)	0.0% (0)	5.4% (5)	0.0% (0)
Seeking Change	“This would be more beneficial earlier in curriculum or should be optional.”	0.0% (0)	16.7% (5)	6.5% (6)	9.7% (9)

*Averaged across both thematic scorers’ total proportions for paired response data

FOOTNOTES

a Apple Numbers, 2018, Apple Inc., Cupertino, CA

b R Software, version 1.1.383, R Core Team, Vienna, Austria

REFERENCES

1. Hewson CJ. Focus on animal welfare. *The Canadian Veterinary Journal* 2003;44:335-336.
2. Estol LR. Animal Welfare in the Veterinary Curriculum. *Global Conference on Animal Welfare: An OIE Initiative*. Paris: European Communities, 2004;33-45.
3. Broom DM. Animal welfare education: development and prospects. *Journal of Veterinary Medical Education* 2005;32:438-441.
4. WSAVA. World Small Animal Veterinary Association. 2018. International Veterinary Oaths. Available at: https://www.wsava.org/WSAVA/media/PDF_old/WSAVA-Veterinary-Oath.pdf. Accessed January 10, 2019.
5. Broom DM. Animal Welfare: An Aspect of Care, Sustainability, and Food Quality Required by the Public. *Journal of Veterinary Medical Education* 2010;37:83-88.
6. Thiermann A, Babcock S. Animal welfare and international trade. *Revue Scientifique Et Technique-Office International Des Epizooties* 2005;24:747.
7. AVMA/AAVMC. Animal Welfare in Veterinary Medical Education and Research. International Educational Symposium on Animal Welfare 2009.
8. AVMA. Joint AVMA-FVE-CVMA Statement on the Roles of Veterinarians in Ensuring Good Animal Welfare. 2018; <https://www.avma.org/KB/Policies/Pages/Joint-Statement-Animal-Welfare.aspx>. Accessed April 6 2018, 2018.
9. AVMA. Veterinarian's Oath. 2018; <https://www.avma.org/KB/Policies/Pages/veterinarians-oath.aspx>. Accessed April 6 2018.
10. Shivley CB, Garry FB, Kogan LR, et al. Survey of animal welfare, animal behavior, and animal ethics courses in the curricula of AVMA Council on Education-accredited veterinary colleges and schools. *Journal of the American Veterinary Medical Association* 2016;248:1165-1170.
11. AVMA (American Veterinary Medical Association). (2017). COE Accreditation Policies and Procedures: Requirements. Available at: <https://www.avma.org/ProfessionalDevelopment/Education/Accreditation/Colleges/Page/coe-pp-requirements-of-accredited-college.aspx>. Accessed June 6, 2018.
12. Main DC. Evolution of animal-welfare education for veterinary students. *Journal of Veterinary Medical Education* 2010;37:30-35.
13. Paul ES, Podberscek AL. Veterinary education and students' attitudes towards animal welfare. *The Veterinary record* 2000;146:269-272.
14. Levine ED, Mills DS, Houpt KA. Attitudes of Veterinary Students at One US College toward Factors Relating to Farm Animal Welfare. *Journal of Veterinary Medical Education* 2005;32:481-490.
15. Lord LK, Walker JB, Croney CC, et al. A comparison of veterinary students enrolled and not enrolled in an animal-welfare course. *Journal of veterinary medical education* 2010;37:40-48.
16. Hazel SJ, Signal TD, Taylor N. Can teaching veterinary and animal-science students about animal welfare affect their attitude toward animals and human-related empathy? *Journal of Veterinary Medical Education* 2011;38:74-83.
17. Abood SK, Siegford JM. Student Perceptions of an Animal-Welfare and Ethics Course Taught Early in the Veterinary Curriculum. *Journal of Veterinary Medical Education* 2012;39:136-141.

18. Verrinder JM, Phillips CJ. Assessing veterinary and animal science students' moral judgment development on animal ethics issues. *Journal of veterinary medical education* 2015;42:206-216.
19. Lord LK, Millman ST, Carbone L, et al. A model curriculum for the study of animal welfare in colleges and schools of veterinary medicine. *Journal of the American Veterinary Medical Association* 2017;250:632-640.
20. [https://www.aavmc.org/assets/site_18/files/data/2017-2018%20aavmc%20annual%20data%20report%20\(id%20100161\).pdf](https://www.aavmc.org/assets/site_18/files/data/2017-2018%20aavmc%20annual%20data%20report%20(id%20100161).pdf) . Accessed July 1, 2018. AAoAVMCADR-Aa.
21. Lord LK, Walker JB. An approach to teaching animal welfare issues at the Ohio State University. *Journal of veterinary medical education* 2009;36:276-279.
22. Rollin BE. Animal pain. *Advances in Animal Welfare Science* 1985: Springer, 1986;91-106.
23. Rollin BE. Animal Pain: What It is and Why It Matters. *The Journal of Ethics* 2011;15:425.
24. Carbone L. Expertise and advocacy in animal-welfare decision making: Considerations for a veterinary curriculum in animal welfare. *Journal of veterinary medical education* 2010;37:36-39.
25. AVMA (American Veterinary Medical Association. (2018). Animal Welfare Position Statements. Available at: <https://www.avma.org/KB/Resources/Reference/AnimalWelfare/Pages/Animal-Welfare-Policy-statements.aspx>. Accessed May 10, 2018.

CHAPTER III: SURVEY INVESTIGATING CURRENT ATTITUDES TOWARDS PAIN AND PAIN MITIGATION AND USE OF PAIN MITIGATION PRACTICES IN BEEF AND DAIRY CATTLE IN THE UNITED STATES BY VETERINARIANS AND PRODUCERS

Introduction

Decades of research have demonstrated the ability of animals to experience physical and psychological pain.¹⁻⁹ Different from animals, human reasoning and unique ability to be aware of pain's duration and expected cessation can provide a tempering effect to the pain's severity. Given animals' diminished capacities for reasoning and anticipation^{1,10-12}, it is likely that animals cannot understand the reasoning behind inflicted pain nor can they anticipate its end---an animal's experience of physical pain is potentially more severe than that of a higher functioning human.^{13,14} If this suffering is to be prevented by those who care for an animal, the veterinarian, owner, or caretaker, pain control is necessary during procedures or conditions known or expected to inflict pain.

In the dairy and beef cattle industries, recognizing and treating cattle pain is an important aspect of minimizing animal suffering, optimizing animal health and well-being¹⁵, and thereby maximizing production and profit.¹⁶⁻²⁰ Cattle regularly endure painful husbandry procedures and are susceptible to painful diseases such as castration^{4,21}, disbudding and dehorning²²⁻³², lameness^{33,34}, and mastitis.^{35,36} Changes in physiology and behavior indicative of pain have been observed following these procedures and conditions, such as immobility, abnormal posture^{21,29,30,37} and prominent physiological indicators^{3,8,28,32,37}, including changes in heart rate^{24,27} and blood cortisol.^{22,23} A multitude of research has revealed that pain-specific behaviors

and indicators for these various conditions and procedures are altered, if not eliminated, by analgesia.^{21,22,26,31,38}

Pain mitigation in cattle typically can be divided into two main categories: local anesthetics and systemic analgesics. Local anesthetic use via nerve blocks can be used to control pain during procedures such as dehorning^{26,28,37}, castration^{39,40}, and abdominal surgery. Local anesthetics significantly reduce pain behavior and physiological markers of pain in animals.^{2,37,41} However, after the local anesthetic has been eliminated from the site of the damaged tissue, pain indicators and behaviors reappear and resume.²³ The combination of a local anesthetic and a non-steroidal anti-inflammatory drug (NSAID) has been shown to reduce pain following painful procedures to the greatest degree in animals.^{25,26,28,40} However, in practice there exists a lack of use of systemic drugs to control preoperative and postoperative pain and painful conditions in cattle.⁴²

Veterinarians and producers alike face multiple challenges in implementing pain management in their practices and on their operations.^{39,43,44} Of primary concern to the progress of pain management in cattle is the lack of FDA approved drugs for use in cattle intended for food production. Currently, flunixin meglumine is the only NSAID approved in the United States for use in cattle and the topical formula is only approved for fever, foot rot, and endotoxemia.^{43,45} However, in the United Kingdom, a number of NSAIDs are approved for use.^{8,46} The lack of pain management drugs that are FDA-approved for use in cattle provides ranchers, farmers, and veterinarians with limited options, from both financial and practical perspectives, for treatment of pain in cattle. Despite these challenges, there has been progress in the past 20 years in the ability of veterinarians to recognize pain in animals and to be willing to use pain management

drugs for painful husbandry procedures.^{39,43,44,46,47} There is no published research available on the prevalence of use of pain management by cattle producers in the United States.

In the absence FDA-approved drugs to alleviate pain during and following painful procedures such as dehorning and castration or painful illnesses, understanding current pain management practices and issues facing members of the cattle industries in improving their pain management practices is necessary to guide future progress in food animal pain mitigation. The purpose of this study was to investigate cattle producers' and veterinarians' current uses of pain management and opinions towards issues relating to pain and pain management in the United States. This chapter will focus on a segment of the larger study with emphasis on differences between producer and veterinarian use of pain management for various procedures and conditions in beef and dairy cattle, how this use may have changed in the last ten years, and how producers and veterinarians think about pain management issues.

Materials and Methods

Survey development and implementation

Survey questions regarding veterinarian and producer opinions and use of pain mitigation during husbandry procedures and illnesses in beef and dairy cattle in the United States were developed by Colorado State University in partnership with Kansas State University. Informa Engage^a, the parent company of *BEEF* which owns and operates *BEEF* Magazine, aided in the facilitation of the survey. *BEEF* Magazine is a periodical source of information for the beef industry, publishing material relating to all aspects of beef cattle production, business management, and industry outlook. *BEEF* Magazine has subscribers nationwide participating in multiple segments of the beef industry with varying sizes of cattle operations and diverse production practices. The survey was constructed for electronic dissemination using Qualtrics

survey software ^b. The survey was pre-tested by 20 individuals from four outlets: Colorado Cattlemen's Association, Colorado Livestock Association, Colorado State University (CSU) College of Veterinary Medicine, and private-practice beef and dairy cattle veterinarians known to the co-author of this paper (ECSJ). This survey was submitted to the CSU Institutional Review Board and deemed exempt from full board review. Methodology, survey administration, and analysis were performed by CSU and Informa Engage Research, the research branch of Informa Engage ^a. Data was collected June 11 through August 10, 2018.

The population of interest was veterinarians in the United States who treat dairy and/or beef cattle and producers who raise dairy and/or beef cattle in the United States. On June 11, 2018, Informa Engage Research emailed invitations to participate in an online survey to a net 34,681 beef operations with any cattle in inventory contained in the *Farm Progress* master file; *Farm Progress* is Informa's agriculture media division. A follow-up email was sent to all non-respondents on June 18, 2018. The survey was also distributed electronically via email to the distribution lists managed by American Association of Bovine Practitioners (AABP), Academy of Veterinary Consultants (AVC) and the National Milk Producers Federation (NMPF). On June 8th, 2018, the initial survey invitation was sent to all members of AABP's listserv (N=3628) with follow-up email invitations sent to all members on June 15, 2018 and June 25th, 2018. On June 19th, 2018, invitations were sent to all members of AVC's listserv (N=901) and follow-up invitations were sent to all members on July 2, 2018 and July 9, 2018. On June 29th, 2018, invitations were sent to evaluators of the FARM program of NMPF (N=643) with follow-up invitations were sent to these members on July 9th, 2018 and July 25th, 2018. Additional invitations were sent to members of the Dairy Moms (N=1,797 members) and Dairy Girl

Network (N=4,927 members) Facebook groups on July 11, 2018. The survey closed on August 10, 2018 and Informa Engage Research had received 1,222 completed surveys by that date.

Survey questions

Survey questions were developed through adaptation of survey questions from a 2017 UK survey⁴⁶ exploring pain mitigation use in veterinarians. The survey included 46 questions and these questions used “branch logic” so, for example, if the respondent indicated he/she was a veterinarian, questions applicable to veterinarians were asked of that respondent. If a respondent indicated he/she were “other”, the respondent would be asked both producer and veterinarian-focused questions (Appendix B).

Demographic Questions

The first section of the survey consisted of demographic questions. All respondents were asked: the location of the operation or practice within the United States, gender, age, and role within the cattle industry (producer, veterinarian, or other), the type of operation owned or veterinary practice served, and the number of head of cattle on the operation. Multiple selections were allowed for the question regarding type of operation owned by the producer or served by the veterinary practice. Respondents who identified as producers were asked what relationship they had with the cattle operation (owner, manager, foreman, supervisor, etc) and were asked to indicate the highest degree or level of school they had completed. Producers were also asked how their operations were classified (conventional, USDA certified organic, naturally-raised, other) and if their cattle were part of a verified program (yes/no) with an option for a write-in response to indicate what specific program. Veterinarians were specifically asked when they graduated from veterinary school.

Pain Mitigation Questions

Questions that related to cattle age were asked for three age categories: calves less than two months of age, calves two to twelve months of age, and cattle more than 12 month of age. All respondents were asked whether or not they currently use pain management (local or systemic) for the three age categories of cattle. A response option indicating that they do not use pain management in any of their cattle was also available.

The survey included six Likert-scale questions regarding the frequency of local and systemic pain management use in the three age categories. Respondents were asked to indicate how likely (never, sometimes, about half the time, most of the time, always, would not perform this procedure) they were to use a local anesthetic for surgical castration, band castration, dehorning, and abdominal surgery in cattle of varying ages. Respondents were subsequently asked to indicate, on the same Likert scale, how likely they were to use a systemic pain relief drug for seven different procedures and conditions, including surgical castration, dehorning, lameness, and mastitis in calves less than two months of age, calves two-twelve months of age, and cattle more than 12 months of age. Respondents were not asked to indicate their use of local or systemic pain management for band castration of cattle more than 12 months of age given that this procedure is not commonly performed for this age of animal. In addition, all respondents were asked one question in which they selected from a list of eight analgesic drugs (e.g. lidocaine, oral meloxicam, flunixin injection, etc.) which drugs they had knowledge of or felt comfortable using in their operation or practice, with one write-in option for “other” and one option to select “none of these.” Multiple selections were allowed for this question.

All respondents were asked three questions regarding how painful (no pain, mild, moderate, severe, very severe, worst pain imaginable) they would consider different procedures

and conditions to be in the three age categories, with only one selection allowed. Respondents were asked about fifteen different procedures and conditions, including surgical castration, hot iron and paste dehorning, branding, and limb fractures, in calves less than two months of age, 13 different procedures and conditions in calves two to twelve months of age, and 16 different procedures and conditions in cattle more than 12 month of age.

All respondents were asked to rank on a 5-point Likert scale, how important various factors were in impacting their decision to use an analgesic drug in cattle more than 12 months of age and calves. Thirteen factors were listed, including FDA approval status, cost of the drug, request of producer or recommendation of veterinarian, and ease of administration. Respondents were also asked what they would consider an acceptable cost/head for a course of analgesia for various procedures and conditions in calves less than two months of age (9 procedures/conditions), two-twelve months of age (11 procedures/conditions), and cattle more than 12 months of age (11 procedures/conditions). Six categories of costs were available for selection, ranging from \$0 to \$30 or more.

Respondents were asked to select between three levels of agreement (agree, not sure, disagree) with regards to 10 statements relating to pain management, with only one response permitted. These statements were adapted from Remnant et al. (2017), which included statements “analgesics may mask the deterioration in the animal’s condition” and “Farmers would like cattle to receive analgesia but cost is a major issue.”

Respondents were also asked to indicate how their use of analgesia had changed in the last 10 years by selecting either “increased use, stayed the same, or decreased use”, which was a question asked by Remnant et al. (2017). Subsequently, respondents who indicated their use had increased, were asked to indicate the reasons for their increased use (multiple selections were

allowed). Some of the reasons listed included “new evidence of analgesic effectiveness”, “decreased prices for analgesics”, and “changing farmer or veterinarian attitudes.” Six reasons came from the Remnant et al. (2017) survey and 5 additional options were included by the authors of this paper. For those respondents that indicated that their analgesic use had decreased, these respondents were asked to indicate the reasons for their decreased use (multiple selections were allowed). Some of the reasons listed for decreased use included “currently available analgesic drugs are not effective at reducing pain”, “I do not know the meat and milk withhold periods for the analgesic drugs”, and “I am not comfortable using an analgesic unless it has been approved by the FDA.”

In a unique departure from previous surveys^{39,46,47}, both producers and veterinarians were asked how frequently disagreements regarding pain management affect the relationship between themselves and the veterinarian or producer with whom they maintain a veterinary-client-patient relationship and what actions they would take if a disagreement about the use or lack of use of pain management for cattle under their care arose between these two parties. Options for frequency of disagreements included daily, once weekly, few times monthly, several times a year, less than once a year, and never. For the question regarding what action they may take in such a disagreement, a five-point Likert scale was provided ranging from extremely unlikely to extremely likely and five action statements were listed, including “Terminate the VCPR/relationship”, “Do what the client/ veterinarian asks/suggests” and “Do what you want without the veterinarian knowing/charge the client accordingly”. One response was allowed for each of these questions.

Two questions were included asking if the respondent considers their current knowledge of recognizing and treating pain in cattle more than 12 months of age and calves to be adequate

(yes/no) and from where they felt they obtained most of their knowledge on these subjects. Some examples of sources of knowledge included FFA/4-H training, college classes, journals/articles, continuing education, and personal experience. One response was allowed for each of these questions.

The final questions of the survey pertained to specific local and systemic drug use in dehorning, castration, and branding of calves, lameness, mastitis, and calving in cattle more than 12 months of age. Some of the drugs available for selection included lidocaine, oral meloxicam, meloxicam injection, flunixin injection, and flunixin pour-on. Veterinarians were asked whether or not the type of illness or procedure affected the likelihood of using a specific analgesic drug in cattle they treated. If these factors did not impact the type of drug used, veterinarian respondents were asked to select on a five-point Likert scale how likely they were to consider using eight different analgesic drugs in cattle in general.

A selection of 9 questions from the survey that fit the specific goals of this chapter were analyzed further with statistical testing. These questions focused on the frequency of general use of pain management in cattle of three age categories, the frequency of use of local and systemic pain management in various painful conditions and procedures of cattle, the change in pain management use in the last ten years, and respondents' levels of agreement with various statements relating to pain management in cattle.

Statistical analysis

Surveys that were less than 80% complete were discarded and responses were not included in analyses. All other responses were compiled into a master spreadsheet in Microsoft Excel[®]. Additional surveys were discarded which were from respondents who identified as having roles in the cattle industry that did not involve working directly with and/or treating

cattle, such as seedstock salesmen, nutritionists, working in corporate positions, or working in academia. Data describing demographic information such as gender, age, role, location within the United States, and type of operation owned or affiliated with were summarized in frequency tables using R software^d. In order to consolidate the presentation of the data regarding respondent location within the United States, regions were defined using the National Geographic United States Regions tool⁴⁸. A selection of 12 questions from the survey were analyzed further with statistical testing, of which 9 are discussed that fit the specific goals of this paper. These questions focused on the frequency of general use of pain management in cattle of three age categories, the frequency of use of local and systemic pain management in various painful conditions and procedures of cattle, the change in pain management use in the last ten years, and respondents' levels of agreement with various statements relating to pain management in cattle. Descriptive statistics were calculated for selected questions using R software^d and SAS software^c and presented in frequency tables. Chi-square with Yates' continuity correction tests were performed using R software^d for a preliminary analysis of the relationship between gender of producer, veterinarian, or producer-veterinarian respondents and general use of pain management (local or systemic). Further regression analyses for this paper was generated using SAS software^e. Multivariate logistic regressions were performed to analyze the effect of demographic variables such as gender, role in the cattle industries, age, type of operation, and classification of operation on respondent use of general pain management in three age categories of cattle.

Multivariate regressions were performed on veterinarian-only use of pain management with gender, age, and year of graduation from veterinary school to analyze the impact of these factors. Age and year of graduation were not found to be significant variables in this regression.

Additionally, a multivariate regression model was also performed on only producer and producer-veterinarian use of pain management and its association with producer gender, age, type of operation the producer owned, and classification of that operation.

Ordinal logistic regressions were performed on questions involving Likert scale responses that investigated respondent use of local and systemic pain management for specific painful conditions and procedures in three different age categories of cattle. For these questions, additional frequency tables were generated that described the differences in the use of local and systemic pain management by the three roles of veterinarian, producer, and producer-veterinarian during castration and dehorning of cattle. This further analysis was of interest to the authors of this paper given the previous research that has focused specifically on pain management use during castration and dehorning.

Ordinal logistic regressions were also used to investigate the relationship between gender, role, and age of respondents on the change in respondent use of pain management in the last ten years. To perform these ordinal regressions, the sixth Likert response option of “Would not perform this procedure” was removed as the authors believed this did not fit with the response scale of increasing frequency of use. Statistical significance was designated *a priori* as a p-value of less than or equal to 0.05.

Results

Surveys were sent electronically to 46,577 individual members of six outlets of beef and dairy producers and veterinarians in the United States. The response rate was 3.8% (1,790 surveys). Of these surveys, 1,222 were at least 80% complete. Thirty-five additional surveys were discarded during initial analysis of the data based on the respondents' roles within the cattle industry that were deemed by the authors of this paper to be too far removed from treating and

caring for cattle. The final analyses included 1,187 surveys of producers, veterinarians, or respondents who occupied both roles within the dairy and beef cattle industries. Total responses to different questions varied as not all respondents answered all questions.

Of all survey respondents, 497 (41.9%) were producers, 569 (47.9%) were veterinarians and 121 (10.2%) were both veterinarians and producers (producer-veterinarians) (Table 2). A majority of all respondents in each category identified as male; 80.3% of producers were male, 63.4% of veterinarians were male, and 61.2% of producer-veterinarians identified as male. The majority of producers identified being in the age category of 51 to 70 years old (50.9%) while the smallest proportion of producers identified their ages as 21 to 30 (6.6%) and over 70 years old (11.5%). More veterinarian respondents belonged to younger age categories, with 44.9% of respondents indicating they were between 21 and 40 years old and 34.8% of veterinarians indicated they were between 41 and 60 years old. Those that identified as producer-veterinarians had a similar spread between age categories as veterinarian respondents, with 73.9% indicating they were below the age of 60 (Table 2).

All regions of the United States were represented in the survey by all three roles within the cattle industries. The greatest proportion of producers (42.1%), veterinarians (52.2%), and producer-veterinarians (51.2%) identified being located in the Midwest⁴⁸. The smallest proportion of producer and producer-veterinarian respondents were located in the northeast (9.1% and 5.0%, respectively) and the smallest proportion of veterinarian respondents were located in the southeast (10.9%) (Table 2).

The largest proportion of producers indicated they had completed a bachelor's degree (34.8%) while 19.9% indicated they had completed further higher education. Approximately 25% of producer-veterinarian respondents indicated they had completed a PhD in addition to

their professional degree (24.8%). More than half of veterinarians (52.8%) indicated they had graduated from veterinary school in 2001 or later whereas 46.2% of producer-veterinarian respondents graduated in these years (Table 2.).

The majority of producer and producer-veterinarian respondents owned cow-calf operations (66.4% and 77.7%, respectively; Table 3). About a quarter of both groups of respondents indicated owning dairies (28.0% and 22.3%, respectively). Calf ranches and “other” operations were the least represented in this survey. Many producer respondents indicated owning multiple types of operations. When asked about their role in these operations, the majority of producer and producer-veterinarian respondents indicated they were the owner of the operation (86.7% and 77.7%, respectively) (Table 3). Veterinarians and producer-veterinarians indicated that their practices served multiple types of operations, with a large majority of veterinarians practicing on dairies (74.3%) and cow-calf operations (82.1%) with the lowest proportion of veterinarians practicing on calf ranches (22.8%) (Table 3). Producer-veterinarians indicated primarily serving cow-calf operations (85.1%), stocker-backgrounder operations (62.8%), and dairies (49.6%) (Table 3).

