INFLUENCE OF PROVIDER CHARACTERISTICS ON OPIOID PRESCRIBING BEHAVIOR AMONG IDAHO VETERINARIANS

by

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A thesis

submitted in partial fulfillment

of the requirements for the degree of

Master of Health Science in Health Promotion

Boise State University

May 2020

BOISE STATE UNIVERSITY GRADUATE COLLEGE

DEFENSE COMMITTEE AND FINAL READING APPROVALS

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Thesis Title: Influence of Provider Characteristics on Opioid Prescribing Behavior Among Idaho Veterinarians

Date of Final Oral Examination: 04 March 2020

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DEDICATION

To Finn, whose patience and lack of patience always kept me moving forward.

ACKNOWLEDGMENTS

First and foremost, I would like to express my sincere gratitude to Dr. Smith—it is no exaggeration to say that this project would not have succeeded without her. Her tremendous patience and steady encouragement during the evolution of this project kept me optimistic and moving forward. Her knowledge and expertise have offered invaluable direction and scholarship to this research; it has sincerely been a privilege to work under her guidance.

I want to express gratitude also to the rest of my thesis committee: Dr. Sarah Toevs and Dr. Leslie Tengelsen. Dr. Toevs brings a passion and dedication for public health that inspired and enriched my growth as a student. Her excitement and cheerful encouragement were always tangible—not just for this project, but for every undertaking I attempted throughout my graduate studies. Dr. Tengelsen's generosity to partner on this project offered me a chance to conclude my graduate career working on a topic that I found truly interesting and enjoyable. She kindly shared her valuable time and expertise, in addition to facilitating connections with all the veterinary stakeholders involved in this research.

Last but not least, I would like to thank my parents; I am successful in so many ways because of you, this thesis included. Thank you for your never-ending love, your prayers, your encouragement, and your parking pass. I am so lucky to have such great friends and family; your support made this thesis possible.

ABSTRACT

Opioid addiction and misuse have become widespread in the U.S. over the past decade, causing a rise in opioid related mortality. High opioid prescribing rates have led public health agencies to examine provider prescribing practices. Research has identified provider characteristics such as gender, age, and years of experience are predictive of opioid prescribing in human medical providers. Veterinarians are frequently licensed to prescribe opioids, yet less is known about the prescribing practices of veterinarians. From a public health perspective, it is important to explore the potential connection between veterinary medicine and the opioid epidemic. The current study assessed whether variations in provider characteristics have similar patterns of influence on veterinary prescribing behaviors. Survey participants (n=369, response rate 48%) were veterinarians currently practicing and licensed through the Idaho Board of Veterinary Medicine. A hierarchical multiple regression model was employed using the sum score of opioid prescribing frequency as the dependent variable ($F(4, 352) = 8.52$, $p < 0.05$, $R^2 = .09$). Four independent variables (gender, age, years of experience, and opioid education received in veterinary school) predicted provider characteristics. Of the characteristics selected for analysis, younger age and female gender significantly predicted higher opioid prescribing rates. When opioid education was included in the model, only gender remained significant. This study suggests that while physician characteristics can predict opioid prescribing behaviors in human healthcare providers, these characteristics do not seem to have the same influence on opioid prescribing in Idaho's veterinary population.

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LIST OF ABBREVIATIONS

AVMA	American Veterinary Medical Association
CDC	The Centers for Disease Control and Prevention
CSA	Controlled Substances Act
DEA	Drug Enforcement Administration
FDA	Food and Drug Administration
IBVM	Idaho Board of Veterinary Medicine
IDHW	Idaho Department of Health and Welfare
IVMA	Idaho Veterinary Medical Association
MME	Morphine Milligram Equivalents
NIH	National Institutes of Health
PDMP	Prescription Drug Monitoring Program