Producers were asked how many head of cattle they had on their various operations (Table 3). The majority of producers and producer-veterinarians who owned cow-calf operations had 199 or less beef cows in their inventory (76.7% and 76.1%, respectively). The greatest proportion of producers and producer-veterinarians who owned cattle on feed owned less than 1,000 head (90.6% and 80.9%, respectively). Of those producers and producer-veterinarians who owned stocker/backgrounder operations, 78.8% and 75.0%, respectively, had less than 500 head of cattle. The majority of producers and producer-veterinarians that owned dairies owned less than 1,000 cows (69.6% and 59.2%, respectively) (Table 3).

Use of Pain Management by All Respondents

The percentage of total respondents using pain management, either local and systemic, numerically increased with age of cattle (Table 4). Of all respondents, 57.6% indicated they currently use pain management in calves less than two months of age, 69.5% indicated they use pain management in calves two to twelve months of age, and 71.6% indicated they use pain management in cattle older than twelve months of age.

The following results will be presented as a grouping of “always” and “most of the time” responses or “never”, dependent on what procedure or disease state is discussed. These data were grouped this way to facilitate comparisons between previous studies that asked similar questions but with broader frequency categories of pain management use.^{39,43,46} Frequencies of use for the full Likert scale are reported in Tables 5 and 6.

The majority of respondents indicated they always or most of the time use local pain management during abdominal surgery for all ages of cattle (69.3% for calves less than two months, 69.9% for calves two to twelve months, 77.7% for cattle more than 12 months of age) (Table 5). Approximately a quarter of respondents indicated they never use local pain management for dehorning calves less than two months of age (24.5%). The proportion of respondents who indicated never using pain management for dehorning decreased as cattle age increased (19.3% for calves two to twelve months, 14.3% for cattle more than 12 months old). During surgical castration, more than a third of respondents indicated they never use local pain management when castrating calves less than two months of age (44.0%) and calves two to twelve months of age (37.3%) and approximately 20% of respondents indicated they never use local pain management when castrating cattle more than 12 months old (20.8%) (Table 5).

The husbandry procedure that had the numerically greatest proportion of respondents who indicated never using local pain management was band castration. For both calves less than two months of age (59.5%) and calves two to twelve months of age (53.3%), over half of respondents indicated they never use local pain management for band castration (Table 5).

More than a quarter of respondents indicated they would not perform surgical castration on cattle older than 12 months (35.9%) and band castration on calves two to twelve months of age (25.4%) and just under a quarter of respondents indicated they would not perform dehorning on cattle older than 12 months (23.3%) (Table 5). A fifth of respondents indicated they would not band castrate calves less than two months of age (20.3%) and would not perform abdominal surgery in calves less than two months of age or between two and twelve months of age (19.2% and 20.2%, respectively). Less than 15% of respondents indicated they would not dehorn calves less than two months of age (11.2%) and calves two to twelve months of age (12.3%) and would not surgically castrate calves less than two months of age (14.8%) (Table 5).

Generally, respondents indicated lower frequency of use for systemic pain management than local pain management use for all procedures summarized (Table 6). More than half of all respondents indicated they always or most of the time used systemic pain management for abdominal surgery (55.3% for calves less than two months, 59.8% for calves two to twelve months, 61.73% for cattle more than 12 months of age). Almost half of respondents indicated always or most of the time using systemic pain management in all ages of cattle for bovine respiratory disease (47.3% for calves less than two months, 47.2% for calves two to twelve months, 48.3% for cattle more than 12 months of age) and lameness (48.9% for calves less than two months, 49.3% for calves two to twelve months, 48.6% for cattle more than 12 months of age). More than 35% of respondents indicated they never used systemic pain management for

branding in cattle of all ages (37.7% for calves less than 2 months of age, 37.0% for calves two to twelve months of age, 35.1% for cattle older than 12 months).

More than a quarter of respondents indicated always or most of the time using systemic pain management in dehorning calves less than two months of age (28.8%) (Table 6). More than a third of respondents indicated always or most of the time using systemic pain management in dehorning calves between two to twelve months of age (34.6%) and dehorning cattle more than 12 months of age (38.5%). Less than a fifth of respondents either always use or use systemic pain management most of the time for surgically castrating calves less than two months of age (18.6%) while approximately a quarter of respondents always use or use systemic pain management most of the time for surgically castrating calves two to twelve months of age (23.6%) and for surgical castration of cattle more than 12 months of age (27.4%).

Factors Associated with Use of Pain Management

Descriptive statistics were calculated for the relationship between role within the industry (producer, veterinarian, producer-veterinarian) and use of pain management. More than 80% of veterinarians indicated using pain management, either local or systemic, in cattle of all ages whereas less than 50% of producers indicated this use (Table 7). Of all producer respondents, 43.5% indicated they do not use pain management at all on their operation whereas 3.2% of veterinarians and 9.1% of producer-veterinarians indicated pain management was not used at all in their practice and/or operation.

More than 30% of veterinarians indicated always or most of the time using management during surgical castration in calves less than two months of age (32.5%) and calves two to twelve months of age (39.0%) and almost half of veterinarian respondents always or most of the time used local pain management in cattle more than 12 months of age (47.4%) (Table 8a). Less than

15% of producer respondents used local pain management always or most of the time for surgical castration in all ages of cattle (11.3% for calves less than two months of age, 13.1% for calves two to twelve months of age, 10.1% for cattle more than 12 months old). The frequency of use of local analgesics during surgical castration by producer-veterinarian respondents was between that of producers and veterinarians (14% in calves less than two months of age, 21.5% in cattle two to twelve months of age, and 31.4% in cattle more than 12 months old) (Table 8a).

Veterinarians had a numerically greater frequency of local pain management use in disbudding or dehorning compared to both producers and producer-veterinarians (Table 8a). More than 60% of veterinarians indicated they always used or used local pain management most of time when disbudding/dehorning calves less than two months of age (64.9%) and calves two to twelve months of age (72.0%) compared to 19.9% and 19.5% of producers for each age group, respectively. For dehorning cattle older than 12 months, more than three quarters of veterinarians indicated they always used or used local pain management most of time (77.6%) compared to 18.1% of producers for that age group. The frequency of use of local pain management during disbudding/dehorning cattle for producer-veterinarian respondents was between that of producers and veterinarians, with more than 50% of these respondents indicating they always used or used local pain management most of time when disbudding/dehorning calves less than two months of age (53.8%) and more than 60% of these respondents indicating this frequency of use for calves two to twelve months of age (60.4%) and for cattle older than 12 months (64.4%) (Table 8a).

More than a quarter of veterinarian respondents indicated they currently use systemic pain management always or most of the time when surgically castrating calves less than two months of age (28.8%) while more than a third of veterinarian respondents (34.6%) indicated this frequency of use when castrating calves two to twelve months of age and more than 40% of

veterinarians indicated this frequency of use when castrating cattle older than 12 months (42.2%) (Table 8b). Comparatively, 10% or less of producer respondents indicated they always or most of the time used systemic pain management when surgically castrating all ages of cattle (7.9% for calves less than two months of age, 10.1% for calves two to twelve months of age, 8.9% for cattle older than 12 months). Producer-veterinarian frequency of use of systemic pain management during castration of cattle was between that of producer and veterinarian respondents (14.1% for calves less than two months of age, 26.5% for calves two to twelve months, 33.1% for cattle older than 12 months) (Table 8b).

Almost 40% of veterinarian respondents currently use systemic pain management always or most of the time when disbudding calves less than two months of age (39.0%), almost half currently use systemic pain management always or most of the time when disbudding or dehorning calves two to twelve months of age (48.2%) and more than 50% use this frequency of systemic pain management when dehorning cattle older than 12 months (55.7%) (Table 8b). Less than 20% of producer respondents indicated they always or most of the time used systemic pain management when disbudding or dehorning cattle of all ages. Approximately 15% of producers indicated always or most of the time using systemic pain management when disbudding the youngest age of calves (15.4%), 16.4% indicated that frequency of use when disbudding or dehorning calves two to twelve months of age and 14.6% of producers indicated that frequency of use for dehorning cattle older than 12 months (Table 8b). Producer-veterinarian frequency of use of systemic pain management during disbudding/dehorning of cattle was between that of producer and veterinarian respondents (35.5% for calves less than two months of age, 44.6% for calves two to twelve months, 54.5% for cattle older than 12 months) (Table 8b).

Multivariate regressions were performed on all respondents' use of pain management with predictor variables of gender, role within the cattle industries, and respondent age (Table 9a). Consideration of "age" in the regressions in this study has been eliminated given the number of age categories included in the survey which were numerous and reduced the significance of the discussion of the impact of age on pain management use. For all ages of cattle, male respondents had significantly lower odds of using pain management on their operations or in their practices than females (OR [95% CI] = 0.37 [0.26-0.52] for calves less than two months of age, OR [95% CI] = 0.41 [0.27-0.61] for calves two to twelve months of age, OR [95% CI] = 0.48 [0.32-0.71] for cattle older than 12 months). In addition, for all ages of cattle, respondents who were veterinarians had significantly greater odds of using pain management than respondents who were producers (OR [95% CI] = 10.2 [7.2-14.4], OR [95% CI] = 14.2 [9.9-20.3], OR [95% CI] = 11.6 [8.1-16.6]). Respondents who were producer-veterinarians also had significantly greater odds of using pain management in all ages of cattle than respondents who were producers (OR [95% CI] = 3.3 [2.0-5.4], OR [95% CI] = 6.2 [3.7-10.4], OR [95% CI] = 5.4 [3.2-9.1]; Table 9a).

A multivariate regression model was also performed on only producer and producer-veterinarian use of pain management and its association with producer gender, age, type of operation the producer owned, and classification of that operation (Table 9b). Respondents were permitted to select multiple responses for the type of operations owned and overlap was seen in the data, therefore results need to be interpreted with caution. In addition, more than 85% of the operations represented in this survey were classified as "conventional" and results relating to operation classification need to be interpreted with caution (Table 9b). Across all ages of cattle, the odds of male producers and producer-veterinarians using pain management were

significantly lower than the odds of female producers and producer-veterinarians (OR [95% CI] = 0.45 [0.28-0.73] for calves less than two months, OR [95% CI] = 0.43 [0.27-0.69] for calves two to twelve months, OR [95% CI] = 0.44 [0.27-0.74]). The odds of producer-veterinarians using pain management (local or systemic) on their operations or in their practices were significantly greater than the odds of producers using pain management on their operations for cattle of all ages (OR [95% CI] = 4.77 [2.92-7.78] for calves less than two months, OR [95% CI] = 6.56 [3.81-11.3] for calves two to twelve months, OR [95% CI] = 7.56 [4.23-13.34]). With “dairy” as the reference variable for the multivariate regressions involving type of operation owned by the respondent, cow-calf operations had significantly lower odds of using pain management than dairies for calves less than two months of age and cattle older than 12 months (OR [95% CI] = 0.15 [0.09-0.26], OR [95% CI] = 0.18 [0.10-0.34]). Naturally raised operations had significantly lower odds of using pain management than conventional operations for all ages of cattle (OR [95% CI] = 0.38 [0.15-0.99], OR [95% CI] = 0.31 [0.15-0.67], OR [95% CI] = 0.38 [0.19-0.79]; Table 9b).

Ordinal logistic regressions were performed to analyze the effect of gender, role in the cattle industries, and age on respondent use of local anesthetic in calves and cattle older than 12 months during various husbandry procedures (Table 10). For all procedures over all ages of cattle, female respondents had greater odds of using more local pain management than male respondents (Table 10). Additionally, for all procedures over all ages of cattle, veterinarian respondents had greater odds of using more local pain management than producer respondents (Table 10). For surgical castration, male respondents had lower odds of using local pain management than female respondents for all ages of cattle (OR [95% CI] = 0.53 [0.40-0.71], OR [95% CI] = 0.58 [0.44-0.78], OR [95% CI] = 0.54 [0.39-0.75]). In addition, veterinarians had

greater odds of using more local pain management than producers during surgical castration in all ages of cattle (OR [95% CI] = 2.44 [1.82-3.23], OR [95% CI] = 2.94 [2.22-4.00], OR [95% CI] = 4.76 [3.33-6.67]). Producer-veterinarians also had greater odds of using more local pain management during surgical castration than producers for calves two to twelve months of age and cattle older than 12 months (OR [95% CI] = 2.00 [1.35-2.94], OR [95% CI] = 3.03 [1.85-4.76]). For dehorning of all ages of cattle, male respondents had lower odds of using local pain management than female respondents (OR [95% CI] = 0.52 [0.39-0.72], OR [95% CI] = 0.51 [0.39-0.67], OR [95% CI] = 0.46 [0.33-0.65]). In addition, veterinarian respondents had greater odds of using more local pain management during dehorning of all ages of cattle than producer respondents (OR [95% CI] = 5.88 [4.55-7.69], OR [95% CI] = 8.33 [6.25-11.11], OR [95% CI] = 10.00 [7.69-14.29]). Similarly, producer-veterinarian respondents also had greater odds of using more pain management than producer respondents for dehorning of cattle of all ages (OR [95% CI] = 3.70 [2.44-5.26], OR [95% CI] = 5.26 [3.57-7.14], OR [95% CI] = 7.69 [5.00-12.50]; Table 10).

Ordinal logistic regressions were also performed to analyze the relationships between gender, role, and age of all respondents on use of systemic pain management during various husbandry procedures and illness conditions (Table 11). For all procedures and conditions surveyed in calves less than two months of age, veterinarian respondents had greater odds of using more systemic pain management than producer respondents (Surgical castration: OR [95% CI] = 04.17 [3.03-5.56], Band Castration: OR [95% CI] = 3.45 [2.44-4.76], Dehorning: OR [95% CI] = 4.00 [3.03-5.26], Abdominal Surgery: OR [95% CI] = 1.89 [1.41-2.50], Branding: OR [95% CI] = 2.17 [1.41-3.45], BRD: OR [95% CI] = 2.33 [1.85-2.94], Lameness: OR [95% CI] = 3.23 [2.56-4.17]). In addition, male respondents had lower odds of using systemic pain

management than female respondents for all conditions and procedures in calves less than two months except branding (Surgical castration: OR [95% CI] = 0.56 [0.43-0.75], Band Castration: OR [95% CI] = 0.48 [0.35-0.65], Dehorning: OR [95% CI] = 0.53 [0.40-0.68], Abdominal Surgery: OR [95% CI] = 0.52 [0.39-0.71], BRD: OR [95% CI] = 0.49 [0.40-0.63], Lameness: OR [95% CI] = 0.67 [0.52-0.85]). Producer-veterinarian respondents had greater odds of using more systemic pain management than producer respondents for all conditions and procedures in calves less than two months except for band castration and branding (Surgical castration: OR [95% CI] = 2.22 [1.43-3.45], Dehorning: OR [95% CI] = 2.86 [1.89-5.26], Abdominal Surgery: OR [95% CI] = 2.00 [1.27-3.13], BRD: OR [95% CI] = 2.56 [1.75-3.70], Lameness: OR [95% CI] = 3.23 [2.56-4.17]).

For calves two to twelve months of age, male respondents had significantly lower odds of using systemic pain management than female respondents for all procedures and conditions except for branding (Surgical castration: OR [95% CI] = 0.55 [0.42-0.72], Band Castration: OR [95% CI] = 0.42 [0.31-0.58], Dehorning: OR [95% CI] = 0.63 [0.49-0.81], Abdominal Surgery: OR [95% CI] = 0.53 [0.39-0.72], BRD: OR [95% CI] = 0.49 [0.38-0.63], Lameness: OR [95% CI] = 0.65 [0.50-0.83]). In addition, veterinarians and producer-veterinarians had significantly greater odds of using more systemic pain management than producers for all procedures and conditions (Veterinarian--Surgical castration: OR [95% CI] = 4.35 [3.23-5.88], Band Castration: OR [95% CI] = 3.45 [2.50-4.76], Dehorning: OR [95% CI] = 5.00 [3.70-6.25], Abdominal Surgery: OR [95% CI] = 2.04 [1.52-2.70], Branding: OR [95% CI] = 2.22 [1.45-3.45], BRD: OR [95% CI] = 2.22 [1.75-2.86], Lameness: OR [95% CI] = 3.23 [2.50-4.17]; Producer-veterinarian--(Surgical castration: OR [95% CI] = 3.23 [2.17-4.76], Band Castration: OR [95% CI] = 1.89 [1.14-3.13], Dehorning: OR [95% CI] = 4.00 [2.70-5.88], Abdominal Surgery: OR

[95% CI] = 3.13 [1.92-5.00], Branding: OR [95% CI] = 2.17 [1.22-3.85], BRD: OR [95% CI] = 2.56 [1.79-3.70], Lameness: OR [95% CI] = 3.70 [2.56-5.56]) (Table 11).

For cattle older than 12 months, male respondents had significantly lower odds of using systemic pain management than female respondents for all procedures and conditions (Surgical castration: OR [95% CI] = 0.51 [0.36-0.70], Dehorning: OR [95% CI] = 0.56 [0.41-0.74], Abdominal Surgery: OR [95% CI] = 0.64 [0.48-0.85], Branding: OR [95% CI] = 0.56 [0.35-0.90], BRD: OR [95% CI] = 0.47 [0.36-0.60], Lameness: OR [95% CI] = 0.68 [0.53-0.88], Mastitis: OR [95% CI] = 0.56 [0.44-0.72]) (Table 11). Veterinarians had significantly greater odds of using more systemic pain management than producers for all procedures and conditions except for abdominal surgery in cattle older than 12 months (Surgical castration: OR [95% CI] = 6.25 [4.55-9.09], Dehorning: OR [95% CI] = 5.56 [4.17-7.69], Branding: OR [95% CI] = 1.72 [1.10-2.63], BRD: OR [95% CI] = 2.22 [1.75-2.78], Lameness: OR [95% CI] = 2.78 [2.17-3.57], Mastitis: OR [95% CI] = 3.45 [2.70-4.55]). Producer-veterinarians had significantly greater odds of using more systemic pain management than producers for all procedures and conditions in cattle older than 12 months (Surgical castration: OR [95% CI] = 6.25 [3.70-10.00], Dehorning: OR [95% CI] = 5.88 [3.70-9.09], Abdominal Surgery: OR [95% CI] = 1.64 [1.06-2.56], Branding: OR [95% CI] = 1.89 [1.04-3.45], BRD: OR [95% CI] = 2.38 [1.64-3.45], Lameness: OR [95% CI] = 3.85 [2.63-5.56], Mastitis: OR [95% CI] = 3.85 [2.70-5.56]) (Table 11).

Descriptive statistics were calculated for the change in respondent use in pain management in the last ten years on their operations or in their practices (Table 12). More than half of all respondents (57.5%) indicated their use of pain management had increased in the last ten years. More than a third of respondents (36.8%) indicated their use had remained the same while less than 5% of respondents (4.7%) indicated their use had decreased. When respondents

were divided by role, more than three quarters of veterinarian respondents indicated their use of pain management had increased in the last ten years (76.4%) whereas less than a third of producer respondents indicated their use had increased (31.6%) (Table 12). Change in producer-veterinarian use of pain management in the last ten years was similar to that of veterinarian respondents; 74.4% of producer-veterinarian respondents indicated their use had increased (Table 12). More than 50% of producer respondents indicated their use of pain management had stayed the same compared to approximately 20% of respondents in the other two roles (22.2% veterinarians, 21.5% producer-veterinarians). Ordinal logistic regressions were performed to analyze the relationships between gender, role, and age and the change in respondent use of pain management in the last ten years (Table 13). Male respondents had lower odds of increasing their use than female respondents (OR [95% CI] = 0.65 [0.48-0.89]) and both veterinarians and producer-veterinarians had greater odds of increasing their use than producer respondents (OR [95% CI] = 7.53 [5.65-10.03], OR [95% CI] = 6.49 [4.07-10.35]).

Agreement with Pain Management Statements

Descriptive statistics were calculated for 10 statements which asked respondents to indicate their level of agreement with each statement regarding issues with pain management in cattle. For almost all statements, more than a fifth of all respondents indicated they were unsure about their level of agreement with the statement given (Table 14). The greatest uncertainties were found with the statements “The benefits of analgesia outweighs the cost of the analgesia” (39.71%), “Cattle experiencing a fever are in pain” (37.0%), and “Most farmers are willing to pay the costs involved with giving analgesics to cattle” (35.1%). The largest proportion of respondents agreed with the statement “Cattle benefit from receiving analgesic drugs as part of their treatment.” (76.6%). More than 60% of all respondents also agreed with the statements

“US/USDA/FDA regulations limit my ability to use analgesic drugs in cattle” (64.0%) and “Cattle recover faster if given analgesic drugs” (62.6%). More than 50% of all respondents agreed with the statement “Farmers would like cattle to receive analgesia but cost is a major issue” (56.2%) (Table 14).

Frequencies of agreement with these statements were summarized by role as well (Table 14). More than 25% of producers indicated they were unsure of their level of agreement with each statement provided. Approximately half of producers were unsure if the benefits of analgesia outweigh the cost of the analgesia (48.7%) whereas a third of veterinarians were unsure of their agreement with this statement (33.7%). A third of producers were unsure of their agreement with the statement “cattle benefit from receiving analgesic drugs as part of their treatment” (32.9%) whereas 9% of veterinarians indicated they were unsure of their agreement. Almost all veterinarians agreed with this statement (89.8%) and approximately 60% of producers agreed.

Approximately three quarters of veterinarians agreed that cattle recover faster when given analgesic drugs (74.1%) and less than half of producers agreed with this statement (45.6%); more than 40% of producers indicated they were unsure if this statement was true (43.0%). Less than a quarter of both producers and veterinarians and producer-veterinarians indicated that drug side effects were a limitation to the usefulness of giving analgesics to cattle. More than 30% of veterinarians (31.0%) and 40% of producers were unsure of whether or not “most farmers are willing to pay the costs involved with giving analgesics to cattle” and similarly, more than a third of veterinarians (33.7%) and almost half of producers (48.7%) indicated they were unsure that “the benefits of the analgesia outweighs the costs of the analgesia” (Table 14). More than 60% of veterinarians agreed that “farmers would like cattle to receive analgesia but cost is a major issue”

however less than half of producers agreed with this statement (48.3%). The highest level of agreement with any statement was by all three roles was with the statement “U.S./USDA/FDA regulations limit my ability to use analgesic drugs in cattle” (Veterinarians: 89.8%; Producers: 58.6%; Producer-veterinarians: 87.6%). For all statements, producer-veterinarians had similar frequency of levels of agreement as veterinarian respondents (Table 14).

Discussion

Mitigating pain in cattle is necessary for optimal animal welfare^{49,50} and production outcomes.^{18,51,52} Current methods of pain management primarily involve combinations of local and systemic analgesic drugs that work to reduce the pain experienced by the animal through nerve blocks and anti-inflammatory mechanisms.^{7,21,22,29,30,37} However, there exists very options of analgesic and anesthetic drugs that are approved to treat pain in cattle in the United States^{21,39,43,53}. Federal regulations, concerns over milk and meat withdrawal times, and the apparent costs of both the drugs and labor associated with pain management are some of the obstacles and concerns that veterinarians and producers face when considering implementation of pain mitigation protocols.^{39,43} The United Kingdom and Canada have had greater success with federally approving and labeling drugs for pain management in cattle than the United States.^{43,44,46,54} There is a need for further research that demonstrates not only that analgesic options are necessary for cattle in the U.S. but that producers and veterinarians are interested in and willing to invest in more effective pain management options. Past survey-based research on attitudes towards cattle pain and pain management use has been focused on veterinarians in various countries^{36,39,43,46,47,55,56} but not on cattle producers, who are at the forefront of implementing pain mitigation on-farm.

The survey response rate of 3.8% was lower than previous studies that have surveyed veterinarians only,^{36,39,43,46} however, this response rate was similar to a previous survey of *BEEF* magazine members with a similar total target population size of over 40,000 individuals.⁵⁷ The electronic nature of the survey distribution may have contributed to the low survey response rate and added some sampling bias given that internet access and comfort with web-based surveys was required, biasing the response group towards the younger, more technological generations. Additionally, those responding to an emailed survey may come from a biased population of more progressive producers, individuals more interested in seeking out information, and early-responder individuals. Sampling bias may also have resulted from the possibility that individuals who responded to the survey may have had a greater interest in the subject matter of pain management which spurred them to invest the time in responding. Additionally, the length of the survey and time of year (June through August) may have contributed to the low response rate.

The majority of producers and veterinarians identified as male, which is similar to previous studies.^{39,43,58,59} Gender of the respondent was found to be a significant predictor of the odds of pain management use by veterinarians and producers in almost all procedures and conditions in this study. Previous research has identified some associations between the male gender and concern for animal welfare and animal pain^{43,47,60-62}. Survey-based studies have found that gender of the veterinarian plays a role in respondent attitudes towards animal pain and its severity.^{43,46,47} Previous studies have primarily focused on veterinarians but one study noted that female producers were more ready to medicate calves for pain than male producers.⁶³ It is difficult to speculate the psychological or sociological reasons for these different attitudes between men and women. Additionally, some caution must be used when interpreting the results of this survey in relation to gender given the biased representation towards males.

The greatest proportion of respondents in this survey were from the Midwest and worked primarily on or with smaller to mid-size operations, which is similar to previous surveys of veterinarians^{39,43} and producers⁵⁷ in the United States.

Veterinarians and producers were nearly evenly represented in this study, which differs from the few surveys of both veterinarians and producers on pain management performed previously, none of which were conducted in the United States.^{58,59} The general use of pain management by respondents increased with cattle age, which is similar to the findings in other studies of veterinarian use of pain management in the United States and Canada.^{36,39,43} A recent study in Canada⁶⁴ also found that producers used less pain management with younger cattle. There may be a perception held by both producers and veterinarians that younger animals have a diminished capacity to feel pain compared to older animals. While young animals may have a more limited capacity to develop emotional responses to pain, they have a lower tolerance for acute pain and feel pain caused by dehorning and castration intensely.⁶⁵

This is one of the first studies to be able to compare the overall use of pain management between veterinarians and producers. Previous studies have been performed in other countries to compare veterinarian and producer use of local anesthetic during cattle disbudding and dehorning.^{58,59,63} These studies found producer use of local pain mitigation to be lower than veterinarian use.^{58,59,63} In a survey performed in Ontario, CA in 2004 of dairy producers and veterinarians, 22% of producers who dehorn their own calves used local anesthetics whereas 92% of veterinarians used this type of pain mitigation.⁵⁹ A similar study performed more recently in 2014 in Ontario, CA found that 97% of veterinarians reported using local anesthetic when dehorning or disbudding dairy calves compared to 62% of producers.⁵⁸

It must be noted that a range of respondents in the current study indicated they “would not perform [that] procedure” for each question regarding local and systemic pain management for certain procedures and conditions. Due to the way the questions were asked in this survey, the reason why individuals selected this response is unknown; this selection may or may not be related to how these respondents feel about pain in animals, the painfulness of the procedure, or the need for pain management for that procedure. Future studies are encouraged to investigate this issue further perhaps with a clarification question associated with the selection of “would not perform.” Additionally, those respondents that selected the response option of “would not perform [that] procedure” were included in the summary calculations of pain management (local or systemic) use by role within the cattle industries. Due to this inclusion, the proportion of respondents that are discussed in this paper who selected they “always or most of the time” use pain management (local or systemic) may be slightly deflated compared to what the values would be if this response option was removed from frequency calculations. Selection of this response option of “would not perform [that] procedure” may likely be related to both the type of operation and the age of cattle with which the producer or veterinarian are involved.

The proportions of veterinarians who administered analgesia during dehorning or disbudding of calves and cattle older than 12 months in this study were similar to those of a previously published study in the US.⁴³ Fajt et al. (2011) found that 74% and 69.5% of veterinarians in the US administered analgesic drugs to more than 50% of beef and dairy calves more than six months of age, respectively, while 68.1% and 62.5% of veterinarians administered analgesic drugs to more than 50% of beef and dairy calves less than six months of age, respectively. When compared with the present study data, which found that 72% of veterinarians always or most of the time use local pain management when dehorning both beef and dairy

calves two to twelve months of age, this comparison suggests that use of local pain mitigation during dehorning or disbudding has not substantially increased in over a decade. It must be noted that as of 2017, Dean Foods' Dairy-Well Audit⁶⁶ requires the use of local anesthetic during disbudding or dehorning of cattle and recommends that disbudding occur by eight weeks of age. It is anticipated that with the creation of audits such as Dairy-Well, there will be an increase in pain mitigation use for disbudding on dairies in future years as supply chain and industry requirements and expectations change. As discussed, there is a lack of research exploring pain mitigation use in producer populations, which limits comparisons that can be made between the findings of this study and previous research.

Two survey studies performed in the last fifteen years in the United Kingdom demonstrated very high frequencies of local anesthetic use by veterinarians during disbudding and dehorning of cattle.^{46,47} Stricter regulations exist in the UK for pain management use during painful procedures which do impact the results demonstrated by these studies when compared to studies performed in the United States.⁶⁷ Under these regulations, castration of calves older than eight weeks of age must be performed with the use of anesthetic and band castration is only permitted when applied in the first week of life. Additionally, dehorning of cattle of any age must be accompanied by the use of anesthetic, except when chemical paste is used.⁶⁷ In studies conducted in the U.K. in 2006⁴⁷ and 2017⁴⁶, 98.7% and 95% of veterinarian respondents used local anesthetic when disbudding or dehorning beef and dairy calves. The proportion of veterinarian respondents regularly employing pain management in the present study fall well below those frequencies (64.9% for calves less than two months old, 72.0% for calves two to twelve months old).

Use of local anesthetic when castrating cattle has historically been less common than use of local blocks for dehorning.^{36,43,46,47} Administering a local block during castration of calves has its challenges, particularly on beef operations that may have less intensive husbandry than dairy operations. The administration of local blocks for castration may seem daunting to some producers when considering the time involved for effectively blocking the testicular region and for the anesthetic to take effect when castrating a large group of calves. However, when considering the definite benefits to calf comfort^{21,32,40} and the improved public perception of castration when pain is controlled, the small amount of extra time may be worthwhile. A fifteen-year old Canadian study³⁶ found that more than 80% of veterinarians did not use analgesia when castrating calves less than six months old and up to 60% of respondents did not use analgesia when castrating calves more than six months old. In a 2010 study of castration methods and pain mitigation used by veterinarians in the US,³⁹ 22% of veterinarians routinely used local anesthetic when castrating calves. The current study shows that a higher proportion of veterinarians currently use local anesthetic at least most of the time when castrating calves up to twelve months of age (32.5% for calves less than two months, 39.0% for calves two to twelve months). These results indicate that veterinarian use of local pain management when castrating calves has increased in the past fifteen years although there is still room for improvement. Reasons for this change may include an increased emphasis on pain management in veterinarian continuing education, progressiveness in veterinary school programs, or industry pressure to improve the public perception of castration practices that pushes both producers and veterinarians to make changes to on-farm protocols.

When compared to veterinarian usage, the proportion of producers who use local anesthetic during castration in all ages of cattle was less than half that of veterinarians in even

the youngest ages of calves. Research has indicated that when producers use local anesthetic for pain management, there is a positive correlation between this use and a more cooperative producer-veterinarian relationship when making pain management decisions about painful procedure protocols, such as those pertaining to castration and dehorning.⁵⁹ Not only do the producers require a valid veterinary-client-patient relationship to use local anesthetic drugs⁶⁸, but perhaps producers who are willing to implement pain mitigation in their operations are more interested in a collaborative relationship with their veterinarian where progress towards further pain management strategies and overall improved animal welfare can be made.

The use of systemic pain management, primarily NSAIDs, by veterinarians and producers has not been extensively studied in the U.S. Options for NSAID products in the US are limited compared to both the UK and Canada^{43,53}. Only one drug in the U.S., flunixin meglamine pour-on, is labeled to treat chronic pain associated with endotoxemia and footrot^{43,53}; use of any NSAID or local anesthesia (such as lidocaine) to treat pain associated with husbandry procedures in cattle must be used extra-label under the supervision of a veterinarian in accordance with the Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA)⁶⁹. In the UK and Canada, meloxicam, a longer lasting NSAID^{29,53,70,71} than flunixin meglamine, is also approved for use in cattle.^{53,72} Meloxicam administered to cattle prior to painful procedures has been shown to improve behavior and physiological pain indicators, as reviewed by Adcock and Tucker (2017),⁷³ however it must be used extra-label in cattle in the United States⁶⁸.

In the study by Huxley and Whay (2006), less than 5% of veterinary practitioners indicated systemic pain management was used when castrating or dehorning cattle.⁴⁷ A more recent survey study from 2017 in the UK indicated this use had increased to approximately 30% by veterinarians.⁴⁶ A study by Coetzee et al. (2010) in the US indicated that 21% of veterinary

practitioners were currently using systemic pain management when castrating calves. The current study found that approximately the same proportion of veterinarians indicated they “always” use systemic pain management for castrating calves less than twelve months of age compared to the Coetzee et al. (2010) study. However, in the current study, an additional 10-15% of veterinarian respondents indicated they use systemic pain management “most of the time” when castrating calves less than twelve months old, which may indicate that systemic pain management use in castration of calves may in fact be more common than it was nearly 10 years ago. Veterinarian use of systemic pain management was greater for disbudding or dehorning than for castration in this study. More than 25% of veterinarian respondents indicated they currently always use systemic pain management when disbudding calves less than two months old and more than 40% indicated they always use NSAIDs when dehorning calves between two and twelve months of age. However, given the information available on the pain experienced by calves after these procedures^{74,75} and the commitment of the veterinary profession to managing animal pain, both acute and chronic⁷⁶, these proportions are disappointingly low and improvements must be made.

In the present study, for almost all procedures and conditions, veterinary respondents had greater odds of using systemic pain management more frequently than producer respondents. Similar differences were found by Winder et al. (2016), who found that 48% of veterinarians reported using NSAID drugs when dehorning or disbudding cattle while 24% of producers reported using NSAIDs during these procedures. For surgical castration and dehorning, the proportion of producers in this study who reported using systemic pain management at least most of the time was consistently below 20%. As already mentioned, the availability of NSAIDs approved for use in cattle is limited and there are no NSAIDs approved for use in cattle for dehorning and castration procedures^{39,43}. These restrictions limit the access many producers have

to effective pain management. The absence of analgesia specifically labeled for use in cattle also creates concern over milk and meat withdrawal times. The burden of stress associated with milk and meat residue avoidance creates a real roadblock to many producers who may want to improve their pain mitigation practices.

The most recent study of veterinarian uses of pain management identified that 2/3 of respondents had increased their use of pain management in the last ten years.⁴⁶ Winder et al. (2016) identified promising improvements in pain management use by both veterinarians and producers, with 72% of veterinarians and 63% of producers indicating their use of pain management during disbudding or dehorning practices had changed in the last decade.⁵⁸ A large proportion of producers in this survey indicated their use of pain management had stayed the same in the last ten years. Multiple factors may be influencing the self-reported lack of progress in producer pain management practices compared to veterinarian practices. The lack of approved products, lack of education and awareness of new ideas, reasonable fears over drug residues, and frustrations with the costs, both of the drugs themselves and of labor, versus efficacies of existing drugs are all issues that producers may face when making decisions about pain management for their animals. When faced with these issues that make pain mitigation seem unaffordable and risky, producers may likely decline analgesia unless they are convinced of its practicality and worth. Making concerted efforts to impress upon producers the benefits and affordability of pain mitigation and to convince producers of the important role they play in demanding more analgesic options is the crucial role of veterinarians and heads of industry that dictate and disseminate policies and procedures.

It is interesting to note that the producer-veterinarians indicated pain management use and agreement with pain statements that was between that of producer and veterinarian

respondents for all conditions and procedures. These data point to the probable influence of veterinary education in affecting an individual's use of pain management and how that individual thinks about pain management issues. Creating education opportunities for producers that deliver information and encourage improvements in pain mitigation can be implemented outside the veterinary school curriculum. Basic knowledge of the physiology and psychology of pain in animals should not be reserved for those that seek a medical degree; this information should be communicated to the individuals who have daily control over changes in their operation and ultimately are the primary individuals who can make improvements in the well-being of their animals.

There may be a misconception that producers are unwilling or uninterested in pain management for their animals, lack the initiative to want change, and only make changes when they feel external pressures. It was a goal of this study to illuminate the opinions and practices of producers regarding pain management that have been lacking in research literature. This study sought to demonstrate some potential similarities between producers and veterinarians in how these groups of individuals think about and relate to pain management in order to find some common ground for progress.

Responses to agreement statements collected in this study indicate that overall, both producers and veterinarians believe in the benefits of pain management and are interested in its application in their operations. Previous research that has measured producer agreement with pain statements with which to make comparisons has not been performed. Veterinarian agreement with some of these statements was similar to the agreement found to similar statements in previous studies in the US and UK.^{43,46} When asked to give their level of agreement with the statement "Cattle recover faster if given analgesic drugs," approximately

three quarters of veterinarians agreed with this statement, which indicates similar agreement as the mean Likert value (7.4 out of 10) found in response to similar questions in the study by Fajt et al. (2011). Additionally, the majority of veterinarians in both the study by Fajt et al. (2011) and the present study did not agree that drug side effects limited or outweighed the benefits of analgesic drugs. In response to the statement “Analgesics may mask deterioration in the animal’s condition,” 21% of UK veterinarians surveyed⁴⁶ agreed with this statement which is similar to the proportion of veterinarians in this current study. Additionally, approximately 50% of UK veterinarians in 2017⁴⁶ and 40% of US veterinarians in this present study agreed that “farmers are happy to pay the costs associated with giving analgesics to cattle,” and less than 20% of veterinarians in both studies agreed that “some pain is necessary to stop the animal from becoming too active.” These responses indicate that overall, veterinarians believe in the benefits of analgesia, reject the suggestion that pain may somehow be advantageous to an animal and reject the notion that analgesia may be more harmful than beneficial. These responses also indicate that veterinarians experience resistance to analgesic drug use by producers due to concerns over costs, including the cost of labor to administer the drugs and of the drugs themselves.

As noted before, regulations differ with regards to pain management between the US and UK and comparisons must be made cautiously. These differences can be seen most starkly when comparing the 29% of UK veterinarians who agreed that “EU legislation limits my ability to use analgesic drugs in cattle” (UK)⁴⁶ and the 89.8% of US veterinarians who agreed that “U.S/USDA/FDA regulations limit my ability to use analgesic drugs in cattle.” Clearly, government regulations play a large role in limiting veterinarian use of analgesics in the US compared to the UK. Additionally, fewer veterinarians in the UK⁴⁶ agreed that cost impacted

their use of analgesics than in the US. This may indicate that either drug pricing and labor wages are true impediments to analgesic use in this country or that there is a misconception that the costs, both of the drugs and of hired labor, are unmanageable. Finally, 99% of UK veterinarians agreed that “cattle benefit from receiving analgesic drugs as part of their treatment” which is 10% more than the present study and 96% of UK veterinarians⁴⁶ agreed that “cattle recover faster if given analgesic drugs” which is 22% more than the present study. While these proportions in both studies are encouraging, this data reveals that UK veterinarians may agree with the usefulness of pain management more than veterinarians in the US. It is possible that given the ability of veterinarians in the UK to more easily use analgesic drugs when faced with less regulations and less concerns over the costs of drugs and labor, these veterinarians have been able to see the benefits of pain mitigation more frequently than veterinarians in the US and have thus been more convinced of its worth.

The majority of both producers and veterinarians in this present study agreed that pain in cattle should be managed and that, overall, analgesia is beneficial. These data indicate that veterinarians and producers who care for cattle in the US share a real interest in mitigating pain in cattle and that they believe in pain management. However, the majority of both groups of individuals also agreed that governmental regulations limit their ability to use pain mitigation. Potential differences between how producers and veterinarians think about pain management issues can be seen in responses to the statements: “cattle recover faster if given analgesic drugs” and “the benefits of the analgesia outweigh the cost of the analgesia.” The majority of veterinarians agreed with these statements, however, the minority of producers expressed agreement. Federal regulations may limit access to effective analgesic drugs yet that access is inconsequential if producers are not convinced of the rate of efficacy of those drugs or that those

drugs may be too expensive. Producers may question why they should push for more approved products when they may already have unaddressed concerns over cost, applicability, and efficacy of existing pain mitigation. Loss of trust in both the veterinarian recommending pain management and in the pharmaceutical industries selling a minimal selection of poorly effective products are both consequences of the lack of choice of cattle analgesics in this country.

Results from this survey indicate that both producers and veterinarians share a lot of uncertainty about pain management issues. For many of the agreement statements, many respondents from all three groups indicated they were “not sure” whether they agreed or disagreed with the statements. For example, a large proportion of producers were unsure if drug side effects limited analgesia’s usefulness or if their fellow farmers were even willing to pay the costs associated with analgesia. This lack of clarity demonstrated by respondents indicates that more work has yet to be done to improve how producers and veterinarians think about cattle pain and its management. Often, change to a common practice begins with increased awareness of an issue and its complexities. Continuing education is an important source of new information and standards regarding pain management practices for all members of the cattle industry. Collaboration between heads of industry, pharmaceutical companies, veterinarians, and producers representing their communities’ needs and priorities is necessary to produce and put into practice effective and affordable analgesia options. Communication between the veterinarian and producer of these new methods, strategies to transition to better practices, and ways to overcome challenges is key to implementing better pain management on-farm. Producers and veterinarians must be given the tools to have confidence in how they agree or disagree with statements regarding pain management. By having confidence in these convictions, they can effectively share information and encourage pain mitigation within their own communities,

thereby spreading change that will improve not only the well-being of cattle but also the public perception of the cattle industries' commitments to animal welfare.

Conclusion

Improvements in producer and veterinarian use of pain management is driven by internal and external pressures. Through popular press, community discussion, or continuing education, these individuals may read or hear of the necessity, affordability, and applicability of pain management. Internal pressure to improve pain mitigation protocols on-farm will come from educated and forward-thinking producers who wish to see their operations be respected, profitable, and inspirational through responsible husbandry practices. As public demand for improved animal welfare standards puts external pressure on those that dictate policy for the cattle industries, producers are asked to make improvements to on-farm pain mitigation protocols. Veterinarians are obligated to develop trusting, cooperative, and collaborative relationships with cattle producers within which these improvements can be made and future changes to optimize cattle well-being can be introduced.

The data from this study provides references for how both U.S. producers and veterinarians currently use pain mitigation in cattle and the perceived issues they face when seeking to implement pain management methods. The results from this study can inform how the beef and dairy industries approach the creation and implementation of new pain mitigation policies, drugs, and education of industry members that seek to improve the welfare and productivity of cattle experiencing pain.

TABLES

Table 3.1a. Survey questions regarding use of pain management

In my operation or practice, I currently use pain management (local anesthetic (lidocaine), systemic analgesia (e.g., Aspirin/ Banamine®) with: (Select all that apply.)		Calves < 2 mo.				Calves 2-12 mo.				Cattle > 12 mo.			
How likely are you to use a local anesthetic (lidocaine) for the following conditions?	Surgical Castration	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Band Castration	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Dehoming	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Abdominal Surgery†	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Surgical Castration	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Band Castration	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Dehoming	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Abdominal Surgery†	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	How likely are you to use a systemic pain relief drug (analgesic) for the following conditions	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Abdominal Surgery	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
How has your use of analgesics changed in the last 10 years?	Branding	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	BRD	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Lameness	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not	Nev er	Som etim es	Abo ut half	Mos t of the	Alw ays	Wou ld not
	Mastitis												
	How has your use of analgesics changed in the last 10 years?	Increased Use				Stayed the Same				Decreased Use			

* Respondents not asked about band castration for cattle > 12 mo. of age
†incl. umbilical abscess, DA, and Cesarean

Table 3.1b. Survey Questions Regarding Pain Management Statements

Analgesics may mask deterioration in the animal's condition	Agree	Not Sure	Disagree
Cattle benefit from receiving analgesic drugs as part of their treatment	Agree	Not Sure	Disagree
Cattle that are experiencing a fever are in pain	Agree	Not Sure	Disagree
Some pain is necessary to stop the animal becoming too active	Agree	Not Sure	Disagree
Cattle recover faster if given analgesic drugs	Agree	Not Sure	Disagree
Drug side effects limit the usefulness of giving analgesics to cattle	Agree	Not Sure	Disagree
Most farmers are willing to pay the costs involved with giving analgesics to cattle.	Agree	Not Sure	Disagree
The benefits of the analgesia outweighs the cost of the analgesia	Agree	Not Sure	Disagree
Farmers would like cattle to receive analgesia but cost is a major issue	Agree	Not Sure	Disagree
U.S/USDA/FDA regulations limit my ability to use analgesic drugs in cattle	Agree	Not Sure	Disagree

Table 3.2. Demographics details of respondents (N=1,187)

Respondent Category	Gender			Age						
	Male	Female	No response	21 to 30	31 to 40	41 to 50	51 to 60	61 to 70	Over 70 years old	No response
Producer (n=497)	80.3% (n=399)	19.5% (n=97)	0.2% (n=1)	6.6% (n=33)	16.3% (n=81)	14.1% (n=70)	26.6% (n=132)	24.3% (n=121)	11.5% (n=57)	0.6% (n=3)
Veterinarian (n=569)	63.4% (n=361)	36.2% (n=206)	0.3% (n=2)	17.8% (n=101)	27.1% (n=154)	16.9% (n=96)	17.9% (n=102)	17.2% (n=98)	3.0% (n=17)	0.8% (n=1)
Producer and Veterinarian (n=121)	61.2% (n=74)	38.3% (n=47)	0% (n=0)	14.4% (n=17)	24.8% (n=30)	18.2% (n=22)	16.5% (n=20)	19.0% (n=23)	7.4% (n=9)	0% (n=0)
	Location of Operation or Practice By Region*									
	West	Southwest	Midwest	Southwest	Northeast	No Response				
Producer (n=497)	17.3% (n=86)	14.3% (n=71)	42.1% (n=209)	16.9% (n=84)	9.1% (n=45)	0.4% (n=2)				
Veterinarian (n=569)	14.8% (n=84)	17.4% (n=42)	52.2% (n=297)	10.9% (n=62)	14.6% (n=83)	0.8% (n=1)				
Producer and Veterinarian (n=121)	9.9% (n=12)	14.9% (n=18)	51.2% (n=62)	19.0% (n=23)	5.0% (n=6)	0% (n=0)				
	Highest Degree or Level of School Completed									
	Did not complete high school	High School	Some college	Trade school	Associate Deg.	Bachelor's Deg.	Master's Degree	Prof. Deg.	PhD	No Response
Producer (n=497)	2.2% (n=11)	13.3% (n=66)	14.7% (n=73)	7.8% (n=39)	11.1% (n=55)	34.8% (n=173)	14.1% (n=50)	3.0% (n=15)	2.8% (n=14)	0.2% (n=1)
Producer and Veterinarian (n=121)	0% (n=0)	0% (n=0)	0% (n=0)	0% (n=0)	0% (n=0)	0.8% (n=1)	0.8% (n=1)	71.1% (n=86)	24.8% (n=30)	2.5% (n=3)
	Year of Graduation from Veterinary school									
	Prior to 1970	1970-1980	1981-1990	1991-2000	2001-2010	2011-2018	No response			
Veterinarian (n=569)	1.1% (n=6)	12.7% (n=72)	17.4% (n=99)	15.5% (n=88)	21.3% (n=121)	31.5% (n=179)	0.7% (n=4)			
Producer and Veterinarian (n=121)	3.3% (n=4)	18.2% (n=22)	14.0% (n=17)	15.7% (n=19)	19.8% (n=24)	26.4% (n=32)	2.5% (n=3)			