CHAPTER I: INTRODUCTION

The United States is in the midst of an opioid epidemic that according to the Centers for Disease Control and Prevention (2019) has already resulted in the deaths of over 700,000 people. In fact, medication overdose (caused by legal or illegal drugs, as well as medically prescribed and other drugs) has become the number one cause of accidental death in the United States (Kochanek, Murphy, Xu & Arias, 2019). Nationally, the drug-induced death rate has increased by nearly 40 percent over the past decade, while in the state of Idaho this rate has increased by more than 75 percent (Shaw-Tulloch, 2017). Government and public health agencies have mobilized in response to the crisis through law enforcement, legislation, education and other initiatives, yet these efforts to impact the opioid epidemic have primarily focused on human medical providers, pharmacists and patients. The role of veterinary medicine in the opioid epidemic remains largely unknown, even though many veterinarians hold DEA licenses and can prescribe, administer, carry, and dispense opioids. The general absence of targeted veterinary data has led to questions about the potential role the veterinary profession may play in the opioid crisis. In 2017, the American Veterinary Medical Association formed the Working Group on Opioid Issues and has called for more research to help determine the impact of veterinary prescribing practices on the human opioid epidemic (American Veterinary Medical Association [AVMA], 2020). State veterinary organizations have echoed this appeal, with the Idaho Veterinary Medical Association (IVMA) and the Idaho Board of

Veterinary Medicine (IBVM) requesting a more detailed understanding of the relationship between veterinarians and the current opioid epidemic.

Purpose of the Study

The CDC has identified the overprescribing of prescription opioids as one of the primary drivers behind the increase in the number of opioid overdoses; federal agencies monitoring and investigating the course of the opioid epidemic have identified the abuse of prescription opioids as the principal cause of drug overdose deaths (Wood, 2015). In response, government agencies and public health initiatives began aggressively targeting opioid prescribing practices with new dispensing guidelines, changes to manufacturing availability, and widespread implementation of prescription drug monitoring programs. Some states now require a background check before an opioid prescription can be written (Clarke, Drobatz, Korzekwa, Nelson & Perrone, 2019; McReynolds, 2019). Other guidelines limit the amount or duration of opioid prescriptions (Kogan, Hellyer, Rishniw & Schoenfeld-Tacher, 2019; McReynolds, 2019). Reduced manufacturing quotas for oxycodone, hydrocodone, oxymorphone, hydromorphone, morphine, codeine, meperidine, and fentanyl limit the availability of these analgesics for dispensing or prescribing (Balik, 2017). Despite these initiatives, the number of opioid prescriptions has increased disproportionately compared to the number of patient visits (Clarke et al., 2019; McReynolds, 2019). While the monitoring of opioid prescriptions has increased for medical providers, there is relatively little research concerning opioid prescribing practices in veterinary medicine. Surveys of veterinarians in other states have identified opioid prescribing practices to be a significant research gap (Mason, Tenney, Hellyer & Newman, 2018). In order to help address this gap, a survey questionnaire was created to

assess how Idaho veterinarians currently utilize and prescribe opioids in their clinical practice, evaluate opioid resources and education, and better understand their current awareness of the opioid crisis. This research will allow the IVMA, the IBVM, the Idaho Department of Health and Welfare and other stakeholders to make informed decisions, allocate resources, create targeted interventions, and better serve the public health needs of Idahoans.

Study Questions

This research study was undertaken to examine whether variations in provider characteristics can have any influence on veterinary opioid prescribing behavior. Specifically, this study aimed to determine whether variations in provider characteristics could predict the same patterns of opioid prescribing behavior in veterinarians as they do for human physicians. Gender, age, and years of experience were three variables chosen for this study as these are the provider characteristics frequently reviewed in analogous research studies surveying human medical providers. Research into the characteristics of human physicians examined an additional variable of interest to this study: provider education related to opioid training. To investigate the influence of provider education, opioid training received during veterinary school was also evaluated as an outcome variable in a separate prediction model.

Importance of the Study

Research has identified provider characteristics as a predictor of opioid prescribing patterns for human physicians; understanding and accounting for these factors is paramount to effective strategy development and may have a considerable impact on the success or failure of policies and programs designed to combat the opioid crisis.