Table 3.3. Details of operation or practice of respondent (N=1,187)

	Respondent's Role in Operation								Type of Production Operation*							
	Owner	Manager	Supervisor	Herdsmen	Farm Hand	Milker	Other	No Response	Dairy	Calf Ranch	Feedlot	Stocker/Backgrounder	Cow-Calf	Other		
Producer (n=497)	86.7% (n=431)	7.0% (n=35)	0.6% (n=3)	3.0% (n=15)	0.6% (n=3)	0.2% (n=1)	1.6% (n=8)	0.2% (n=1)	28.0% (n=139)	4.8% (n=24)	14.1% (n=70)	17.5% (n=87)	66.4% (n=330)	3.8% (n=19)		
Producer and Veterinarian (n=121)	77.7% (n=94)	7.4% (n=9)	1.7% (n=2)	0% (n=0)	2.5% (n=3)	0% (n=0)	8.3% (n=10)	2.5% (n=3)	22.3% (n=27)	7.4% (n=9)	18.2% (n=22)	26.4% (n=32)	77.7% (n=94)	3.3% (n=4)		
Types of Cattle Operations Veterinary Practice Serves*																
	Dairy	Calf Ranch	Feedlot	Stocker/Backgrounder	Cow-calf	Other										
Veterinarian (n=569)	74.3% (n=423)	22.8% (n=130)	39.4% (n=224)	44.6% (n=254)	82.1% (n=467)	4.6% (n=26)										
Producer and Veterinarian (n=121)	49.6% (n=60)	19.0% (n=23)	46.3% (n=56)	62.8% (n=76)	85.1% (n=103)	5.0% (n=6)										
	Heads of Cattle in Operation															
	Beef Cows					Cattle On Feed				Stockers/Backgrounders						
	Less than 50	50-199	200-499	500-999	1,000+	Less than 1,000	1,000-4,999	5,000-9,999	30,000-49,999	Less than 500	500-999	1,000-1,999	2,000-4,999			
Producer (n=497)	22.1% (n=110)	28.2% (n=140)	10.9% (n=54)	3.4% (n=17)	4.1% (n=5)	11.7% (n=58)	0.8% (n=4)	0.2% (n=1)	0.2% (n=1)	12.7% (n=63)	2.6% (n=13)	0.4% (n=2)	0.4% (n=2)			
Producer and Veterinarian (n=121)	24.8% (n=30)	33.1% (n=40)	10.7% (n=13)	6.6% (n=8)	0.8% (n=1)	14.0% (n=17)	3.3% (n=4)	0% (n=0)	0% (n=0)	17.4% (n=21)	1.7% (n=2)	1.7% (n=2)	2.5% (n=3)			
	Dairy Calves					Dairy Cows										
	Less than 5,000		5,000 to 9,999		20,000 or more	Less than 50	50-99	100-199	200-499	500-999	1,000-1,999	2,000-4,999	5,000-9,999	10,000+		
Producer (n=497)	2.6% (n=13)		0% (n=0)		0.2% (n=1)	1.4% (n=7)	3.8% (n=19)	3.8% (n=19)	6.0% (n=30)	5.2% (n=26)	4.2% (n=21)	1.0% (n=5)	1.2% (n=6)	1.0% (n=5)		
Producer and Veterinarian (n=121)	3.3% (n=4)		1.7% (n=2)		0% (n=0)	4.1% (n=5)	2.5% (n=3)	2.5% (n=3)	2.5% (n=5)	0% (n=0)	3.3% (n=4)	0% (n=0)	3.3% (n=4)	2.5% (n=3)		
	Classification of Production Operation								Involved in a Verified Program (Certified Humane, Source and Age Verified, etc.)							
	Conventional		USDA Certified Organic		Naturally-raised		Other		No Response		Yes		No		No response	
Producer (n=497)	88.3% (n=439)		0.2% (n=1)		10.3% (n=51)		1.0% (n=5)		0.2% (n=1)		12.3% (n=61)		87.7% (n=436)		0% (n=0)	
Producer and Veterinarian (n=121)	86.8% (n=105)		1.7% (n=2)		5.0% (n=6)		4.1% (n=5)		2.5% (n=3)		14.9% (n=18)		82.6% (n=100)		2.5% (n=3)	

Table 3.4. Use of pain management in operations and practices by all respondents

	Calves <2 mo	Calves 2-12 mo.	Cattle > 12 mo.	No Response
	% total (n)	% total (n)	% total (n)	% total (n)
Currently Uses Pain Management	57.58% (n=680)	69.52% (n=821)	71.55% (n=845)	0.08% (n=2)
Currently Does Not Use Pain Management	42.42% (n=501)	30.48% (n=360)	28.45% (n=336)	

Table 3.5. Use of local pain management during various husbandry procedures in dairy and beef calves and cattle > 12 mo. by all respondents (n=1,181)

		Surgical Castration	Band Castration	Dehorning	Abdominal Surgery†
		% total (n)	% total (n)	% total (n)	% total (n)
Calves <2 mo	No response*	1.52% (n=18)	1.95% (n=23)	1.35% (n=16)	1.69% (n=20)
	Never Use	44.03% (n=520)	59.53% (n=703)	24.47% (n=289)	4.49% (n=53)
	Sometimes Use	15.50% (n=183)	8.21% (n=97)	14.99% (n=177)	4.40% (n=52)
	Use About Half the Time	2.37% (n=28)	1.27% (n=15)	3.05% (n=36)	0.93% (n=11)
	Use Most of the Time	6.52% (n=77)	3.90% (n=46)	10.75% (n=127)	5.93% (n=70)
	Always Use	15.24% (n=180)	4.83% (n=57)	34.21% (n=404)	63.34% (n=748)
	Would not perform this procedure*	14.82% (n=175)	20.32% (n=240)	11.18% (n=132)	19.22% (n=227)
Calves 2-12 mo.	No response*	1.61% (n=19)	1.86% (n=22)	1.61% (n=19)	1.44% (n=17)
	Never Use	37.34% (n=441)	53.34% (n=630)	19.31% (n=228)	3.98% (n=47)
	Sometimes Use	16.85% (n=199)	8.72% (n=103)	14.99% (n=177)	3.56% (n=42)
	Use About Half the Time	2.71% (n=32)	1.19% (n=103)	2.96% (n=35)	0.85% (n=10)
	Use Most of the Time	7.87% (n=93)	3.81% (n=45)	11.43% (n=135)	4.49% (n=53)
	Always Use	18.54% (n=219)	5.67% (n=67)	37.43% (n=442)	65.45% (n=773)
	Would not perform this procedure*	15.07% (n=178)	25.40% (n=300)	12.28% (n=145)	20.24% (n=239)
Cattle > 12 mo.	No response*	1.52% (n=18)	*	1.02% (n=12)	1.19% (n=14)
	Never Use	20.75% (n=245)	*	14.31% (n=169)	3.05% (n=36)
	Sometimes Use	9.91% (n=117)	*	8.30% (n=98)	1.95% (n=23)
	Use About Half the Time	1.69% (n=20)	*	1.69% (n=20)	0.68% (n=8)
	Use Most of the Time	5.50% (n=65)	*	7.45% (n=88)	3.56% (n=42)
	Always Use	24.72% (n=292)	*	43.95% (n=519)	74.17% (n=876)
	Would not perform this procedure*	35.90% (n=424)	*	23.29% (n=275)	15.41% (n=182)

*Respondents not asked about band castration for cattle > 12 mo. of age

†incl. umbilical abscess, DA, and Cesarean

Table 3.6. Use of systemic pain management during various procedures and conditions in dairy and beef calves and cattle > 12 mo. by all respondents (n=1,181)

		Surgical Castration	Band Castration	Dehorning	Abdominal Surgery†	Branding	BRD	Lameness	Mastitis
		% total (n)	% total (n)	% total (n)	% total (n)	% total (n)	% total (n)	% total (n)	% total (n)
Calves <2 mo	No response*	1.02% (n=12)	1.44% (n=17)	1.86% (n=22)	1.95% (n=23)	2.62% (n=31)	1.52% (n=18)	1.52% (n=18)	
	Never Use	42.59% (n=503)	51.31% (n=606)	32.85% (n=388)	7.28% (n=86)	37.68% (n=445)	14.65% (n=173)	10.33% (n=122)	
	Sometimes Use	18.97% (n=224)	12.96% (n=153)	19.73% (n=233)	11.09% (n=131)	5.33% (n=63)	21.17% (n=250)	23.54% (n=278)	
	Use About Half the Time	3.13% (n=37)	1.61% (n=19)	4.83% (n=57)	2.96% (n=35)	0.51% (n=6)	10.75% (n=127)	9.82% (n=116)	
	Use Most of the Time	6.69% (n=79)	5.17% (n=61)	8.55% (n=101)	11.01% (n=130)	1.19% (n=14)	26.67% (n=315)	27.27% (n=322)	
	Always Use	11.85% (n=140)	5.67% (n=67)	20.24% (n=239)	44.28% (n=523)	2.46% (n=29)	20.58% (n=243)	21.59% (n=255)	
	Would not perform this procedure*	15.75% (n=186)	21.85% (n=258)	11.94% (n=141)	21.42% (n=253)	50.21% (n=593)	4.66% (n=55)	5.93% (n=70)	
Calves 2- 12 mo.	No response*	1.44% (n=17)	1.69% (n=20)	1.95% (n=23)	2.20% (n=26)	2.54% (n=30)	1.95% (n=23)	1.86% (n=22)	
	Never Use	32.68% (n=386)	44.62% (n=527)	24.56% (n=290)	5.67% (n=67)	37.0% (n=437)	13.12% (n=155)	10.41% (n=123)	
	Sometimes Use	22.44% (n=265)	13.89% (n=164)	20.15% (n=238)	9.48% (n=112)	5.50% (n=65)	21.85% (n=258)	22.44% (n=265)	
	Use About Half the Time	4.15% (n=49)	2.62% (n=31)	5.93% (n=70)	2.96% (n=35)	0.93% (n=11)	11.18% (n=132)	11.35% (n=134)	
	Use Most of the Time	8.98% (n=106)	5.25% (n=62)	11.26% (n=133)	10.33% (n=122)	1.52% (n=18)	27.10% (n=320)	25.74% (n=304)	
	Always Use	14.56% (n=172)	6.10% (n=72)	23.29% (n=275)	49.45% (n=584)	2.03% (n=24)	20.07% (n=237)	23.54% (n=278)	
	Would not perform this procedure*	15.75% (n=186)	25.83% (n=305)	12.87% (n=152)	19.90% (n=235)	50.47% (n=596)	4.74% (n=56)	4.66% (n=55)	
Cattle > 12 mo.	No response*	1.44% (n=17)	*	1.52% (n=18)	1.52% (n=18)	2.62% (n=31)	1.61% (n=19)	1.44% (n=17)	2.20 % (n=26)
	Never Use	17.61% (n=208)	*	17.53% (n=207)	5.17% (n=61)	35.06% (n=414)	14.06% (n=166)	9.48% (n=112)	13.12% (n=155)
	Sometimes Use	11.09% (n=131)	*	13.38% (n=158)	12.36% (n=146)	4.74% (n=56)	20.41% (n=241)	23.96% (n=283)	28.96% (n=342)
	Use About Half the Time	2.46% (n=29)	*	3.22% (n=38)	4.15% (n=49)	0.93% (n=11)	10.67% (n=126)	12.28% (n=145)	11.26% (n=133)
	Use Most of the Time	8.30% (n=98)	*	9.99% (n=118)	10.84% (n=128)	1.27% (n=15)	27.52% (n=325)	26.76% (n=316)	22.10% (n=261)
	Always Use	19.05% (n=225)	*	28.45% (n=336)	50.89% (n=601)	2.37% (n=28)	20.75% (n=245)	21.85% (n=258)	13.12% (n=155)
	Would not perform this procedure*	40.04% (n=473)	*	25.91% (n=306)	15.07% (n=178)	53.01% (n=626)	5.00% (n=59)	4.23% (n=50)	9.23% (n=109)

*Respondents not asked about band castration for cattle > 12 mo. of age

†incl. umbilical abscess, DA, and Cesarean

Table 3.7. Use of pain management in operations or practices by role (N=1,181)

Role of Respondent	Calves < 2 months	Calves 2-12 months	Cattle > 12 months	Don't use pain management
Producers	29.4%	40.6%	45.3%	43.5%
Veterinarians	81.2%	91.7%	91.9%	3.2%
Both a veterinarian and a producer	62.0%	82.6%	83.5%	9.10%

Table 3.8a. Use of local pain management during castration* and dehorning* of cattle by role (n=1,181)

Role	Frequency of Use	Surgical Castration			Disbudding/Dehorning		
		Calves < 2mo.	Calves 2-12 mo.	Cattle > 12 mo.	Calves < 2mo.	Calves 2-12 mo.	Cattle > 12 mo.
Veterinarian (n=567)	No response	0.35% (n=2)	0.53% (n=3)	0.71% (n=4)	0.18% (n=1)	0.18% (n=1)	0.18% (n=1)
	Never Use	43.74% (n=248)	35.10% (n=199)	17.64% (n=100)	11.64% (n=66)	6.70% (n=38)	5.47% (n=31)
	Sometimes Use	18.87% (n=107)	21.16% (n=120)	12.87% (n=73)	18.17% (n=103)	16.05% (n=91)	8.29% (n=47)
	Use About Half the Time	3.35% (n=19)	3.17% (n=18)	2.47% (n=14)	4.41% (n=25)	4.23% (n=24)	2.65% (n=15)
	Use Most of the Time	10.41% (n=59)	11.99% (n=68)	8.64% (n=49)	14.46% (n=82)	15.87% (n=90)	9.52% (n=54)
	Always Use	22.05% (n=125)	26.98% (n=153)	38.80% (n=220)	50.44% (n=286)	56.08% (n=318)	68.08% (n=386)
	Would Not Perform This Procedure	1.23% (n=7)	1.06% (n=6)	18.87% (n=107)	0.71% (n=4)	0.88% (n=5)	5.82% (n=33)
Producer (n=493)	No response	3.25% (n=16)	3.25% (n=16)	2.64% (n=13)	3.04% (n=15)	3.65% (n=18)	2.23% (n=11)
	Never Use	41.78% (n=206)	40.37% (n=199)	24.95% (n=123)	39.96% (n=197)	35.70% (n=176)	27.18% (n=134)
	Sometimes Use	9.13% (n=45)	7.91% (n=39)	5.07% (n=25)	10.55% (n=52)	12.98% (n=64)	7.71% (n=38)
	Use About Half the Time	1.22% (n=6)	1.42% (n=7)	0.61% (n=3)	1.83% (n=9)	1.01% (n=5)	0.61% (n=3)
	Use Most of the Time	2.84% (n=14)	2.84% (n=14)	1.42% (n=7)	4.87% (n=24)	4.67% (n=23)	3.65% (n=18)
	Always Use	8.52% (n=42)	10.34% (n=51)	8.72% (n=43)	15.01% (n=74)	14.81% (n=73)	14.40% (n=71)
	Would Not Perform This Procedure	33.27% (n=164)	33.87% (n=167)	56.59% (n=279)	24.75% (n=122)	27.18% (n=134)	44.22% (n=218)
Both (n=121)	No response	0.00% (n=0)	0.00% (n=0)	0.83% (n=1)	0.00% (n=0)	0.00% (n=0)	0.00% (n=0)
	Never Use	54.55% (n=66)	35.54% (n=43)	18.18% (n=22)	21.49% (n=26)	11.57% (n=14)	3.31% (n=4)
	Sometimes Use	25.62% (n=31)	33.06% (n=40)	15.70% (n=19)	18.18% (n=22)	18.18% (n=22)	10.74% (n=13)
	Use About Half the Time	2.48% (n=3)	5.79% (n=7)	2.48% (n=3)	1.65% (n=2)	4.96% (n=6)	1.65% (n=2)
	Use Most of the Time	3.31% (n=4)	9.09% (n=11)	7.44% (n=9)	17.36% (n=21)	18.18% (n=22)	13.22% (n=16)
	Always Use	10.74% (n=13)	12.40% (n=15)	23.97% (n=29)	36.36% (n=44)	42.15% (n=51)	51.24% (n=62)
	Would Not Perform This Procedure	3.31% (n=4)	4.13% (n=5)	31.40% (n=38)	4.96% (n=6)	4.96% (n=6)	19.83% (n=24)

*Selected for further analysis in order to make further comparisons with previous research^{36,39,43,58,59}

Table 3.8b. Use of systemic pain management during castration* and dehorning* of cattle by role in cattle industries (n=1,181)

Role	Frequency of Use	Surgical Castration			Disbudding/Dehorning		
		Calves < 2mo.	Calves 2-12 mo.	Cattle > 12 mo.	Calves < 2mo.	Calves 2-12 mo.	Cattle > 12 mo.
Veterinarian (n=567)	No response	0.00% (n=0)	0.53% (n=3)	0.53% (n=3)	0.18% (n=1)	0.53% (n=3)	0.53% (n=3)
	Never Use	38.10% (n=216)	26.10% (n=148)	13.23% (n=75)	23.28% (n=132)	14.46% (n=82)	10.76% (n=61)
	Sometimes Use	27.51% (n=156)	31.92% (n=181)	17.99% (n=102)	29.28% (n=166)	27.69% (n=157)	19.93% (n=113)
	Use About Half the Time	4.59% (n=26)	6.00% (n=34)	3.17% (n=18)	7.58% (n=43)	8.64% (n=49)	5.11% (n=29)
	Use Most of the Time	11.82% (n=67)	14.11% (n=80)	11.99% (n=68)	13.23% (n=75)	15.87% (n=90)	13.40% (n=76)
	Always Use	16.93% (n=96)	20.46% (n=116)	30.16% (n=171)	25.75% (n=146)	32.38% (n=183)	42.33% (n=240)
	Would Not Perform This Procedure	1.06% (n=6)	0.88% (n=5)	22.93% (n=130)	0.71% (n=4)	0.53% (n=3)	7.94% (n=45)
Producer (n=493)	No response	2.23% (n=11)	2.84% (n=14)	2.84% (n=14)	4.26% (n=21)	4.06% (n=20)	3.04% (n=15)
	Never Use	46.04% (n=227)	40.77% (n=201)	23.94% (n=118)	43.20% (n=213)	37.53% (n=185)	26.77% (n=132)
	Sometimes Use	7.51% (n=37)	8.72% (n=43)	3.25% (n=16)	8.52% (n=42)	9.94% (n=49)	6.29% (n=31)
	Use About Half the Time	0.81% (n=4)	1.62% (n=8)	1.22% (n=6)	1.83% (n=9)	2.64% (n=13)	1.01% (n=5)
	Use Most of the Time	1.22% (n=6)	2.23% (n=11)	3.65% (n=18)	2.43% (n=12)	4.26% (n=21)	4.06% (n=20)
	Always Use	6.69% (n=33)	7.91% (n=39)	5.27% (n=26)	12.98% (n=64)	12.17% (n=60)	10.55% (n=52)
	Would Not Perform This Procedure	35.50% (n=175)	35.90% (n=177)	59.84% (n=295)	26.77% (n=132)	29.41% (n=145)	48.28% (n=238)
Both (n=121)	No response	0.83% (n=1)	0.00% (n=0)	0.00% (n=0)	0.00% (n=0)	0.00% (n=0)	0.00% (n=0)
	Never Use	49.59% (n=60)	30.58% (n=37)	12.40% (n=15)	35.54% (n=43)	19.01% (n=23)	11.57% (n=14)
	Sometimes Use	25.62% (n=31)	33.88% (n=41)	10.74% (n=13)	20.66% (n=25)	26.45% (n=32)	11.57% (n=14)
	Use About Half the Time	5.79% (n=7)	5.79% (n=7)	4.13% (n=5)	4.13% (n=5)	6.61% (n=8)	3.31% (n=4)
	Use Most of the Time	4.96% (n=6)	12.40% (n=15)	9.92% (n=12)	11.57% (n=14)	18.18% (n=22)	18.18% (n=22)
	Always Use	9.09% (n=11)	14.05% (n=17)	23.14% (n=28)	23.97% (n=29)	26.45% (n=32)	36.36% (n=44)
	Would Not Perform This Procedure	4.13% (n=5)	3.31% (n=4)	39.67% (n=48)	4.13% (n=5)	3.31% (n=4)	19.01% (n=23)

*Selected for further analysis in order to make further comparisons with previous research^{36,39,43,58,59}

Table 3.9. Odds ratio estimates: Regression* model: Effect of gender, role in industry, and age on general use of pain management in calves and cattle > 12 mo. by beef and dairy producers and veterinarians

		Calves 0-60d			Calves 2-12 mo.			Cattle > 12 mo.		
		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits	
Gender	Male	0.37	0.26	0.52	0.41	0.27	0.61	0.48	0.32	0.71
	Female	-	-	-	-	-	-	-	-	-
Role	Both	3.30	2.02	5.39	6.20	3.69	10.4	5.35	3.16	9.06
	Vet	10.20	7.21	14.4	14.20	9.93	20.3	11.59	8.10	16.59
	Prod	-	-	-	-	-	-	-	-	-
Age	21 to 30	2.820	1.21	6.58	1.89	0.91	3.90	3.13	1.48	6.62
	31 to 40	2.99	1.39	6.44	3.11	1.65	5.84	3.27	1.76	6.09
	41 to 50	2.90	1.31	6.43	1.73	0.96	3.28	2.50	1.33	4.71
	51 to 60	2.70	1.24	5.88	1.92	1.06	3.46	2.14	1.20	3.80
	61 to 70	1.91	0.89	4.12	1.61	0.89	2.89	1.43	0.80	2.55
	Over 70 years old	-	-	-	-	-	-	-	-	-

*Multivariate logistic regression

Table 3.9b. Odds ratio estimates: Regression* model: Effect of type of ownership within industry, classification of operation, gender, role in industry, and age on general use of pain management in calves and cattle > 12mo. by dairy and beef producer respondents

		Calves 0-60d			Calves 2-12 mo.			Cattle > 12 mo.		
Gender		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits	
	Male	0.46	0.28	0.73	0.43	0.27	0.69	0.44	0.27	0.74
	Female	-	-	-	-	-	-	-	-	-
Role										
	Both	4.77	2.92	7.78	6.56	3.8	11.31	7.56	4.28	13.34
	Prod	-	-	-	-	-	-	-	-	-
Age										
	21 to 30	1.68	0.59	4.82	1.21	0.48	3.05	1.22	0.46	3.21
	31 to 40	3.12	1.27	7.68	2.94	1.38	6.28	2.20	1.02	4.74
	41 to 50	2.60	1.04	6.52	1.53	0.71	3.30	1.57	0.72	3.41
	51 to 60	1.97	0.83	4.68	1.75	0.87	3.53	1.44	0.71	2.90
	61 to 70	1.82	0.76	4.32	1.64	0.81	3.31	1.28	0.64	2.58
	Over 70 years old	-	-	-	-	-	-	-	-	-
Type of Operation Owned by Respondent										
	Dairy	-	-	-	-	-	-	-	-	-
	Calf Ranch	1.21	0.07	20.50	<0.001	<0.001	-	<0.001	<0.001	
	Feedlot	0.06	0.01	0.47	0.42	0.12	1.48	0.14	0.04	0.49
	Stocker/Backgrounder	<0.001	<0.001	-	1.46	0.51	4.19	0.03	0.01	0.13
	Cow-calf	0.15	0.09	0.26	0.45	0.27	0.74	0.12	0.06	0.21
	Other	3.24	0.29	36.12	1.56	0.20	12.57	0.36	0.04	2.90
	More than one type	0.23	0.13	0.40	0.77	0.46	1.31	0.18	0.10	0.34
Classification of Operation										
	Conventional	-	-	-	-	-	-	-	-	-
	USDA Certified Organic	2.31	0.19	28.32	>999.9	<0.001	-	0.58	0.05	6.82
	Naturally Raised	0.38	0.15	0.99	0.31	0.15	0.67	0.38	0.19	0.79
	Other	1.67	0.39	7.20	1.81	0.37	8.78	0.94	0.21	4.30

*Multivariate logistic regression

Table 3.10. Odds ratio estimates: Regression model: Effect of gender, role in industry, and age on respondent use of local anesthetic in calves and cattle > 12 mo. during various husbandry procedures

Calves 0-60d					
		Surgical Castration	Band Castration	Dehorning	Abdominal Surgery†
		OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Gender	Male	0.53 (0.40-0.71)	0.55 (0.39-0.78)	0.52 (0.39-0.72)	0.59 (0.39-0.92)
	Female	-	-	-	-
Role	Both	1.32 (0.87-2.0)	0.75 (0.43-1.32)	3.70 (2.44-5.26)	7.69 (3.70-14.29)
	Vet	2.44 (1.82-3.23)	1.59 (1.15-2.22)	5.88 (4.55-7.69)	4.77 (3.33-6.25)
	Prod	-	-	-	-
Age	21 to 30	0.78 (0.43-1.41)	0.66 (0.30-1.45)	1.59 (0.88-2.94)	2.94 (1.39-6.25)
	31 to 40	0.89 (0.52-1.54)	0.84 (0.41-1.72)	1.59 (0.91-2.78)	4.35 (2.27-8.33)
	41 to 50	1.05 (0.61-1.82)	1.12 (0.54-2.33)	1.45 (0.83-2.56)	2.86 (1.47-5.56)
	51 to 60	1.08 (0.63-1.82)	1.15 (0.56-2.33)	1.64 (0.95-2.86)	3.85 (2.08-7.14)
	61 to 70	0.78 (0.46-1.33)	1.04 (0.51-2.13)	1.49 (0.87-2.56)	2.70 (1.45-5.00)
	Over 70 years old	-	-	-	-
Calves 2 -12 month					
		OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Gender	Male	0.58 (0.44-0.78)	0.58 (0.42-0.83)	0.51 (0.39-0.67)	0.55 (0.34-0.89)
	Female	-	-	-	-
Role	Both	2.00 (1.35-2.94)	1.21 (0.72-2.08)	5.26 (3.57-7.14)	11.11 (4.55-25.00)
	Vet	2.94 (2.22-4.00)	1.79 (1.28-2.50)	8.33 (6.25-11.11)	5.00 (3.57-7.69)
	Prod	-	-	-	-
Age	21 to 30	0.89 (0.49-1.64)	0.85 (0.39-1.85)	1.41 (0.77-2.56)	2.13 (0.94-4.76)
	31 to 40	1.18 (0.68-2.04)	1.09 (0.53-2.22)	1.52 (0.87-2.63)	4.17 (2.00-8.33)
	41 to 50	1.19 (0.68-2.08)	1.23 (0.60-2.56)	1.20 (0.68-2.13)	2.27 (1.12-4.55)
	51 to 60	1.39 (0.80-2.33)	1.12 (0.55-2.27)	1.64 (0.94-2.86)	2.70 (1.37-5.26)
	61 to 70	0.81 (0.47-1.41)	1.12 (0.55-2.27)	1.25 (0.73-2.17)	2.22 (1.15-4.35)
	Over 70 years old	-	-	-	-
Cattle > 12 mo.					
		OR (95%CI)	*	OR (95%CI)	OR (95%CI)
Gender	Male	0.54 (0.39-0.75)	*	0.46 (0.33-0.65)	0.54 (0.39-0.75)
	Female	-	*	-	-
Role	Both	3.03 (1.85-4.76)	*	7.69 (5.00-12.50)	3.03 (1.85-4.76)
	Vet	4.76 (3.33-6.67)	*	10.00 (7.69-14.29)	4.76 (3.33-6.67)
	Prod	-	*	-	-
Age	21 to 30	1.08 (0.54-2.13)	*	0.89 (0.45-1.75)	1.08 (0.54-2.13)
	31 to 40	1.82 (0.97-3.33)	*	1.00 (0.54-1.89)	1.82 (0.97-3.33)
	41 to 50	1.67 (0.89-3.13)	*	1.00 (0.53-1.89)	1.67 (0.89-3.13)
	51 to 60	1.79 (0.96-3.33)	*	1.23 (0.66-2.33)	1.79 (0.96-3.33)
	61 to 70	1.11 (0.60-2.04)	*	0.83 (0.45-1.54)	1.11 (0.60-2.04)
	Over 70 years old	-	*	-	-

*Respondents not asked about band castration for cattle > 12 mo. of age

†incl. umbilical abscess, DA, and Cesarean

Table 3.11. Odds ratio estimates: Regression model: Effect of gender, role in industry, and age on respondent use of a systemic pain relief drug in calves and cattle > 12 mo. during various procedures and conditions

Calves 0-60d								
		Surgical Castration	Band Castration	Dehorning	Abdominal Surgery*	Branding	BRD (Pneumonia)	Lameness
		OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Gender	Male	0.56 (0.43-0.75)	0.48 (0.35-0.65)	0.53 (0.40-0.68)	0.52 (0.39-0.71)	0.66 (0.42-1.05)	0.49 (0.40-0.63)	0.67 (0.52-0.85)
	Female	-	-	-	-	-	-	-
Role	Both	2.22 (1.43-3.45)	1.56 (0.93-2.63)	2.86 (1.89-4.17)	2.00 (1.27-3.13)	1.79 (0.96-3.23)	2.56 (1.75-3.70)	3.70 (2.56-5.56)
	Vet	4.17 (3.03-5.56)	3.45 (2.44-4.76)	4.00 (3.03-5.26)	1.89 (1.41-2.50)	2.17 (1.41-3.45)	2.33 (1.85-2.94)	3.23 (2.56-4.17)
	Prod	-	-	-	-	-	-	-
Age	21 to 30	0.65 (0.35-1.18)	0.88 (0.41-1.85)	0.99 (0.54-1.82)	1.08 (0.55-2.08)	1.43 (0.56-3.57)	1.79 (1.03-3.13)	1.30 (0.75-2.27)
	31 to 40	0.92 (0.52-1.59)	1.25 (0.66-2.56)	1.52 (0.85-2.70)	1.67 (0.89-3.13)	1.64 (0.70-3.85)	2.08 (1.23-3.45)	1.89 (1.12-3.13)
	41 to 50	0.99 (0.59-1.75)	1.56 (0.77-3.23)	1.35 (0.75-2.44)	1.67 (0.89-3.13)	1.54 (0.65-3.70)	1.59 (0.94-2.70)	1.37 (0.81-2.33)
	51 to 60	1.25 (0.72-2.13)	2.00 (1.00-4.00)	1.89 (1.08-3.33)	1.96 (1.06-3.70)	2.33 (1.01-5.26)	1.89 (1.15-3.31)	1.52 (0.91-2.50)
	61 to 70	0.59 (0.34-1.03)	0.85 (0.42-1.75)	1.14 (0.64-2.00)	1.14 (0.61-2.13)	1.92 (0.85-4.35)	1.15 (0.69-1.89)	0.94 (0.57-1.56)
	Over 70 years old	-	-	-	-	-	-	-
Calves 2 -12 month								
		Surgical Castration	Band Castration	Dehorning	Abdominal Surgery*	Branding	BRD (Pneumonia)	Lameness
		OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Gender	Male	0.55 (0.42-0.72)	0.42 (0.31-0.58)	0.63 (0.49-0.81)	0.53 (0.39-0.72)	0.70 (0.44-1.11)	0.49 (0.38-0.63)	0.65 (0.50-0.83)
	Female	-	-	-	-	-	-	-
Role	Both	3.23 (2.17-4.76)	1.89 (1.14-3.13)	4.00 (2.70-5.88)	3.13 (1.92-5.00)	2.17 (1.22-3.85)	2.56 (1.79-3.70)	3.70 (2.56-5.56)
	Vet	4.35 (3.23-5.88)	3.45 (2.50-4.76)	5.00 (3.70-6.25)	2.04 (1.52-2.70)	2.22 (1.45-3.45)	2.22 (1.75-2.86)	3.23 (2.50-4.17)
	Prod	-	-	-	-	-	-	-
Age	21 to 30	0.69 (0.38-1.25)	0.71 (0.34-1.45)	0.86 (0.48-1.56)	0.88 (0.45-1.72)	0.91 (0.37-2.22)	1.69 (0.97-2.94)	1.33 (0.76-2.33)

	31 to 40	1.27 (0.73-2.17)	1.05 (0.53-2.04)	1.32 (0.76-2.27)	1.27 (0.67-2.38)	1.39 (0.62-3.03)	1.82 (1.09-3.13)	1.89 (1.12-3.13)
	41 to 50	1.30 (0.74-2.27)	1.32 (0.67-2.63)	1.25 (0.71-2.17)	1.19 (0.63-2.27)	1.35 (0.59-3.03)	1.47 (0.87-2.50)	1.35 (0.79-2.27)
	51 to 60	1.54 (0.90-2.63)	1.72 (0.89-3.33)	1.54 (0.89-2.63)	1.41 (0.75-2.63)	1.79 (0.81-3.85)	1.69 (1.03-2.86)	1.39 (0.83-2.27)
	61 to 70	0.81 (0.47-1.39)	0.95 (0.49-1.85)	1.16 (0.68-2.00)	1.06 (0.57-2.00)	1.39 (0.64-3.03)	1.05 (0.63-1.75)	0.98 (0.59-1.61)
	Over 70 years old	-	-	-	-	-	-	-
Cattle > 12 mo.								
		Surgical Castration	Dehorning	Abdominal Surgery*	Branding	BRD (Pneumonia)	Lameness	Mastitis
		OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Gender	Male	0.51 (0.36-0.70)	0.56 (0.41-0.74)	0.64 (0.48-0.85)	0.56 (0.35-0.90)	0.47 (0.36-0.60)	0.68 (0.53-0.88)	0.56 (0.44-0.72)
	Female	-	-	-	-	-	-	-
Role	Both	6.25 (3.70-10.00)	5.88 (3.70-9.09)	1.64 (1.06-2.56)	1.89 (1.04-3.45)	2.38 (1.64-3.45)	3.85 (2.63-5.56)	3.85 (2.70-5.56)
	Vet	6.25 (4.55-9.09)	5.56 (4.17-7.69)	1.30 (0.98-1.72)	1.72 (1.10-2.63)	2.22 (1.75-2.78)	2.78 (2.17-3.57)	3.45 (2.70-4.55)
	Prod	-	-	-	-	-	-	-
Age	21 to 30	0.69 (0.35-1.37)	0.90 (0.47-1.72)	0.53 (0.27-1.04)	0.79 (0.32-1.96)	1.08 (0.62-1.89)	0.97 (0.56-1.69)	1.22 (0.68-2.17)
	31 to 40	0.98 (0.51-1.85)	1.11 (0.60-2.04)	0.74 (0.39-1.43)	0.65 (0.28-1.49)	1.28 (0.76-2.17)	1.33 (0.81-2.22)	1.37 (0.79-2.33)
	41 to 50	1.30 (0.67-2.50)	1.49 (0.79-2.78)	0.85 (0.44-1.64)	1.19 (0.52-2.78)	1.25 (0.74-2.13)	1.22 (0.73-2.04)	1.39(0.8-2.44)
	51 to 60	1.28 (0.68-2.44)	1.67 (0.91-3.13)	0.99 (0.52-1.89)	1.03 (0.46-2.33)	1.33 (0.80-2.22)	1.20 (0.74-2.00)	1.52 (0.88-2.56)
	61 to 70	0.98 (0.52-1.85)	1.20 (0.65-2.22)	0.93 (0.49-1.79)	1.03 (0.46-2.27)	0.84 (0.51-1.41)	0.84 (0.51-1.39)	1.19 (0.69-2.04)
	Over 70 years old	-	-	-	-	-	-	-

* incl. umbilical abscess, DA, and Cesarean

Table 3.12. Change in respondents' use of pain management in their operations or practices in the last 10 years by role

		Role	% of role (n)	% of all respondents (n)
Use of Pain Management	No Response	Veterinarians	0.0% (n=0)	1.10% (n=13)
		Producers	2.43% (n=12)	
		Producer-Veterinarian	0.83% (n=1)	
	Increased Use	Veterinarians	76.37% (n=433)	57.49% (n=679)
		Producers	31.64% (n=156)	
		Producer-Veterinarian	74.38% (n=90)	
	Stayed the Same	Veterinarians	22.22% (n=126)	36.75% (n=434)
		Producers	57.20% (n=282)	
		Producer-Veterinarian	21.49% (n=26)	
	Decreased Use	Veterinarians	1.41% (n=8)	4.66% (n=55)
		Producers	8.72% (n=43)	
		Producer-Veterinarian	3.31% (n=4)	

Table 3.13. Odds ratio estimates: Regression* model: Effect of gender, role in industry, and age on the change in respondent use of analgesia in their operation or practice in the last 10 years

		OR (95%CI)
Gender	Male	0.65 (0.48-0.89)
	Female	-
Role	Both	6.49 (4.07-10.35)
	Vet	7.53 (5.65-10.03)
	Prod	-
Age	21 to 30	0.47 (0.26-0.85)
	31 to 40	1.12 (0.65-1.95)
	41 to 50	1.52 (0.86-2.71)
	51 to 60	1.64 (0.97-2.80)
	61 to 70	1.38 (0.81-2.35)
	Over 70 years old	-

*Ordinal logistic regression: 1) increased use 2) stayed the same 3) decreased use; odds express the odds of respondents selecting answer of lower value

Table 3.14. Respondents' level of agreement to statements regarding cattle pain by role

	% Agree (n)				% Not Sure (n)				% Disagree (n)				% No Response (n)			
	Vet	Prod.	Both	All	Vet	Prod.	Both	All	Vet	Prod.	Both	All	Vet	Prod.	Both	All
Analgesics may mask deterioration in the animal's condition	28.40% (n=161)	39.76% (n=196)	35.54% (n=43)	33.87% (n=402)	23.10% (n=131)	37.53% (n=185)	18.18% (n=22)	28.64% (n=340)	48.15% (n=273)	18.46% (n=91)	45.45% (n=55)	35.47% (n=421)	0.35% (n=2)	4.26% (n=21)	0.83% (n=1)	2.02% (n=24)
Cattle benefit from receiving analgesic drugs as part of their treatment	89.77% (n=509)	58.62% (n=289)	87.60% (n=106)	76.58% (n=909)	8.99% (n=51)	32.86% (n=162)	8.26% (n=10)	18.87% (n=224)	1.06% (n=6)	4.26% (n=21)	2.48% (n=3)	2.53% (n=30)	0.18% (n=1)	4.26% (n=21)	1.65% (n=2)	2.02% (n=24)
Cattle that are experiencing a fever are in pain	37.21% (n=211)	45.03% (n=222)	47.11% (n=57)	41.43% (n=493)	40.39% (n=229)	34.48% (n=170)	30.58% (n=37)	36.98% (n=439)	22.05% (n=125)	16.23% (n=80)	20.66% (n=25)	19.38% (n=230)	0.35% (n=2)	4.26% (n=21)	1.65% (n=2)	2.11% (n=25)
Some pain is necessary to stop the animal becoming too active	19.58% (n=111)	25.96% (n=128)	29.75% (n=36)	23.29% (n=275)	20.99% (n=119)	27.38% (n=125)	19.83% (n=24)	23.54% (n=278)	58.91% (n=334)	42.60% (n=210)	48.76% (n=59)	51.06% (n=603)	0.53% (n=3)	4.06% (n=20)	1.65% (n=2)	2.12% (n=25)

Cattle recover faster if given analgesic drugs	74.96% (n=425)	45.64% (n=225)	73.55% (n=89)	62.57% (n=739)	21.16% (n=120)	43.00% (n=212)	20.66% (n=25)	30.23% (n=357)	3.53% (n=20)	7.30% (n= 36)	4.96% (n=6)	5.25% (n=62)	0.35% (n=2)	4.06% (n=20)	0.83% (n=1)	1.95% (n=23)
Drug side effects limit the usefulness of giving analgesics to cattle	14.11% (n=80)	23.33% (n=115)	19.83% (n=24)	18.54% (n=219)	16.05% (n=91)	46.65% (n=230)	18.18% (n=22)	29.04% (n=343)	69.49% (n=394)	25.96% (n=128)	60.44% (n=73)	50.38% (n=595)	0.35% (n=2)	4.06% (n=20)	1.65% (n=2)	2.03% (n=24)
Most farmers are willing to pay the costs involved with giving analgesics to cattle.	42.68% (n=242)	33.47% (n=165)	35.54% (n=43)	38.10% (n=450)	31.04% (n=176)	39.96% (n=197)	34.71% (n=42)	35.14% (n=415)	26.28% (n=149)	22.11% (n=109)	28.93% (n=35)	24.81% (n=293)	0.00% (n=0)	4.46% (n=22)	0.83% (n=1)	1.95% (n=23)
The benefits of the analgesia outweighs the cost of the analgesia	57.85% (n=328)	36.31% (n=179)	54.55% (n=66)	48.52% (n=573)	33.69% (n=191)	48.68% (n=240)	31.40% (n=38)	39.71% (n=469)	8.29% (n=47)	10.34% (n=51)	13.22% (n=16)	9.65% (n=114)	0.18% (n=1)	4.67% (n=23)	0.83% (n=1)	2.12% (n=25)
Farmers would like cattle to receive analgesia but cost is a major issue	62.61% (n=355)	48.28% (n=238)	58.68% (n=71)	56.22% (n=664)	21.34% (n=121)	32.05% (n=158)	22.31% (n=27)	25.91% (n=306)	15.87% (n=90)	15.42% (n=76)	18.18% (n=22)	15.92% (n=188)	0.18% (n=1)	4.26% (n=21)	0.83% (n=1)	1.95% (n=23)

U.S./USDA/FDA regulations limit my ability to use analgesic drugs in cattle	89.77% (n=509)	58.62% (n=289)	87.60% (n=106)	64.01% (n=756)	8.99% (n=51)	32.86% (n=162)	8.26% (n=10)	20.83% (n=246)	1.06% (n=6)	4.26% (n=21)	2.38% (n=3)	12.96% (n=153)	0.18% (n=1)	4.26% (n=21)	1.65% (n=2)	2.20% (n=26)
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FOOTNOTES

a Informa, London, UK

b Qualtrics, Provo, Utah, USA

c Microsoft Excel, 2018, Microsoft Corporation, Redmond, WA

d R Software, version 1.1.383, R Core Team, Vienna, Austria.

e SAS Software, version 9.4 TS Level 1M3 for Windows, SAS Institute INC, Cary, NC, USA.

REFERENCES

1. Duncan IJH. The changing concept of animal sentience. *Applied Animal Behaviour Science* 2006;100:11-19.
2. Wood GN. Recognition and assessment of pain in lambs. 1991.
3. Molony V, Kent JE. Assessment of acute pain in farm animals using behavioral and physiological measurements2. *Journal of Animal Science* 1997;75:266-272.
4. Molony V, Kent JE, Robertson IS. Assessment of acute and chronic pain after different methods of castration of calves. *Applied Animal Behaviour Science* 1995;46:33-48.
5. Anil SS, Anil L, Deen J. Challenges of pain assessment in domestic animals. *Journal of the American Veterinary Medical Association* 2002;220:313-319.
6. Rutherford K. Assessing pain in animals. *Animal Welfare* 2002;11:31-53.
7. Weary DM, Niel L, Flower FC, et al. Identifying and preventing pain in animals. *Applied Animal Behaviour Science* 2006;100:64-76.
8. Hudson C, Whay H, Huxley J. Recognition and management of pain in cattle. *In Practice* 2008;30:126.
9. Sneddon LU, Elwood RW, Adamo SA, et al. Defining and assessing animal pain. *Animal Behaviour* 2014;97:201-212.
10. Griffin DR, Speck GB. New evidence of animal consciousness. *Animal cognition* 2004;7:5-18.
11. Mendl M, Burman O, Laughlin K, et al. Animal Memory and Animal Welfare. *Animal Welfare* 2001;10:141-159.
12. Waldmann MR, Schloegl C, Fischer J. Causal Reasoning in Non-Human Animals: Oxford University Press, 2017.
13. Rollin BE. Animal pain. *Advances in Animal Welfare Science* 1985: Springer, 1985;91-106.
14. Rollin BE. Animal Pain: What It is and Why It Matters. *The Journal of Ethics* 2011;15:425.
15. American Veterinary Medical Association. Castration and Dehorning of Cattle. <https://www.avma.org/KB/Policies/Pages/Castration-and-Dehorning-of-Cattle.aspx>, Accessed June. 19, 2019.
16. Collier RJ, Doelger SG, Head HH, et al. Effects of Heat Stress during Pregnancy on Maternal Hormone Concentrations, Calf Birth Weight and Postpartum Milk Yield of Holstein Cows. *Journal of Animal Science* 1982;54:309-319.
17. Sordillo LM, Aitken SL. Impact of oxidative stress on the health and immune function of dairy cattle. *Veterinary Immunology and Immunopathology* 2009;128:104-109.
18. Warnick LD, Janssen D, Guard CL, et al. The effect of lameness on milk production in dairy cows. *J Dairy Sci* 2001;84:1988-1997.
19. West JW. Effects of Heat-Stress on Production in Dairy Cattle. *Journal of Dairy Science* 2003;86:2131-2144.
20. Tao S, Monteiro APA, Thompson IM, et al. Effect of late-gestation maternal heat stress on growth and immune function of dairy calves. *Journal of Dairy Science* 2012;95:7128-7136.
21. Coetzee JF, Gehring R, Tarus-Sang J, et al. Effect of sub-anesthetic xylazine and ketamine ('ketamine stun') administered to calves immediately prior to castration. *Veterinary Anaesthesia and Analgesia* 2010;37:566-578.