Existing studies have identified the relationship between physician characteristics and opioid prescribing patterns in human medical practice; to our knowledge, similar research into the influence of veterinary provider characteristics on opioid prescribing behaviors has not yet been undertaken. A more comprehensive awareness of whether veterinary provider characteristics are predictive of opioid prescribing behaviors may help answer whether veterinarians, like physicians, have a role in the current opioid epidemic. The results of this study could provide a foundation for future research as well as inform strategies and interventions seeking to target opioid prescribing behaviors.

CHAPTER II: LITERATURE REVIEW

In recent decades, from the late 1990's through the present, the United States has experienced an unprecedented increase in the number of overdose-related deaths involving prescription and illicit opioid drugs (Centers for Disease Control and Prevention [CDC], 2018). In 2017, the scale of the opioid epidemic led the Department of Health and Human Services to declare the crisis a public health emergency (CDC, 2018). Investigations into the opioid crisis have traced the origins of this epidemic back to an increase in the rate of opioid prescriptions following growing advocacy for better pain management and a misunderstanding of opioid addiction potential (deShazo, Johnson, Eriator & Rodenmeyer, 2018). Between the late 1990s and early 2000s, patient advocacy groups such as the American Pain Foundation, the American Pain Society, and the International Association for the Study of Pain began gathering support for better access to pain management, including opioid therapy for chronic non-cancer pain (deShazo et al., 2018). Pharmaceutical companies and opioid manufacturers joined in support of opioid therapy for chronic pain, often providing physicians and patients with coupons for free supply. Pain studies, advocacy groups, and treatment guidelines supported by funding from the pharmaceutical industry minimized the abuse potential associated with opioid use; for example, drug-seeking by pain patients was considered a reflection of pain under-treatment (deShazo et al., 2018). Sales of prescription opioids quadrupled, despite reports of pain prevalence remaining the same (Kim, Nolan & Ti, 2017). The number of overdose related deaths began to rise, with over half (57%) the result of prescription

opioids (Coston, n.d.). Government and public health agencies mobilized, issuing recommendations limiting the quantity and duration of opioid prescriptions (Daly, Ulrich-Schad, Gu, Yingling & Ayres, 2019). The new guidelines resulted in a drop in opioid prescribing (by an average of eight pills per patient) and in some states reduced the opioid-related overdose deaths by half (Appleby & Lucas, 2019; Franklin et al., 2012). Recognizing that there was a relationship between increased opioid prescribing behavior and opioid dependence, interventions targeting prescribing behaviors were identified by the National Institute on Drug Abuse as having a "key role in stopping the opioid overdose epidemic" (2017).

Opioid Physiology

The opioid system is the biological mechanism whereby endogenous or synthetic opioid proteins interact with receptors throughout the body (Le Merrer, Becker, Befort & Kieffer, 2009). Opioid receptors are structural membrane proteins which become activated when bound to opioid proteins with a corresponding selectivity and affinity, similar to complementary puzzle pieces (Koneru, Satyanarayana & Rizwan, 2009). Four types of opioid binding sites have so far been identified: the *mu*, *delta*, *kappa*, and *orphanin FQ* opioid receptors (Stevens, 2009). Studies have confirmed the first three of these receptors result in a physiological analgesic effect when activated (Stevens, 2009).

Acting on these receptors are the four categories of opioids: agonists (which have a high affinity for *mu* receptors), partial agonists, antagonists (with affinity for both *mu* and *kappa* receptors) and mixed agonists/antagonists (McNerney, 2017). Agonists are drugs that, by binding to matching receptors, result in a biologic response; an antagonist, by contrast, is a drug that blocks the biological response from occurring (Kahn & Line,

2005). Activated opioid receptors control physiological responses such as blood pressure and body temperature, cardiac regulation, and respiration (Vuong, Van Uum, O'Dell, Lufty & Friedman, 2009). The location of opioid receptors throughout the body's central and peripheral nervous system, brain, and gastrointestinal tract is the reason opioid overdose requires such little effort—by occupying these receptors, the body is unable to perform its normal functions, including heartrate and breathing (U.S. National Library of Medicine, 2018).