22. Petrie NJ, Mellor DJ, Stafford KJ, et al. Cortisol responses of calves to two methods of disbudding used with or without local anaesthetic. *New Zealand Veterinary Journal* 1996;44:9-14.
23. Sutherland MA, Mellor DJ, Stafford KJ, et al. Cortisol responses to dehorning of calves given a 5-h local anaesthetic regimen plus phenylbutazone, ketoprofen, or adrenocorticotrophic hormone prior to dehorning. *Research in Veterinary Science* 2002;73:115-123.
24. GrØNdahl-Nielsen C, Simonsen HB, Damkjer Lund J, et al. Behavioural, Endocrine and Cardiac Responses in Young Calves Undergoing Dehorning Without and With Use of Sedation and Analgesia. *The Veterinary Journal* 1999;158:14-20.
25. Heinrich A, Duffield TF, Lissemore KD, et al. The impact of meloxicam on postsurgical stress associated with cautery dehorning. *Journal of Dairy Science* 2009;92:540-547.
26. McMeekan C, Stafford KJ, Mellor DJ, et al. Effects of a local anaesthetic and a non-steroidal anti-inflammatloray analgesic on the behavioural responses of calves to dehorning. *New Zealand Veterinary Journal* 1999;47:92-96.
27. Stewart M, Stafford KJ, Dowling SK, et al. Eye temperature and heart rate variability of calves disbudded with or without local anaesthetic. *Physiology & Behavior* 2008;93:789-797.
28. Stewart M, Stookey JM, Stafford KJ, et al. Effects of local anesthetic and a nonsteroidal antiinflammatory drug on pain responses of dairy calves to hot-iron dehorning. *Journal of Dairy Science* 2009;92:1512-1519.
29. Heinrich A, Duffield TF, Lissemore KD, et al. The effect of meloxicam on behavior and pain sensitivity of dairy calves following cautery dehorning with a local anesthetic. *Journal of Dairy Science* 2010;93:2450-2457.
30. Faulkner PM, Weary DM. Reducing Pain After Dehorning in Dairy Calves. *Journal of Dairy Science* 2000;83:2037-2041.
31. Morisse JP, Cotte JP, Huonnic D. Effect of dehorning on behaviour and plasma cortisol responses in young calves. *Applied Animal Behaviour Science* 1995;43:239-247.
32. Coetzee JF, Lubbers BV, Toerber SE, et al. Plasma concentrations of substance P and cortisol in beef calves after castration or simulated castration. *American journal of veterinary research* 2008;69:751-762.
33. Whay HR. Lameness and pain in dairy cows: does it hurt and does it matter? *Proceedings of the first Regional Conference on Cow Comfort and Lameness (RCCCL)*. Tehran 2016.
34. Flower FC, Sedlbauer M, Carter E, et al. Analgesics Improve the Gait of Lamé Dairy Cattle. *Journal of Dairy Science* 2008;91:3010-3014.
35. Leslie KE, Petersson-Wolfe CS. Assessment and Management of Pain in Dairy Cows with Clinical Mastitis. *Veterinary Clinics of North America: Food Animal Practice* 2012;28:289-305.
36. Hewson CJ, Dohoo IR, Lemke KA, et al. Canadian veterinarians' use of analgesics in cattle, pigs, and horses in 2004 and 2005. *The Canadian Veterinary Journal* 2007b;48:155-164.
37. Graf B, Senn M. Behavioural and physiological responses of calves to dehorning by heat cauterization with or without local anaesthesia. *Applied Animal Behaviour Science* 1999;62:153-171.
38. Glerup KB, Andersen PH, Munksgaard L, et al. Pain evaluation in dairy cattle. *Applied Animal Behaviour Science* 2015;171:25-32.
39. Coetzee JF, Nutsch AL, Barbur LA, et al. A survey of castration methods and associated livestock management practices performed by bovine veterinarians in the United States. *BMC Veterinary Research* 2010;6:12.

40. Earley B, Crowe MA. Effects of ketoprofen alone or in combination with local anesthesia during the castration of bull calves on plasma cortisol, immunological, and inflammatory responses. *J Anim Sci* 2002;80:1044-1052.
41. Wood G, Molony V. Welfare aspects of castration and tail docking of lambs. *In Practice* 1992;14:2-7.
42. Flecknell P. Analgesia from a veterinary perspective. *British Journal of Anaesthesia* 2008;101:121-124.
43. Fajt VR, Wagner SA, Norby B. Analgesic drug administration and attitudes about analgesia in cattle among bovine practitioners in the United States. *Journal of the American Veterinary Medical Association* 2011;238:755-767.
44. Hewson CJ, Dohoo IR, Lemke KA, et al. Factors affecting Canadian veterinarians' use of analgesics when dehorning beef and dairy calves. *The Canadian Veterinary Journal* 2007a;48:1129-1136.
45. CFR Title 21: Extralabel Drug Use in Animals In: Services DoHaH, ed, 1996.
46. Remnant JG, Tremlett A, Huxley JN, et al. Clinician attitudes to pain and use of analgesia in cattle: where are we 10 years on? *Veterinary Record* 2017;181:400.
47. Huxley JN, Whay HR. Current attitudes of cattle practitioners to pain and the use of analgesics in cattle. *Veterinary Record* 2006;159:662.
48. O'Connor SP. United States Regions. 2012;
<https://www.nationalgeographic.org/maps/united-states-regions/> Accessed February 18, 2018.
49. Broom DM. Animal Welfare: An Aspect of Care, Sustainability, and Food Quality Required by the Public. *Journal of Veterinary Medical Education* 2010;37:83-88.
50. Fraser D, Duncan IJH, Edwards SA, et al. General Principles for the welfare of animals in production systems: The underlying science and its application. *The Veterinary Journal* 2013;198:19-27.
51. O'Callaghan-Lowe K, Downham D, Murray R, et al. Effect of lameness treatment on pain and milk production in dairy cattle. 13th International Symposium on Lameness in Ruminants, Slovenia 11th–15th February 2004 2004;237-238.
52. Tenhagen B-A, Helmbold A, Heuwieser W. Effect of Various Degrees of Dystocia in Dairy Cattle on Calf Viability, Milk Production, Fertility and Culling. *Journal of Veterinary Medicine Series A* 2007;54:98-102.
53. Allen K, Coetzee J, Edwards-Callaway L, et al. The effect of timing of oral meloxicam administration on physiological responses in calves after cautery dehorning with local anesthesia. *Journal of dairy science* 2013;96:5194-5205.
54. EMEA (European Agency for the Evaluation of the Medicinal Products). 1999. Committee for Veterinary Medicinal Products. Meloxicam Summary Report. .
http://www.ema.europa.eu/docs/en_GB/document_library/Maximum_Residue_Limits_-_Report/2009/11/WC500014941.pdf. Accessed June 14, 2019.
55. Thomsen PT, Gidekull M, Herskin MS, et al. Scandinavian bovine practitioners' attitudes to the use of analgesics in cattle. *Veterinary Record* 2010;167:256.
56. Laven RA, Huxley JN, Whay HR, et al. Results of a survey of attitudes of dairy veterinarians in New Zealand regarding painful procedures and conditions in cattle. *New Zealand Veterinary Journal* 2009;57:215-220.
57. Martin MS, Grau SA, Rutherford BW, et al. Survey of cow-calf producer perspectives on management strategies and industry challenges. Part 1: handling practices, and health and industry challenges. *Translational Animal Science* 2018;3:195-203.

58. Winder CB, LeBlanc SJ, Haley DB, et al. Practices for the disbudding and dehorning of dairy calves by veterinarians and dairy producers in Ontario, Canada. *J Dairy Sci* 2016;99:10161-10173.
59. Misch LJ, Duffield TF, Millman ST, et al. An investigation into the practices of dairy producers and veterinarians in dehorning dairy calves in Ontario. *Can Vet J* 2007;48:1249-1254.
60. Paul ES, Podberscek AL. Veterinary education and students' attitudes towards animal welfare. *The Veterinary record* 2000;146:269-272.
61. Hazel SJ, Signal TD, Taylor N. Can teaching veterinary and animal-science students about animal welfare affect their attitude toward animals and human-related empathy? *Journal of Veterinary Medical Education* 2011;38:74-83.
62. Heleski CR, Mertig AG, Zanella AJ. Assessing attitudes toward farm animal welfare: a national survey of animal science faculty members. *J Anim Sci* 2004;82:2806-2814.
63. Wikman I, Hokkanen AH, Pastell M, et al. Dairy producer attitudes to pain in cattle in relation to disbudding calves. *J Dairy Sci* 2013;96:6894-6903.
64. Moggy MA, Pajor EA, Thurston WE, et al. Management practices associated with pain in cattle on western Canadian cow-calf operations: A mixed methods study. *J Anim Sci* 2017;95:958-969.
65. American College of Veterinary Anesthesiologists' Position Paper on the Treatment of Pain in Animals. http://www.acvaa.org/docs/Pain_Treatment. Accessed June 22, 2019.
66. Walker JB, N.B. Cook, C.B. Tucker, M.A.G. von Keyserlingk. Dairy Cattle Animal Welfare Audit Program: Dean Foods Co., 2017;36-41.
67. Code of Recommendations for the Welfare of Livestock: Cattle In: Department for Environment FaRA, ed. London: Defra Publi 2003;30-31.
68. Extralabel drug use in animals; final rule, 21 CFR Part 530. *Federal Register* 1996;61:57731-57746.
69. US FDA. Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA). <https://www.fda.gov/animal-veterinary/acts-rules-regulations/animal-medicinal-drug-use-clarification-act-1994-amduca>. Accessed June 2019.
70. Friton GM, Cajal C, Ramirez-Romero R. Long-term effects of meloxicam in the treatment of respiratory disease in fattening cattle. *Veterinary Record* 2005;156:809.
71. Theurer ME, White BJ, Coetzee JF, et al. Assessment of behavioral changes associated with oral meloxicam administration at time of dehorning in calves using a remote triangulation device and accelerometers. *BMC Veterinary Research* 2012;8:48.
72. Health Canada. Drug Product database. 2015; <https://www.canada.ca/en/health-canada/services/drugs-health-products/drug-products/drug-product-database.html>. Accessed June 13 2019.
73. Tucker C. *Advances in Cattle Welfare*: Woodhead Publishing, 2017.
74. Stafford KJ, Mellor DJ. Addressing the pain associated with disbudding and dehorning in cattle. *Applied Animal Behaviour Science* 2011;135:226-231.
75. Stock ML, Baldridge SL, Griffin D, et al. Bovine Dehorning: Assessing Pain and Providing Analgesic Management. *Veterinary Clinics of North America: Food Animal Practice* 2013;29:103-133.
76. American Veterinary Medical Association. Pain in Animals. <https://www.avma.org/KB/Policies/Pages/Pain-in-Animals.aspx>. Accessed July 2, 2019.

APPENDIX A: SURVEY QUESTIONS INVESTIGATING THE ATTITUDES AND COMPETENCIES OF THIRD YEAR VETERINARY STUDENTS TOWARDS ANIMAL PAIN MANAGEMENT DURING HUSBANDRY PROCEDURES AND THE USE OF STUNNING DURING LIVESTOCK SLAUGHTER

Summary

Associations were found between the lack of use of pain management during bull castration and cattle dehorning and those students who identified coming from rural communities ($p=0.02$; $p=0.02$) or were tracking large animal medicine ($p=0.03$; $p=0.02$). After completing the course, not all students believed stunning should be used during cattle, pig, sheep, and poultry slaughter despite its mandated use nationwide.

Materials and Methods

General

The methodology for this data collection is described by (Johnstone et al. 2019), whose research, focused on veterinary animal welfare education, was responsible for the original collection of the data used in this study.

Survey questions regarding third-year veterinary students' attitudes towards and knowledge of animal welfare topics, animal pain, animal welfare education, and their responsibilities as animal welfare advocates in their personal and professional communities were developed by Colorado State University Department of Animal Science and the College of Veterinary Medicine. This survey was examined by the Institutional Review Board (IRB) at Colorado State University and deemed exempt from full IRB review (CSU IRB #240-18H). A

paper survey was developed to be administered in-person to veterinary students (N=145) enrolled in the inaugural animal welfare course that was newly added (approved via university curriculum committee Fall 2017) as a required element of the second semester third-year veterinary school curriculum. A pre-course survey and an identical post-course survey (except for demographic information) would be administered to the course registrants. On January 19th, 2018, the paper survey was administered to the third-year veterinary student attendees of the first day of the animal welfare course by one of the co-authors. The animal welfare course, which met twice weekly for two hours, was established in the second semester of the third-year veterinary curriculum to introduce students to the basic principles of animal welfare science through lectures, discussions, professional panels, and student activities. Participants were informed of the anonymous and voluntary nature of the survey. Respondents were asked to fill out a “Survey ID code” at the top of the survey which consisted of the last two letters of their mother’s maiden name and the first three numbers of the respondent’s hometown zip code. This identifier would be used to match post-course surveys in order to assess change in responses for individuals. Completed surveys were turned in following completion with a total of 131 completed survey responses. On April 25th, 2018, the same survey was administered to the attendees of the animal welfare course’s final day of class. The survey was modified by removing the demographic questions and Question 24, which asked for a ranking of the respondent’s level of concern regarding the effects of cage/housing dimensions on the welfare of different animal species. Pre-course survey responses indicated that this question was confusing and potentially unnecessary for achieving the goals of this research and after consideration by researchers was removed from the post-course survey. Respondents were asked to write the same ID code at the top of the post-

course surveys as was done on the pre-course survey. The post-course paper survey was collected from voluntary respondents (n=125) in-person after completion.

The first section of the pre-course survey consisted of five demographic questions asking respondent age, gender, race or ethnicity, home community, and dietary preference. For each demographic question apart from age, respondents were given the choice of selecting “Not Defined” with a write-in option if they did not identify with any of the categories listed. Pre-course surveys that did not have ID codes written were given a unique identifier and were included in the pre-course data analysis (n=15).

The body of the survey consisted of 24 questions (pre-course) and 23 questions (post-course). Respondents were asked to indicate what track they had selected for the upcoming fourth year of veterinary school with options of large, small, and general tracks. Subsequently, respondents were asked to indicate their area of practice interest (food animal, equine, mixed, companion animal, exotics, wildlife, public health/policy, lab animal, research, academia, advocacy, international, or other). Questions were asked regarding respondents’ attitudes towards the inclusion of an animal welfare and ethics course in the veterinary curriculum (using a Likert scale of 1=strongly disagree, 5=strongly agree) and whether or not animal welfare was included in the veterinarian’s oath (using a binary response option of yes/no). A combination of write-in ranking (with a ranking of 1 indicating greatest/highest rank) and Likert scale (1=strongly disagree, 5=strongly agree) response questions were asked about respondents’ feelings of preparedness in discussing the welfare of different species with members of their communities, their confidence in researching animal welfare topics to educate others, their obligation as advocates towards the welfare of all animals, and their concern for the well-being of different categories of animals (food animal, exotics, companion, wildlife, lab animal).

Respondents were also asked to rank the significance they would place on different welfare indicators (health, reproductive success, injuries, etc.). Respondents were asked to rank how when economic limitations threaten the welfare of an animal, different members of the community (the animal, the owner, the veterinarian, industry stakeholders, the public) would influence their decisions, and how influential these members should be in making general welfare decisions within a community. For the particular question (Question 11) asking respondents to indicate by rank how influential members of their community should be in making welfare decisions, 21 pre-course and 11 post-course individuals did not correctly rank their responses. Instead, they gave identical ranking values to multiple categories (veterinarians, animal scientists, industry members all ranked as equally important with a value of 1). These responses were not included in the data analysis.

Binary response questions were also asked about the ability of all animals to feel pain (with a write-in option for those animals that respondents believed could not feel pain), pain management administration during and after painful procedures in dogs, cats, and cattle, and whether or not stunning should be used in slaughter practices for larger mammalian livestock, fish, and poultry.

The final questions of the survey contained Likert scale responses and asked respondent opinions towards the use of gestation crates in the pork industry as well as laboratory beagle environmentally-induced stress. The 24th question, which was removed from the post-course survey, asked respondents to rank, in order of concern for animal welfare, examples of housing environments for lop rabbits, teacup poodles, dairy calves, goldfish, and bearded dragons.

Quantitative Analysis

Pre-course and post-course survey data was manually entered into Numbers^a software. Only completed surveys with all questions answered were included in both the pre and post-course analysis. Demographic data was summarized by calculating percentages for all demographic categories using Numbers^a software. After preliminary review of the data, analysis was performed on five of the twenty-four (twenty-three post-course) questions. The five questions selected all contained binary responses. Data from pre-course survey (n=131) questions and post-course survey (n=125) questions with binary responses were summarized. Questions with binary responses were summarized using percentages of “Yes” responses. For the pre-course survey data analysis, Fisher Exact Tests were used to analyze associations between demographic variables and binary questions using R software^b.

More than half of the survey ID codes written by respondents on the post-course surveys did not match the ID codes given by respondents on the pre-course surveys. Due to these errors, only 61 completed surveys could be paired by ID codes and used for comparative statistical testing. The total group of post-course survey respondents (n = 125) cannot be said to be the same group as the pre-course survey respondents (n = 131) and may contain a proportion of students that did not complete pre-course surveys, thereby making the total post-course sample a different combination of individuals from the pre-course sample. Comparative statistical testing can therefore only be performed on the responses given by the 61 paired respondents. Therefore, statistical testing was not used to compare total pre-course and total post-course response data but summary statistics on these two populations are included for consideration.

For survey questions containing binary responses (Yes/No), McNemar's test in R software^b was used to test significant differences between the proportions of "Yes" responses to particular questions for the paired pre-course and post-course data (n=61).

Statistical significance was designated a priori for all tests performed as p-values less than or equal to 0.

Results

The pre-course survey response rate was 90.3% (n=131). The post-course survey response rate was 86.2% (n=125).

Summary of Responses to Questions Containing Binary Responses

Five questions containing binary responses were selected for analysis (Table 1). These questions pertained to pain management use during dehorning and castration for cattle as well as the use of stunning in the slaughter of cattle, pig, sheep, fish, and poultry. When comparing the responses to the two questions asking about the use of pain management during and following bull castration and cattle dehorning, all paired post-course respondents (n=61; 100%) indicated they would use such pain management for cattle dehorning while 95.1% (n=58) indicated they would use pain management for bull castration (Table 1). The greatest change in proportions of paired respondents indicating they would use pain management in cattle was for the question regarding cattle dehorning. All post-course paired respondents indicated they would use pain management while 91.8% (n=56) of paired pre-course respondents indicated they would use pain management (Table 1).

Overall, a larger percentage of paired post-course respondents (n=61) agreed with the use of pain management during and following painful procedures in cattle compared to the total post-course respondent sample (n=125). All paired post-course respondents indicated that they would

use pain management during and following cattle dehorning but 97.6% (n=122) of all post-course respondents indicated they would use pain management for this procedure (Table 1). In addition, an overall larger percentage of paired post-course respondents agreed with the use of stunning during multiple species slaughter processes compared to the total post-course respondent group (Table 1). All paired post-course respondents agreed that stunning should be used during cattle, pig, and sheep slaughter while the use of this stunning was not unanimous for all post-course respondents. 7.1% more paired post-course respondents agreed with the use of stunning during commercial fish harvest and slaughter compared to all post-course respondents. The course had a significant effect on the proportion of paired respondents who agreed with the use of stunning during poultry slaughter ($p=0.04$; Table 1).

Associations of Respondent Demographics to Pre-Course Binary Response Questions

Percentages of total respondents in demographic categories of gender, home community, and track that responded with the binary response “Yes” (indicating agreement with the question’s statement) to pre-course survey questions 17-21 were calculated and significant differences were tested by the Fisher Exact method (Tables 2.) Significant differences were not found between the responses of individuals of different genders to survey questions regarding the use of pain management during painful procedures in cattle and stunning practices for the slaughter of multiple species ($p \geq 0.36$). A significantly greater percentage of pre-course respondents from non-rural communities indicated that they would use pain management during and following bull castration and cattle dehorning than did respondents from rural communities ($p=0.02$; Table 2.). Significant differences were not found between the responses of individuals from non-rural and rural communities to survey questions regarding the use of stunning during

cattle, pig, and sheep slaughter, fish harvest and slaughter, and poultry slaughter ($p > 0.26$; Table 2.).

Significant differences in willingness to use pain management during and following bull castration were found between the different veterinary school tracks ($p=0.03$; Table 2.). Similar significant differences were found in the willingness to use pain management for cattle dehorning between the different tracks ($p=0.02$). The small animal track had the largest proportion of respondents who indicated they would use pain management for these two procedures ($n=69$; 97.2% for both). Those that chose to track general medicine had the second largest proportion of individuals who indicated they would use pain management for both procedures ($n=30$; 85.7% and $n=31$; 88.6%, respectively). Those that chose to track large animal medicine indicated the least propensity to use pain management during and following bull castration and cattle dehorning ($n=21$; 84.0% and $n=20$; 80.0%, respectively).

Before completing the course, less than 90.0% of students tracking small animal medicine believed stunning should be used during cattle, pig, and sheep slaughter. All respondents tracking large animal medicine indicated they believed stunning should be used during cattle, pig, and sheep slaughter whereas 88.7% ($n=63$) of those respondents tracking small animal and 94.3% ($n=33$) of those tracking general medicine believed in its use (Table 2.). However, the percentage of respondents tracking general animal medicine who agreed that stunning should be used for commercial fish harvest and slaughter ($n=29$; 82.9%) and poultry slaughter ($n=31$; 88.6%) was greater than the percentage of respondents tracking small ($n=58$; 81.7% and $n=58$; 81.7%, respectively) and large animal medicine ($n=20$; 80.0% and $n=21$; 84.0%, respectively). These were not found to be statistically significant differences ($p \geq 0.66$).

Discussion

In the past 20 years, there has been progress in the ability of veterinarians and cattle producers around the world to recognize pain in animals and to be willing to use pain management drugs.¹⁻⁵ Local anesthetic use with nerve blocks are widely used to control pain during procedures such as dehorning and castration but the use of drugs to control preoperative and postoperative pain and painful conditions in cattle is uncommon.⁶ Significant differences have been found between male and female practitioners in their response to how painful they rate certain conditions and procedures in animals, with females attributing greater pain experienced by the animal during conditions and procedures than males.^{1,3} In addition, veterinarians in the United States who were raised on farms, participated in FFA or 4-H, or graduated from a rural high school have been associated with rating procedures and conditions in animals as causing less pain to that animal than veterinarians not from these backgrounds.³ Veterinarians who attributed lower pain scores were also found to use less pain mitigation in cattle.¹

Pain management for dehorning and castration primarily has consisted of local anesthetics administered before the procedure to temporarily reduce surgical pain.^{5,7-10} Post-operative pain control, or NSAID use, by veterinarians in food animal treatment has been historically low and only recently have veterinarians begun to focus on post-operative or chronic condition pain management.^{1,4,6} In this study, significant differences in pre-course respondent willingness to use pain mitigation were not found between males and females. However, significant differences were found in pre-course respondent willingness to use pain mitigation in respondents from rural communities compared to non-rural communities and respondents who are tracking large animal medicine compared to those tracking small animal medicine. Specifically, respondents from rural communities indicated less commitment to using pain

mitigation during and following both bull castration and cattle dehorning. The unwillingness of respondents from rural communities to use pain mitigation in common husbandry procedures like dehorning and castration may be due to several factors. These respondents may be responding based on the culture's practices around which they lived for much of their younger lives. Respondents from rural communities may have grown up on a farm where pain mitigation was not used, as was common in past decades.^{6,11} If these respondents grew up on farms where their family declined pain management for various reasons, they may believe that other producers will act similarly. This may be a misconception on the part of the veterinarian. Producers may be more willing to pay a small fee for the welfare of the animal than veterinarians assume. However, regardless of the communities in which these respondents matured, it is the role of the veterinary college to educate all students equally, without consideration of their background, with the most up-to-date skills and information on pain management. Students should graduate determined to do all that is necessary to prevent unnecessary animal suffering such as providing analgesia during procedures that are known to cause significant pain^{9,11-14}.

Animal pain and pain management is one of the most widely discussed topics in the world of veterinary medicine and animal husbandry.^{1,6,15-17} It is well documented that dehorning and castration is painful to the animal.^{7,13,18-23} Before the course began, only slightly over 90% of students indicated they would use pain management for cattle dehorning and castration. The statement within the question regarding dehorning and castration included the words “before and after” and this could have impacted the percent agreement. It is possible that students indicated they would not use pain management because they would not use pain drugs to control post-procedural pain. However, it is disappointing to see that not all students who completed CSU's animal welfare course would at least attempt to include pain mitigation for cattle dehorning and

castration in their daily practice. Recent studies have found that over 95% of veterinarians in the United Kingdom at least use local anesthesia in cattle dehorning however use of any pain management during or following castration is less common.^{1,4} It is also worrisome that, before taking the course, those who were tracking large animal medicine were significantly more likely to not use pain management during and after cattle painful procedures than those tracking small animal or general medicine. It is possible that some of the same respondents from rural communities who indicated they would not use pain management are also members of the large animal medicine track. Regardless, before the course, a significant proportion of the third-year veterinary students who intended to work with large animals, such as livestock that regularly undergo the husbandry procedures of dehorning and castration, did not intend to mitigate the pain of these animals. Demographic data was not collected on post-course responses so it was not possible to document a change in attitude of respondents from rural communities or who were tracking large animal. However, these results suggest that the veterinary curriculum, without a specific welfare course, has insufficient instruction on the importance of pain mitigation in livestock, how to implement new and existing methods of pain mitigation, and how to influence clients to use pain management in their operations.

While many veterinary students may pursue careers far removed from livestock slaughter,²⁴ awareness of the methods used to humanely slaughter these animals and the current challenges faced by livestock industries in improving public acceptance of food animal production and processing is vital. By fostering understanding, correcting inaccuracies, and encouraging collaborative change through their veterinary-client relationships, veterinarians can make a significant impact on the welfare of numerous species of animals. In this study, there was found to be a significant change in respondent opinion regarding the use of stunning in poultry

slaughter between the pre- and post- survey responses. In the United States, a majority of poultry processing facilities use low-voltage electrical current or controlled atmosphere stunning prior to exsanguination.^{25,26} This process, when applied properly, renders the animal instantaneously insensible prior to slaughter and thereby eliminates the pain and stress experienced by the animal at exsanguination. Prior to completing the welfare course, only 82.0% of paired respondents and 84.0% of total respondents believed stunning should be used during poultry processing. This indicates that either, third-year veterinary students have not been taught about the poultry slaughter process and may not understand what the term “stunning” implies in the question, do not remember that particular lecture’s information, or that they truly do not believe rendering the animal insensible is necessary prior to exsanguination. Given that a significant increase in the proportion of respondents who agreed with the use of stunning was seen post-course, it seems likely that their education in poultry slaughter had been lacking.

It is troubling to acknowledge that not all post-course respondents believed stunning should be used in cattle, pig, and sheep slaughter. The AVMA Humane Slaughter Guidelines discuss multiple methods that can be acceptably used during the slaughter of multiple species.²⁵ Nationwide, with the exception of religious slaughter, stunning must be used with all three of these species in United States Department of Agriculture inspected processing plants and yet, before the course, ten veterinary students in a group of 131 either did not understand what stunning was or did not agree with its use. After completing the course which involved multiple discussions and multiple images of the stunning process, three students in a group of 125 did not agree with the use of stunning. It is possible that these three students disagreed with stunning for religious reasons. Another possible explanation is that these students may have been absent from class when this discussion was held or that despite the completion of this course, they have yet to

fully understand and appreciate the slaughter process. The issue of absenteeism during the course, which may have caused some students to miss vital information, should be addressed by expanding the instruction of welfare issues beyond a single course. By second semester third-year, veterinary students should not be learning about slaughter and stunning for the first time, but rather a course on animal welfare should build upon these basic concepts and aim to create larger discussions on current challenges and methods of improving these industries. Admittedly, three students may seem like an insignificant number of individuals, but when multiplied by the number of veterinary classes nationwide, that number becomes significant. Graduating veterinarians must be able to competently discuss how we, as a country, end animals' lives, particularly those animals we rely on for food. It is unacceptable to permit any number of students, who are expected to be professionals at the forefront of improving animal well-being and public understanding of the value of animals, to enter the workforce with such willful ignorance.

The introduction of an animal welfare course in the third-year veterinary curriculum at Colorado State University demonstrated improvements in student understanding of the practice of stunning used during slaughter within the poultry industry. The results of this survey also demonstrated the relationships between veterinary students from rural communities and those interested in large animal medicine and a decreased tendency to choose to use pain management during certain painful procedures with cattle.

Table 1. Total pre-course¹, total post-course², and paired³ (by matched ID codes) survey responses to questions containing binary responses

Survey Question	Proportion of Respondents Who Answered Yes (#)				
	Pre-Course N=131	Post-Course N=125	<u>Paired N=61</u>		P-value*
			Pre-Course	Post-Course	
Q17 ⁴	91.6% (120)	93.6% (117)	91.8% (56)	95.1% (58)	0.62
Q18 ⁵	91.6% (120)	97.6% (122)	91.8% (56)	100.0% (61)	0.07
Q19 ⁶	92.4% (121)	97.6% (122)	93.4% (57)	100.0% (61)	0.13
Q20 ⁷	81.7% (107)	88.0% (110)	83.6% (51)	95.1% (58)	0.07
Q21 ⁸	84.0% (110)	92.0% (115)	82.0% (50)	93.4% (57)	0.04

1 Total pre-course responses (n=131) ignoring ID code pairing

2 Total post-course responses (n=125) ignoring ID code pairing

3 All pre and post-course responses that were able to be paired by ID codes written by respondents on both pre-course and post-course surveys (n=61)

4 I would administer pain management during and following bull castration

5 I would administer pain management during and following cattle dehorning.

6 Stunning (rendering an animal insensible) should be used during cattle, pig, and sheep slaughter.

7 Stunning should be used during commercial fish harvest and slaughter (wild and farmed).

8 Stunning should be used during poultry slaughter.

*McNemar's Test

Table 2. Associations of Respondent Gender, Home Community, and Track with Pre-Course Survey Responses¹ to Questions Containing Binary Responses

	Q17 ²		Q18 ³		Q19 ⁴		Q20 ⁵		Q21 ⁶	
	Proportion of Respondents Who Answered Yes (#)	<i>p</i> *	Proportion of Respondents Who Answered Yes (#)	<i>p</i> *	Proportion of Respondents Who Answered Yes (#)	<i>p</i> *	Proportion of Respondents Who Answered Yes (#)	<i>p</i> *	Proportion of Respondents Who Answered Yes (#)	<i>p</i> *
Gender										
Male (n=21)	85.7% (18)	0.38	85.7% (18)	0.38	90.5% (19)	0.66	90.5% (19)	0.36	90.5% (19)	0.52
Female (n=110)	92.7% (102)		92.7% (102)		92.7% (102)		80.0% (88)		82.7% (91)	
Home Community										
Rural (n=30)	80.0% (24)	0.02	80.0% (24)	0.02	93.3% (28)	1.0	80.0% (24)	0.79	76.7% (23)	0.26
Non-Rural (n=101)	95.0% (96)		95.0% (96)		92.1% (93)		82.2% (83)		86.1% (87)	
Track										
Small Animal (n=71)	97.2% (69)		97.2% (69)		88.7% (63)		81.7% (58)		81.7% (58)	
Large Animal (n=25)	84.0% (21)	0.03	80.0% (20)	0.02	100.0% (25)	0.20	80.0% (20)	1.0	84.0% (21)	0.66
General (n=35)	85.7% (30)		88.6% (31)		94.3% (33)		82.9% (29)		88.6% (31)	

1 Total pre-course responses (n=131) ignoring ID code pairing

2 I would administer pain management during and following bull castration

3 I would administer pain management during and following cattle dehorning.

4 Stunning (rendering an animal insensible) should be used during cattle, pig, and sheep slaughter.

5 Stunning should be used during commercial fish harvest and slaughter (wild and farmed).

6 Stunning should be used during poultry slaughter.

* Fisher Exact Test

FOOTNOTES

a Apple Numbers, 2018, Apple Inc., Cupertino, CA

b R Software, version 1.1.383, R Core Team, Vienna, Austria

REFERENCES

1. Huxley JN, Whay HR. Current attitudes of cattle practitioners to pain and the use of analgesics in cattle. *Veterinary Record* 2006;159:662.
2. Hewson CJ, Dohoo IR, Lemke KA, et al. Canadian veterinarians' use of analgesics in cattle, pigs, and horses in 2004 and 2005. *The Canadian Veterinary Journal* 2007b;48:155-164.
3. Fajt VR, Wagner SA, Norby B. Analgesic drug administration and attitudes about analgesia in cattle among bovine practitioners in the United States. *Journal of the American Veterinary Medical Association* 2011;238:755-767.
4. Remnant JG, Tremlett A, Huxley JN, et al. Clinician attitudes to pain and use of analgesia in cattle: where are we 10 years on? *Veterinary Record* 2017;181:400.
5. Coetzee JF, Nutsch AL, Barbur LA, et al. A survey of castration methods and associated livestock management practices performed by bovine veterinarians in the United States. *BMC Veterinary Research* 2010;6:12.
6. Flecknell P. Analgesia from a veterinary perspective. *British Journal of Anaesthesia* 2008;101:121-124.
7. McMeekan C, Stafford KJ, Mellor DJ, et al. Effects of a local anaesthetic and a non-steroidal anti-inflammatory analgesic on the behavioural responses of calves to dehorning. *New Zealand Veterinary Journal* 1999;47:92-96.
8. Stafford KJ, Mellor DJ. Addressing the pain associated with disbudding and dehorning in cattle. *Applied Animal Behaviour Science* 2011;135:226-231.
9. Stock ML, Baldrige SL, Griffin D, et al. Bovine Dehorning: Assessing Pain and Providing Analgesic Management. *Veterinary Clinics of North America: Food Animal Practice* 2013;29:103-133.
10. Moggy MA, Pajor EA, Thurston WE, et al. Management practices associated with pain in cattle on western Canadian cow-calf operations: A mixed methods study. *J Anim Sci* 2017;95:958-969.
11. Faulkner PM, Weary DM. Reducing Pain After Dehorning in Dairy Calves. *Journal of Dairy Science* 2000;83:2037-2041.
12. Graf B, Senn M. Behavioural and physiological responses of calves to dehorning by heat cauterization with or without local anaesthesia. *Applied Animal Behaviour Science* 1999;62:153-171.
13. Molony V, Kent JE, Robertson IS. Assessment of acute and chronic pain after different methods of castration of calves. *Applied Animal Behaviour Science* 1995;46:33-48.
14. Hudson C, Whay H, Huxley J. Recognition and management of pain in cattle. *In Practice* 2008;30:126.
15. Thomsen PT, Gidekull M, Herskin MS, et al. Scandinavian bovine practitioners' attitudes to the use of analgesics in cattle. *Veterinary Record* 2010;167:256.
16. Laven RA, Huxley JN, Whay HR, et al. Results of a survey of attitudes of dairy veterinarians in New Zealand regarding painful procedures and conditions in cattle. *New Zealand Veterinary Journal* 2009;57:215-220.
17. Rutherford K. Assessing pain in animals. *Animal Welfare* 2002;11:31-53.

18. Petrie NJ, Mellor DJ, Stafford KJ, et al. Cortisol responses of calves to two methods of disbudding used with or without local anaesthetic. *New Zealand Veterinary Journal* 1996;44:9-14.
19. GrØNdahl-Nielsen C, Simonsen HB, Damkjer Lund J, et al. Behavioural, Endocrine and Cardiac Responses in Young Calves Undergoing Dehorning Without and With Use of Sedation and Analgesia. *The Veterinary Journal* 1999;158:14-20.
20. Sutherland MA, Mellor DJ, Stafford KJ, et al. Cortisol responses to dehorning of calves given a 5-h local anaesthetic regimen plus phenylbutazone, ketoprofen, or adrenocorticotrophic hormone prior to dehorning. *Research in Veterinary Science* 2002;73:115-123.
21. Stewart M, Stafford KJ, Dowling SK, et al. Eye temperature and heart rate variability of calves disbudded with or without local anaesthetic. *Physiology & Behavior* 2008;93:789-797.
22. Coetzee JF, Lubbers BV, Toerber SE, et al. Plasma concentrations of substance P and cortisol in beef calves after castration or simulated castration. *American journal of veterinary research* 2008;69:751-762.
23. Heinrich A, Duffield TF, Lissemore KD, et al. The effect of meloxicam on behavior and pain sensitivity of dairy calves following cautery dehorning with a local anesthetic. *Journal of Dairy Science* 2010;93:2450-2457.
24. AAVMC A. The 2017 AVMA and AAVMC Report on Veterinary Markets, 2017.
25. Leary S, Underwood W, Anthony R, et al. AVMA Guidelines for the humane slaughter of animals: 2016 Edition. 2016.
26. Johnson CL. A review of bird welfare during controlled atmosphere and electrical water-bath stunning. *Journal of the American Veterinary Medical Association* 2014;245:60-68.

APPENDIX B: SURVEY QUESTIONS INVESTIGATING THE KNOWLEDGE AND
OPINIONS OF THIRD YEAR VETERINARY STUDENTS RELEVANT TO ANIMAL
WELFARE BEFORE AND AFTER IMPLEMENTATION OF A CORE WELFARE COURSE

Survey: Animal Welfare Education at Colorado State University

The intent of this survey is to gain a better understanding of the current student perception and knowledge of animal welfare and ethics education at Colorado State University. Thank you for participating.

The survey responses are anonymous but in order to match the response between the two surveys you will take, a Survey ID code needs to be created. In the “Survey ID Code” location below please write down the last two letters of your mother’s maiden name and the first three digits in your hometown zip code.

Survey ID Code: _____

Please circle your response unless instructed otherwise.

Age: 15-19 20-24 25-29 30-34 35-39 40-44 45-50
 50+

Gender: Female Male Transgender Female Transgender Male Gender
variant/non-conforming

Not listed : _____ Prefer not to answer

How would you describe yourself? American Indian or Alaska Native Hispanic or Latino

Black or African American Hawaiian or Pacific Islander Caucasian Asian

Not defined: _____

Home Community: Urban Suburban/near a big city Rural/small town surrounded by
farming

Not defined: _____

Dietary Preferences: Non-vegetarian Vegetarian Vegan

Not defined: _____

1. What track have you selected for your upcoming 4th year?

Large Animal

Small Animal

General

2. What is your practice interest for future work after graduation?

Food Animal

Equine

Mixed

Companion Animal

Exotics or zoo medicine

Wildlife

Public Health/Public Policy

Laboratory Animal

Research

Academia

Advocacy

International

Other (please define) _____

3. It is important to have an animal welfare and ethics course as part of the veterinary curriculum.

1-strongly disagree

2-disagree

3-neutral

4-agree 5-strongly agree

Why or why not?

4. Is upholding and implementing the principles of animal welfare part of the veterinarian's oath?

Yes

No

5. When asked questions by members of your community about animal welfare, which categories do you feel prepared to discuss as an animal care professional?

Place a number 1-6 in the blanks, 1 being the most prepared and 6 being the least prepared.

_____ Food Animal
_____ Equine
_____ Lab Animals
_____ Exotic Species
_____ Companion Animals
_____ Wildlife

6. I feel confident that I know how to research an animal welfare topic, even one that I know very little about, in order to form an educated opinion that I can communicate to others.

1-strongly disagree 2-disagree 3-neutral 4-agree 5-strongly agree

7. When making an assessment of animal welfare, how would you rank the significance of these factors?

Place a number 1-8 in the blanks, 1 being the most valuable to your assessment and 8 being the least valuable.

_____ Physiological health (TPR, blood chemistries, body condition, etc)
_____ Reproductive success
_____ Presence/absence of injuries
_____ Expression of natural behaviors
_____ Presence of stereotypical behaviors
_____ Environmental/Housing Conditions
_____ Availability of Enrichment/Stimulation
_____ Growth and Production

8. How concerned are you with the state of animal well-being in the different categories of animals:

Food Animal

1-strongly concerned 2- concerned 3- mildly concerned 4-unsure 5-not concerned

Exotic Species

1-strongly concerned 2- concerned 3- mildly concerned 4-unsure 5-not concerned

Companion Animal

1-strongly concerned 2- concerned 3- mildly concerned 4-unsure 5-not concerned

Wildlife (not domestic)

1-strongly concerned 2- concerned 3- mildly concerned 4-unsure 5-not concerned

Lab Animal

1-strongly concerned 2- concerned 3- mildly concerned 4-unsure 5-not concerned

9. In a situation where economic benefit and animal welfare oppose each other, how do you rank the value you would place on the following in making your decision? Place a number 1-5 in the blanks, 1 being high consideration and 5 being low consideration.

_____ Animal
_____ Owner
_____ Yourself as the veterinarian
_____ Industry stakeholders
_____ The public

10. When evaluating the welfare of an animal on-site/at their home, name the first three indicators that you would assess.

1. _____ 2. _____ 3. _____

11. How influential should the listed individuals be in making animal welfare decisions within a community? Place a number 1-6 in the blanks, 1 being highly influential and 6 being minimally or not at all influential.

_____ Animal rights organizations/campaigners
_____ Politicians
_____ Animal Scientists
_____ General Public
_____ Animal Industry Members
_____ Veterinarians

12. Animal rights activists and animal welfare scientists share the same core beliefs.

True

False

13. As an expert in a particular animal type, I am obligated to be an advocate for the welfare of all animals in my community.

1-strongly disagree 2-disagree 3-neutral 4-agree 5-strongly agree

14. All animals are capable of experiencing pain.

Yes

No

If no, which type of animals do not _____

15. I would administer pain management during and following feline declaw procedures.

Yes

No

16. I would administer pain management during and following ear and tail docking procedures in canines.

Yes

No

17. I would administer pain management during and following bull castration.

Yes

No

18. I would administer pain management during and following cattle dehorning.

Yes

No

19. Stunning (rendering an animal insensible) should be used during cattle, pig, and sheep slaughter.

Yes

No

20. Stunning should be used during commercial fish harvest and slaughter (wild and farmed).

Yes

No

21. Stunning should be used during poultry slaughter.

Yes

No

22. Beagles housed at a research facility and provided with exercise have some psychological stress associated with the housing type.

1-strongly disagree

2-disagree

3-neutral

4-agree

5-strongly agree

23. Gestation crates are a necessary element of the pork industry.

1-strongly disagree

2-disagree

3-neutral

4-agree

5-strongly agree

24. Of the five examples of species with different housing, rank in order of concern for animal welfare (1=most concerning, 5=least concerning).

___ French lop rabbit(3yr old) housed in a 10" x 15" wire cage

___ Teacup poodle breeding dam housed in 15" x 20" wire cage

___ Dairy calf (4 wk old) housed in 10'x10' plastic hutch

___ Goldfish (2 yr old) housed in an 6" circular bowl

___ Bearded Dragon (5yr old) housed in a 1' x 2' glass tank

**APPENDIX C: SURVEY QUESTIONS INVESTIGATING ANALGESIA USE AND
FACTORS IMPACTING USE BY PRODUCERS AND VETERINARIANS IN THE DAIRY
AND BEEF CATTLE INDUSTRIES IN THE UNITED STATES**

Q1 Where is your operation located?

☐ Alabama (1)	☐ Kentucky (18)	☐ Ohio (36)
☐ Alaska (2)	☐ Louisiana (19)	☐ Oklahoma (37)
☐ Arizona (3)	☐ Maine (20)	☐ Oregon (38)
☐ Arkansas (4)	☐ Maryland (21)	☐ Pennsylvania (39)
☐ California (5)	☐ Massachusetts (22)	☐ Puerto Rico (40)
☐ Colorado (6)	☐ Michigan (23)	☐ Rhode Island (41)
☐ Connecticut (7)	☐ Minnesota (24)	☐ South Carolina (42)
☐ Delaware (8)	☐ Mississippi (25)	☐ South Dakota (43)
☐ District of Columbia (9)	☐ Missouri (26)	☐ Tennessee (44)
☐ Florida (10)	☐ Montana (27)	☐ Texas (45)
☐ Georgia (11)	☐ Nebraska (28)	☐ Utah (46)
☐ Hawaii (12)	☐ Nevada (29)	☐ Vermont (47)
☐ Idaho (13)	☐ New Hampshire (30)	☐ Virginia (48)
☐ Illinois (14)	☐ New Jersey (31)	☐ Washington (49)
☐ Indiana (15)	☐ New Mexico (32)	☐ West Virginia (50)
☐ Iowa (16)	☐ New York (33)	☐ Wisconsin (51)
☐ Kansas (17)	☐ North Carolina (34)	☐ Wyoming (52)
	☐ North Dakota (35)	☐ I do not reside in the United States (53)

West: WA (49), OR (38), CA(5), NV(29), UT(46), ID(13), MT(27), WY(52), CO(6)

Southwest: AZ(3), NM(32), TX(45), OK(37),

Midwest: ND(35), SD(43), NE(28), KS(17), MN(24), IA(16), MO(26), WI(51), IL(14), IN(15), MI(23), OH(36)

Southeast: AR(4), LA(19), MS(25), AL(1), TN(44), KY(18), GA(11), FL(10), SC(42), NC(34), WV(50), VA(48), DC(9), MD(21), DE(8)

Northeast: NJ(31), PA(39), RI(41), CT(7), NY(33), MA(22), VT(47), NH(30), ME(20)

Q2 Are you?

- ☐ Male (1)
- ☐ Female (2)

**Q3 Which of the following best describes your involvement with the cattle industry?
(Select all that apply.)**

- ☐ Producer (beef or dairy) (3)
- ☐ Veterinarian (2)
- ☐ Other (please specify): (1) ___ = Both vet and producer _____

Display This Question: If Q3 = Producer (beef or dairy)

Q4 Which of following apply to your operation? (Select all that apply.)

- ☐ Dairy (1)
- ☐ Calf Ranch (2)
- ☐ Feedlot (3)
- ☐ Stocker/Backgrounder (4)
- ☐ Cow-calf (5)
- ☐ Other (please specify): (6) _____

Display This Question: If Q3 = Veterinarian

Q5 Which of the following cattle operation types does your practice serve? (Select all that apply.)

- ☐ Dairy (1)
- ☐ Calf Ranch (2)
- ☐ Feedlot (3)
- ☐ Stocker/Backgrounder (4)
- ☐ Cow-calf (5)
- ☐ Other (please specify): (6) _____

Display This Question: If Q3 = Producer (beef or dairy)

Q6 How many head of the following do you have in inventory?

Beef cows (1)	Less than 50 cows (1)	50 to 199 cows (2)	200 to 499 cows (3)	500 to 999 cows (4)	1,000 cows or more (5)				
Cattle on feed (2)	Less than 1,000 head (1)	1,000 to 4,999 head (2)	5,000 to 9,999 head (3)	10,000 to 29,999 head (4)	30,000 to 49,999 head (5)	50,000 to 69,999 head (6)	70,000 head or more (7)		
Stocker/Backgrounders (3)	Less than 500 head (1)	500 to 999 head (2)	1,000 to 1,999 head (3)	2,000 to 4,999 head (4)	5,000 head or more (5)				
Dairy calves (4)	Less than 5,000 head (1)	5,000 to 9,999 head (2)	10,000 to 19,999 head (3)	20,000 head or more (4)					
Dairy cows (5)	Less than 50 cows (1)	50 to 99 cows (2)	100 to 199 cows (3)	200 to 499 cows (4)	500 to 999 cows (5)	1,000 to 1,999 cows (6)	2,000 to 4,999 cows (7)	5,000 to 9,999 cows (8)	10,000 cows or more (9)

Q7 How old are you?

- ☐ Under 20 (1)
- ☐ 21 to 30 (2)
- ☐ 31 to 40 (3)
- ☐ 41 to 50 (4)
- ☐ 51 to 60 (5)
- ☐ 61 to 70 (6)
- ☐ 1 (7)

Display This Question: If Q3 = Producer (beef or dairy)

Q8 Which of the following best describes your relationship with your cattle operation?