Opioid Utilization in Veterinary Medicine

Human and animal medicine have had a common trajectory, sharing scientific achievement and discovery over the centuries—from the microscope and germ theory to anesthesia and pharmacologic advancement. Spinal anesthesia, such as that used during childbirth, can be attributed to the discovery that synthetic morphine administered into the spinal cord of a dog produced a temporary anesthetic effect (Goyal, 2015). The introduction of human ophthalmic surgery was made possible after it was discovered that a solution of cocaine applied to the eyes of a dog would produce a localized anesthetic effect (Goyal, 2015). Animals, like humans, have receptors capable of being activated by opioid agonists and antagonists. The *mu* opioid receptors in particular could be characterized as being one of the most well-conserved among animal species, including humans (Myers & Jung, 2009). While there is greater scientific familiarity with the opioid receptors in domestic animals such as dogs, cats and horses, or in laboratory research animals such as rats and mice, science has also discovered opioid receptors in reptiles, birds, fish, and even invertebrates such as the mollusk (KuKanish and Wiese, 2017).

Opioids are used in the treatment of animals for a variety of purposes depending on species and clinical need, but they function primarily for pain management (Dohoo & Dohoo, 1996). Even with differences in sensitivity and biological response between species, opioids remain one of the most effective treatments for acute pain (Kahn & Line, 2005). The plasticity of opioid analgesics is particularly important in veterinary medicine as there is a wide variety in patient size, species, temperament and metabolic demand. For example, opioid drugs can be combined—which allows for the dose-reduction of individual drugs—or even reversed, which increases patient safety (Kahn & Line, 2005). In addition, opioid administration routes can vary widely, allowing for flexibility in a diverse patient population; opioid administration may be oral, transmucosal, transdermal, intramuscular, intravenous, intraspinal, or inhaled depending on the drug and the species (Burwaiss, 2013).

Commonly used opioids in veterinary medicine include hydromorphone, morphine, fentanyl, codeine, hydrocodone, buprenorphine, butorphanol, and tramadol. Opioid drugs utilized within the scope of veterinary medical practice are regulated by either the Food and Drug Administration (responsible for drug safety) or the U.S. Drug Enforcement Agency (DEA). The DEA defines controlled substances under the federal Controlled Substances Act (CSA), but does not regulate the practice of veterinary medicine; regulations pertaining to the prescription of opioids and other controlled substances is under state control. In the state of Idaho, veterinary controlled substance regulations are outlined in Section 154 of the Idaho Administrative Code entitled, “Rules of the State Board of Veterinary Medicine,” which identifies requirements for appropriate

purchase, administration, dispensing, record-keeping, and disposal of controlled substances (Rules of the State Board of Veterinary Medicine of 1997).

Provider Characteristics and Opioid Prescribing Behavior

Public health agencies that include the CDC, the DEA, and the National Institutes of Health (NIH) have established a clear relationship between opioid over-prescribing and a patient's risk of opioid dependence (Meisenberg, Grover, Campbell & Korpon, 2018). While training and clinical indications predominantly guide the decision to prescribe an opioid, studies have found opioid prescribing behavior can also be predicted by gender, age, years of experience, and other provider characteristics (Lebovits, et al., 1997).

Gender

It has been well established within the medical literature that gender disparities exist in the process of clinical decision making. For example, male and female physicians have been found to differ in their decision to initiate preventative screening or whether or not to diagnose a medical condition (Hendersen & Weisman, 2001; McKinlay, Lin, Freund, & Moskowitz, 2002). They differ when deciding to order testing or whether to refer a patient to a specialist (Paull, 2015; Borum, 2000). Even surgical technique can vary between female and male surgeons performing the same procedure (Naidu & Patrick, 2011). Additionally, gender has been found to be predictive of opioid prescribing patterns. Varney et al. (2016) identified that female emergency department providers prescribed fewer opioids than males regardless of concern for prescription opioid abuse. Other studies have reinforced the influence that male gender has on increased opioid prescribing behaviors, with male gender frequently predicting for higher opioid rates

(Huang, Chang, Grogan, Martin & Raldow, 2019). A national survey of opioid prescribing practices found male surgeons more commonly reported not wanting their patients to be in pain (Linnaus et al., 2019).