- ☐ Owner (1)
- ☐ Manager (2)
- ☐ Foreman (3)
- ☐ Supervisor (4)
- ☐ Herdsman (5)
- ☐ Farm/Ranch Hand (6)
- ☐ Milker (7)
- ☐ Other (please specify): (8) _____

Display This Question: If Q3 = Producer (beef or dairy)

Q9 What is the highest degree or level of school you have completed? If currently enrolled, highest degree received.

- ☐ Did not complete high school (1)
- ☐ High School (2)
- ☐ Some College, no degree (3)
- ☐ Trade/technical/vocational training (4)
- ☐ Associate Degree (5)
- ☐ Bachelor's Degree (6)
- ☐ Master's Degree (7)
- ☐ Professional Degree (JD, MD) (8)
- ☐ Doctorate Degree (PhD) (9)

Display This Question: If Q3 = Veterinarian

Q10 When did you graduate from veterinary school?

- ☐ Prior to 1970 (1)
- ☐ 1970-1980 (2)
- ☐ 1981-1990 (3)
- ☐ 1991-2000 (4)
- ☐ 2001-2010 (5)
- ☐ 2011-2018 (6)

Display This Question: If Q3 = Producer (beef or dairy)

Q11 How is your cattle operation classified?

- ☐ Conventional operation (1)
- ☐ USDA Certified Organic (2)
- ☐ Naturally-raised (non-hormone, antibiotic free) (3)
- ☐ Other (please specify): (4) _____

Display This Question: If Q3 = Producer (beef or dairy)

Q12 Are any of your cattle part of a verified program (such as Certified Humane, Source and Age Verified, American Grassfed, Process Verified)?

- ☐ Yes (1)
- ☐ No (2)

Display This Question: If Q12 = Yes

Q13 Which program or programs are your cattle part of?

Q14 In my operation or practice, I currently use pain management (local anesthetic (lidocaine), systemic analgesia (e.g. Aspirin/ Banamine®) with: (Select all that apply.)

- ☐ Calves less than 2 months of age (1)
- ☐ Calves 2 to 12 months of age (2)
- ☐ Adult cattle (more than 12 months of age) (3)
- ☐ Do not use pain management on any of my cattle (4)

Q15 How likely are you to use a local anesthetic (lidocaine) for the following conditions in calves less than 2 months of age?

	Never (1)	Sometimes (2)	About half the time (3)	Most of the time (4)	Always (5)	Would not perform this procedure (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Dehorning (3)	☐	☐	☐	☐	☐	☐
Abdominal surgery (4)	☐	☐	☐	☐	☐	☐

Q16 How likely are you to use a local anesthetic (lidocaine) for the following conditions in calves 2 to 12 months of age?

	Never (1)	Sometimes (2)	About half the time (3)	Most of the time (4)	Always (5)	Would not perform this procedure (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Dehorning (3)	☐	☐	☐	☐	☐	☐
Abdominal surgery (4)	☐	☐	☐	☐	☐	☐

Q17 How likely are you to use a local anesthetic (lidocaine) for the following conditions in ADULT cattle (over 12 months of age)?

	Never (1)	Sometimes (2)	About half the time (3)	Most of the time (4)	Always (5)	Would not perform this procedure (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Dehorning (2)	☐	☐	☐	☐	☐	☐
Abdominal surgery (including DA and Cesarean) (3)	☐	☐	☐	☐	☐	☐

Q18 How likely are you to use a systemic pain relief drug (analgesic) for the following conditions in calves less than 2 months of age?

	Never (1)	Sometimes (2)	About half the time (3)	Most of the time (4)	Always (5)	Would not perform this procedure (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Dehorning (3)	☐	☐	☐	☐	☐	☐
Abdominal surgery (4)	☐	☐	☐	☐	☐	☐
Branding (5)	☐	☐	☐	☐	☐	☐
BRD (Pneumonia) (6)	☐	☐	☐	☐	☐	☐
Lameness (7)	☐	☐	☐	☐	☐	☐

Q19 How likely are you to use a systemic pain relief drug (analgesic) for the following conditions in calves 2 to 12 months of age?

	Never (1)	Sometimes (2)	About half the time (3)	Most of the time (4)	Always (5)	Would not perform this procedure (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Dehorning (3)	☐	☐	☐	☐	☐	☐
Abdominal surgery (4)	☐	☐	☐	☐	☐	☐
Branding (5)	☐	☐	☐	☐	☐	☐
BRD (Pneumonia) (6)	☐	☐	☐	☐	☐	☐
Lameness (7)	☐	☐	☐	☐	☐	☐

Q20 How likely are you to use a systemic pain relief drug (analgesic) for the following conditions in ADULT cattle?

	Never (1)	Sometimes (2)	About half the time (3)	Most of the time (4)	Always (5)	Would not perform this procedure (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Dehorning (2)	☐	☐	☐	☐	☐	☐
Abdominal surgery (including DA and Cesarean) (3)	☐	☐	☐	☐	☐	☐
Branding (4)	☐	☐	☐	☐	☐	☐
BRD (Pneumonia) (5)	☐	☐	☐	☐	☐	☐
Lameness (6)	☐	☐	☐	☐	☐	☐
Mastitis (7)	☐	☐	☐	☐	☐	☐

Q21 Which pain relief drugs (analgesics) do you have knowledge of and feel comfortable using in your operation or practice? (Select all that apply.)

- ☐ Lidocaine (1)
- ☐ Oral Meloxicam (2)
- ☐ Meloxicam Injection (Metacam® Injection) (3)
- ☐ Flunixin (e.g. Banamine®) Injection (4)
- ☐ Flunixin (e.g. Banamine®) pour-on (5)
- ☐ Aspirin (6)
- ☐ Phenylbutazone (7)
- ☐ Ketoprofen (Anafen® Injection) (8)
- ☐ Other (please specify): (9) _____
- ☐ None of these (10)

Q22 How painful would you consider the following conditions to be in calves less than 2 months of age?

	No pain (1)	Mild (2)	Moderate (3)	Severe (4)	Very severe (5)	Worst pain imaginable (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Hot iron dehorning/ disbudding (3)	☐	☐	☐	☐	☐	☐
Paste dehorning/ disbudding (4)	☐	☐	☐	☐	☐	☐
Abdominal surgery/ umbilical abscess (5)	☐	☐	☐	☐	☐	☐
Freeze branding (6)	☐	☐	☐	☐	☐	☐
Hot iron branding (7)	☐	☐	☐	☐	☐	☐
BRD (Pneumonia) (8)	☐	☐	☐	☐	☐	☐
Lameness (9)	☐	☐	☐	☐	☐	☐
Ear tagging (10)	☐	☐	☐	☐	☐	☐
Skin lesions/Dermatitis (11)	☐	☐	☐	☐	☐	☐
Limb fracture (12)	☐	☐	☐	☐	☐	☐
Calving without assistance (13)	☐	☐	☐	☐	☐	☐
Calving with assistance (14)	☐	☐	☐	☐	☐	☐
Diarrhea (scours) (15)	☐	☐	☐	☐	☐	☐

Q23 How painful would you consider the following conditions to be in calves 2 to 12 months of age?

	No pain (1)	Mild (2)	Moderate (3)	Severe (4)	Very severe (5)	Worst pain imaginable (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Hot iron dehorning/ disbudding (3)	☐	☐	☐	☐	☐	☐
Paste dehorning/ disbudding (4)	☐	☐	☐	☐	☐	☐
Abdominal surgery/ umbilical abscess (5)	☐	☐	☐	☐	☐	☐
Freeze branding (6)	☐	☐	☐	☐	☐	☐
Hot iron branding (7)	☐	☐	☐	☐	☐	☐
BRD (Pneumonia) (8)	☐	☐	☐	☐	☐	☐
Lameness (9)	☐	☐	☐	☐	☐	☐
Ear tagging (10)	☐	☐	☐	☐	☐	☐
Skin lesions/Dermatitis (11)	☐	☐	☐	☐	☐	☐
Limb fracture (12)	☐	☐	☐	☐	☐	☐
Diarrhea (13)	☐	☐	☐	☐	☐	☐

Q24 How painful would you consider the following conditions to be in ADULT cattle (older than 12 months of age)?

	No pain (1)	Mild (2)	Moderate (3)	Severe (4)	Very severe (5)	Worst pain imaginable (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Hot iron dehorning/ disbudding (3)	☐	☐	☐	☐	☐	☐
Abdominal surgery (including DA and Cesarean) (4)	☐	☐	☐	☐	☐	☐
Freeze branding (5)	☐	☐	☐	☐	☐	☐
Hot iron branding (6)	☐	☐	☐	☐	☐	☐
BRD (Pneumonia) (7)	☐	☐	☐	☐	☐	☐
Lameness (8)	☐	☐	☐	☐	☐	☐
Ear tagging (9)	☐	☐	☐	☐	☐	☐
Acute Metritis (10)	☐	☐	☐	☐	☐	☐
Acute Mastitis (with fever) (11)	☐	☐	☐	☐	☐	☐
Skin lesions/Dermatitis (12)	☐	☐	☐	☐	☐	☐
Clinical mastitis (no fever) (13)	☐	☐	☐	☐	☐	☐
Calving without assistance (14)	☐	☐	☐	☐	☐	☐
Calving with assistance (15)	☐	☐	☐	☐	☐	☐
Diarrhea (16)	☐	☐	☐	☐	☐	☐

Q25 How important are the following factors in impacting your decision to use an analgesic drug in adult cattle and calves?

	Not at all important (1)	Slightly important (2)	Moderately important (3)	Very important (4)	Extremely important (5)
FDA Approval status (1)	☐	☐	☐	☐	☐
Cost of the drug (2)	☐	☐	☐	☐	☐
Recommendation of veterinarian (Producers only)	☐	☐	☐	☐	☐
Lack of sedative effect (4)	☐	☐	☐	☐	☐
Duration of Pain Control/ Analgesic effect of drug (5)	☐	☐	☐	☐	☐
Ease of administration (6)	☐	☐	☐	☐	☐
Short Withhold Period (7)	☐	☐	☐	☐	☐
Animal's ability to feel pain (8)	☐	☐	☐	☐	☐
Improving Safety of the caregiver/ operator (9)	☐	☐	☐	☐	☐
Improved production outcomes (10)	☐	☐	☐	☐	☐
How painful I consider the procedure to be (11)	☐	☐	☐	☐	☐
Time of onset of drug activity (12)	☐	☐	☐	☐	☐
Request of producer (Veterinarians only)	☐	☐	☐	☐	☐

Q26 What would you consider an acceptable cost/head for a course of analgesia for the following conditions/procedures for calves less than 2 months of age in your operation or practice? (Select one response for each)

	\$0 (1)	Less than \$5 (2)	\$5 to \$9.99 (3)	\$10 to \$19.99 (4)	\$20 to 29.99 (5)	\$30 or more (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Abdominal surgery/umbilical hernia repair (3)	☐	☐	☐	☐	☐	☐
Hot iron dehorning/disbudding (4)	☐	☐	☐	☐	☐	☐
Paste dehorning/disbudding (5)	☐	☐	☐	☐	☐	☐
BRD (Pneumonia) (6)	☐	☐	☐	☐	☐	☐
Lameness (7)	☐	☐	☐	☐	☐	☐
Mastitis (8)	☐	☐	☐	☐	☐	☐
Dystocia/Difficult birth (9)	☐	☐	☐	☐	☐	☐

Q27 What would you consider an acceptable cost/head for a course of analgesia for the following conditions/procedures calves 2 to 12 months of age in your operation or practice? (Select one response for each)

	\$0 (1)	Less than \$5 (2)	\$5 to \$9.99 (3)	\$10 to \$19.99 (4)	\$20 to 29.99 (5)	\$30 or more (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Abdominal surgery/umbilical hernia repair (3)	☐	☐	☐	☐	☐	☐
Hot iron dehorning/disbudding (4)	☐	☐	☐	☐	☐	☐
Paste dehorning/disbudding (5)	☐	☐	☐	☐	☐	☐
BRD (Pneumonia) (6)	☐	☐	☐	☐	☐	☐
Lameness (7)	☐	☐	☐	☐	☐	☐
Mastitis (8)	☐	☐	☐	☐	☐	☐
Dystocia/Difficult birth (9)	☐	☐	☐	☐	☐	☐
Acute Metritis (10)	☐	☐	☐	☐	☐	☐
Mastitis (11)	☐	☐	☐	☐	☐	☐

Q28 What would you consider an acceptable cost/head for a course of analgesia for the following conditions/procedures ADULT cattle (older than 12 months of age) in your operation or practice? (Select one response for each)

	\$0 (1)	Less than \$5 (2)	\$5 to \$9.99 (3)	\$10 to \$19.99 (4)	\$20 to 29.99 (5)	\$30 or more (6)
Surgical castration (1)	☐	☐	☐	☐	☐	☐
Band castration (2)	☐	☐	☐	☐	☐	☐
Abdominal surgery/umbilical hernia repair (3)	☐	☐	☐	☐	☐	☐
Hot iron dehorning/disbudding (4)	☐	☐	☐	☐	☐	☐
Paste dehorning/disbudding (5)	☐	☐	☐	☐	☐	☐
BRD (Pneumonia) (6)	☐	☐	☐	☐	☐	☐
Lameness (7)	☐	☐	☐	☐	☐	☐
Mastitis (8)	☐	☐	☐	☐	☐	☐
Dystocia/Difficult birth (9)	☐	☐	☐	☐	☐	☐
Acute Metritis (10)	☐	☐	☐	☐	☐	☐
Mastitis (11)	☐	☐	☐	☐	☐	☐

**** (Remnant adapted) Q29 Select the response that best reflects your opinion:**

	Agree (1)	Not sure (2)	Disagree (3)
Analgesics may mask deterioration in the animal's condition (1)	☐	☐	☐
Cattle benefit from receiving analgesic drugs as part of their treatment (2)	☐	☐	☐
Cattle that are experiencing a fever are in pain (3)	☐	☐	☐
Some pain is necessary to stop the animal becoming too active (4)	☐	☐	☐
Cattle recover faster if given analgesic drugs (5)	☐	☐	☐
Drug side effects limit the usefulness of giving analgesics to cattle (6)	☐	☐	☐
Most farmers are willing to pay the costs involved with giving analgesics to cattle. (7)	☐	☐	☐
The benefits of the analgesia outweighs the cost of the analgesia (8)	☐	☐	☐
Farmers would like cattle to receive analgesia but cost is a major issue (9)	☐	☐	☐
U.S./USDA/FDA regulations limit my ability to use analgesic drugs in cattle (10)	☐	☐	☐

Q30 How has your use of analgesics changed in the last 10 years? *Remnant

- ☐ Increased use (1)
- ☐ Stayed the same (2)
- ☐ Decreased use (3)

Display This Question: If Q30 = Increased use

Q31 Why has your use of analgesics increased? (Select all that apply.) *Remnant adapted

- ☐ New evidence of analgesic effectiveness (1)
- ☐ Requirement of a quality assurance program (2)
- ☐ Decreased prices for analgesics (3)
- ☐ Change in your perception of pain in cattle (4)
- ☐ Changing farmer or veterinarian attitudes (5)
- ☐ Change in practice or operation protocols (6)
- ☐ Influence from colleagues/fellow producers (7)
- ☐ Mandated by a retailer or packer (8)
- ☐ Maintain consumer confidence in livestock production practices (9)
- ☐ Cattle that receive analgesia look better than cattle that don't (10)
- ☐ Cattle that receive analgesia have improved health and performance (11)

Display This Question: If Q30 = Decreased use

Q32 Why has your use of analgesics decreased? (Select all that apply.)

- ☐ Currently available analgesic drugs are not effective at reducing pain (1)
- ☐ Currently available analgesic drugs are inconvenient to administer (2)
- ☐ Currently available analgesic drugs do not last long enough after 1 dose to justify their use (3)
- ☐ Currently available analgesic drugs are too expensive (4)
- ☐ I do not know the meat and milk withhold periods for the analgesic drugs (5)
- ☐ Currently available drugs do not improve health and performance (6)
- ☐ I am not comfortable using an analgesic unless it has been approved by FDA (7)

Display This Question: If Q3 = Producer (beef or dairy)

Q33 If you and your attending veterinarian disagree about the use or lack of use of pain management for your cattle, how likely would you proceed with the following courses of action? (Please select a choice for each course of action.)

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Find a different veterinarian who agrees with you (1)	☐	☐	☐	☐	☐
Take a chance and try what the veterinarian suggests (2)	☐	☐	☐	☐	☐
Argue with veterinarian until they do what you ask (3)	☐	☐	☐	☐	☐
Do what you want without the veterinarian knowing (4)	☐	☐	☐	☐	☐
Ask to be provided more information about pain in cattle/ perform your own research to either support or change your opinion (5)	☐	☐	☐	☐	☐

Display This Question: If Q3 = Veterinarian

Q34 If you and your client disagree about the use or lack of use of pain management for their cattle, how likely would you proceed with the following courses of action? (Please select a choice for each course of action.)

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Terminate the VCPR/ relationship with client (1)	☐	☐	☐	☐	☐
Do what the client asks (2)	☐	☐	☐	☐	☐
Argue with the client until they agree with your advice (3)	☐	☐	☐	☐	☐
Do what you want and charge the client accordingly (4)	☐	☐	☐	☐	☐
Perform your own research to either support or change your opinion or try to understand the client's wishes. (5)	☐	☐	☐	☐	☐

Display This Question: If Q3 = Veterinarian

Q35 How often do disagreements about the use of pain management in cattle affect your relationship with your producer?

- ☐ Daily (1)
- ☐ Once weekly (2)
- ☐ Few times monthly (3)
- ☐ Several times a year (4)
- ☐ Less than once a year (5)
- ☐ Never (6)

Display This Question: If Q3 = Producer (beef or dairy)

Q36 How often do disagreements about the use of pain management in cattle affect your relationship with your veterinarian?

- ☐ Daily (1)
- ☐ Once weekly (2)
- ☐ Few times monthly (3)
- ☐ Several times a year (4)
- ☐ Less than once a year (5)
- ☐ Never (6)

Q37 Do you consider that your knowledge about recognizing and treating pain in adult cattle and calves is adequate? ** Remant adapted

- ☐ Yes (1)
- ☐ No (2)

Q38 Where do you feel you have obtained most of your knowledge about recognizing and treating pain in adult cattle and calves? **Remnant adapted

- ☐ FFA/ 4-H training (1)
- ☐ College classes (2)
- ☐ Journals / articles (3)
- ☐ Continuing education (4)
- ☐ Personal Experience (5)
- ☐ Online training modules (6)
- ☐ Commercial literature / data sheets (7)
- ☐ Other (please specify): (8) _____

Display This Question: If Q3 = Veterinarian

Q39 Does the type of illness or procedure affect the likelihood of using a specific analgesic drug in the cattle you treat?

- ☐ Yes (1)
- ☐ No (2)

Display This Question: If Q39 = No

Q40 How likely are you to consider using the following analgesic drugs in cattle?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Lidocaine (1)	☐	☐	☐	☐	☐
Oral Meloxicam (2)	☐	☐	☐	☐	☐
Meloxicam Injection (3)	☐	☐	☐	☐	☐
Flunixin (Banamine) Injection (4)	☐	☐	☐	☐	☐
Flunixin (Banamine) pour-on (5)	☐	☐	☐	☐	☐
Aspirin (6)	☐	☐	☐	☐	☐
Phenylbutazone (7)	☐	☐	☐	☐	☐
Ketoprofen (8)	☐	☐	☐	☐	☐
Other (please specify): (9)	☐	☐	☐	☐	☐

Display Q41 to Q46: If Q39 = Yes

Q41 How likely are you to consider using the following analgesic drugs in calves at the time of dehorning?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Lidocaine (1)	☐	☐	☐	☐	☐
Oral Meloxicam (2)	☐	☐	☐	☐	☐
Meloxicam Injection (3)	☐	☐	☐	☐	☐
Flunixin (Banamine) Injection (4)	☐	☐	☐	☐	☐
Flunixin (Banamine) pour-on (5)	☐	☐	☐	☐	☐
Aspirin (6)	☐	☐	☐	☐	☐
Phenylbutazone (7)	☐	☐	☐	☐	☐
Ketoprofen (8)	☐	☐	☐	☐	☐
Other (please specify): (9)	☐	☐	☐	☐	☐

Q42 How likely are you to consider using the following analgesic drugs in calves at the time of castration?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Lidocaine (1)	☐	☐	☐	☐	☐
Oral Meloxicam (2)	☐	☐	☐	☐	☐
Meloxicam Injection (3)	☐	☐	☐	☐	☐
Flunixin (Banamine) Injection (4)	☐	☐	☐	☐	☐
Flunixin (Banamine) pour-on (5)	☐	☐	☐	☐	☐
Aspirin (6)	☐	☐	☐	☐	☐
Phenylbutazone (7)	☐	☐	☐	☐	☐
Ketoprofen (8)	☐	☐	☐	☐	☐
Other (please specify): (9)	☐	☐	☐	☐	☐

Q43 How likely are you to consider using the following analgesic drugs in calves at the time of branding?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Lidocaine (1)	☐	☐	☐	☐	☐
Oral Meloxicam (2)	☐	☐	☐	☐	☐
Meloxicam Injection (3)	☐	☐	☐	☐	☐
Flunixin (Banamine) Injection (4)	☐	☐	☐	☐	☐
Flunixin (Banamine) pour-on (5)	☐	☐	☐	☐	☐
Aspirin (6)	☐	☐	☐	☐	☐
Phenylbutazone (7)	☐	☐	☐	☐	☐
Ketoprofen (8)	☐	☐	☐	☐	☐
Other (please specify): (9)	☐	☐	☐	☐	☐

Q44 How likely are you to consider using the following analgesic drugs in lame cattle?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Lidocaine (1)	☐	☐	☐	☐	☐
Oral Meloxicam (2)	☐	☐	☐	☐	☐
Meloxicam Injection (3)	☐	☐	☐	☐	☐
Flunixin (Banamine) Injection (4)	☐	☐	☐	☐	☐
Flunixin (Banamine) pour-on (5)	☐	☐	☐	☐	☐
Aspirin (6)	☐	☐	☐	☐	☐
Phenylbutazone (7)	☐	☐	☐	☐	☐
Ketoprofen (8)	☐	☐	☐	☐	☐
Other (please specify): (9)	☐	☐	☐	☐	☐

Q45 How likely are you to consider using the following analgesic drugs in mastitis cattle?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Lidocaine (1)	☐	☐	☐	☐	☐
Oral Meloxicam (2)	☐	☐	☐	☐	☐
Meloxicam Injection (3)	☐	☐	☐	☐	☐
Flunixin (Banamine) Injection (4)	☐	☐	☐	☐	☐
Flunixin (Banamine) pour-on (5)	☐	☐	☐	☐	☐
Aspirin (6)	☐	☐	☐	☐	☐
Phenylbutazone (7)	☐	☐	☐	☐	☐
Ketoprofen (8)	☐	☐	☐	☐	☐
Other (please specify): (9)	☐	☐	☐	☐	☐

Q46 How likely are you to consider using the following analgesic drugs in cows at calving?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Lidocaine (1)	☐	☐	☐	☐	☐
Oral Meloxicam (2)	☐	☐	☐	☐	☐
Meloxicam Injection (3)	☐	☐	☐	☐	☐
Flunixin (Banamine) Injection (4)	☐	☐	☐	☐	☐
Flunixin (Banamine) pour-on (5)	☐	☐	☐	☐	☐
Aspirin (6)	☐	☐	☐	☐	☐
Phenylbutazone (7)	☐	☐	☐	☐	☐
Ketoprofen (8)	☐	☐	☐	☐	☐
Other (please specify): (9)	☐	☐	☐	☐	☐