Age

Investigation into the influence of physician age on healthcare outcomes is common in the medical literature. Studies have found that physician age can impact willingness to adjust practices in response to clinical evidence or new standards of treatment (Howard & Hockenberry, 2019). Age can also impact a physician's performance with respect to diagnosis, screening and preventative care measures (Tsugawa, Newhouse, Zaslavsky, Blumenthal & Jena, 2017). Relationships between patient mortality and physician age have also been observed (Tsugawa et al., 2017). Physician age was similarly found to predict opioid prescribing behavior, with younger physicians often prescribing fewer opioids than older physicians. A survey of emergency room providers found that influences on opioid prescribing behavior most strongly correlated with physicians younger than 35 years old (Varney et al., 2016). Other studies have found that younger providers were less confident in their ability to manage pain and so were more reluctant to prescribe opioids (Jamison, Sheehan, Scanlan, Matthews & Ross, 2014). Some providers have revealed outdated prescribing practices influenced by practice habits developed before the opioid crisis (Appleby & Lucas, 2019).

Experience

Clinical experience, or the number of years in practice, has also been found to be a significant predictor of provider variability in clinical decision-making. Provider experience can influence a physicians' estimate of patient survival during illness, or

whether to adhere to clinical treatment guidelines (Bach, Calhoun & Bennett, 1999; Cullas, Gunay, Topcu, & Ciftci, 2018). Experience has also been found to be predictive of opioid prescribing behavior. In general, attending doctors with more training and experience often prescribe more opioid medications than doctors with less experience (Varney et al., 2016). Providers with more years since graduation also predicted higher opioid prescription rates (Huang, Chang, Grogan, Martin & Raldow, 2019). Studies of emergency room physicians often identify a trend in increased opioid prescribing behavior by more experienced attending physicians, and that years in practice significantly predicts opioid prescriptions upon discharge (Leventhal, Nathanson & Landry, 2019; Varney et al., 2016). A national survey of surgeons found that attending physicians were less likely to consider opioid diversion when prescribing opioids, and residents with more experience were more likely to prescribe an increased quantity of opioids as a result of the inconvenience of calling a refill (Linnaus et al., 2019).

Tracking Veterinary Opioid Prescribing Behavior

Due to the lack of an effective data collection instrument, there is not a lot of information available about veterinary prescribing behavior. More is known about physician prescribing behaviors as a result of the widespread implementation of Prescription Drug Monitoring Programs (PDMPs). A PDMP is a comprehensive, electronic database used to collect information about a state's controlled-substance and opioid prescriptions (Norwood & Wright, 2016). In the scope of human medical care, PDMPs have become a valuable tool employed by government and public health agencies to combat the opioid epidemic by tracking provider prescribing information (Norwood & Wright, 2016). For example, after requiring PDMP utilization, some states

saw the number of patients who visited multiple physicians for the same drugs decline by as much as 75 percent (Cima, 2017). All 50 states have enacted legislation requiring these programs for the reporting of scheduled drugs for human use; currently only 20 states mandate reporting for veterinarians (Clarke et al., 2019). In the state of Idaho, reporting is voluntary—Idaho code 37-2726 exempts veterinarians from required registration with the Prescription Monitoring Program (Food, Drugs & Oil Act of 2005). Designed for human patients, utilization of state PDMPs for the purpose of understanding veterinary prescribing behavior is limited. PDMP databases have been unable to effectively navigate the incompatibility between human and animal medical records and can be further hindered by the lack of standardized recordkeeping software in veterinary medicine. Most state PDMPs are not able to differentiate between human and animal prescriptions, and without permanent, unique identifiers for veterinary patients, veterinarian PDMP access also raises issues of privacy rights when animal prescriptions are entered into the database linked to their owners' prescriptions (Cima, 2017).

With the inability to utilize PDMP databases effectively, veterinary medicine lacks an equivalent, effective means of collecting data related to prescribing behavior. This creates a gap in knowledge concerning opioid prescribing behavior that to be assessed, must utilize a different type of data collection instrument.

CHAPTER III: METHODS

Participants

Survey participants were recruited through the Idaho Board of Veterinary Medicine (IBVM) license registration database. Questionnaires were sent via email to 1,068 veterinarians; only currently practicing veterinarians licensed to practice in the State of Idaho were eligible to participate.

Participants ranged in age from 24 to 79 years, with the average age of respondents being 48 years old. Just over half of the participants identified themselves as female (55.4%), with 44.3% identifying as male, and 1% declining to respond. Years of experience practicing veterinary medicine was fairly evenly distributed among participants, ranging from fewer than five years (15.0%) to more than 30 years (23.3%), with the highest percentage of participants having 11-20 years of experience (25.0%). Respondents included representatives from every type of veterinary specialty, with the majority of participants (45.4%) selecting 'Small animal practice' as their veterinary specialty, followed next by 'Mixed animal practice' at 21.4%. Of these respondents, the majority (85.4%) hold a DEA license in the State of Idaho.

Survey Design

The initial survey themes were guided by a combination of global and national veterinary research studies. Search terms were developed for identifying literature relevant to opioid use in veterinary medicine. The results of the search revealed several recurring themes: 1. awareness and knowledge of opioid abuse by clients or staff, 2.

utilization and prescribing practices of opioids and other controlled substances, 3. attitudes and beliefs concerning opioids and controlled substances, 4. opioid and controlled substance education and training, and 5. the impact of the opioid epidemic on veterinary medicine, including the veterinarian's role in the epidemic. A review of similar surveys and questionnaires deployed by other state veterinary boards, national veterinary publications, and related industries (e.g. veterinary compounding pharmacies) narrowed the survey content and provided more focused questions with targeted language. The survey was created and distributed to a sample of local and state veterinarians from the Idaho Board of Veterinary Medicine (IBVM), the Idaho Veterinary Medical Association (IVMA), and the Idaho Department of Health and Welfare (IDHW) who assessed the survey for content, question ambiguity, and appropriate response selections. Their feedback was incorporated into the final version of the electronic survey.

This study's pilot survey was designed to develop a more detailed understanding of how veterinarians in Idaho are currently using and prescribing opioids and controlled substances. Consisting of 48 questions estimated to be completed within 15 minutes, the questionnaire consisted of five sections:

Section I: Demographics

Questions asked for demographic information such as gender, age, ethnicity, veterinary specialty (small animal practice, large animal practice, etc.), and number of years spent practicing veterinary medicine.

Section II: In-house Opioid Use

This section of the survey contained questions focused on the utilization of controlled substances (including opioids), centering on controlled substance use only

within the veterinary setting (i.e. pertaining to medications solely utilized *in* the practice, not sent home with clients/patients). Respondents were asked to identify the estimated frequency of controlled substance utilization from a list of the most commonly available Schedule II through Schedule IV medications. Respondents were asked to identify any difficulties or shortages of these drugs following interventions related to the opioid crisis, as well as to provide insight into the storage, access, and disposal of controlled substances within the practice.

Section III: Dispensing and Prescribing

This section asked respondents to answer questions regarding their controlled substance dispensing and prescribing practices (i.e. pertaining to medications to be administered to patients at home and excluding utilization within the practice setting). Questions aimed to gather information concerning where prescriptions were filled by clients, whether at human pharmacy, online pharmacy, or in-house pharmacy. Respondents were asked about which clinical circumstances warranted prescribing or dispensing of controlled substances (soft tissue surgery, cancer pain, etc.), and to estimate the frequency of controlled substances prescribed/dispensed.

Section IV: Awareness of Abuse Potential

Skip logic allowed respondents who neither used nor prescribed opioids to complete the remaining two sections (Section IV and V). Section IV of the survey explored awareness of abuse and/or diversion of controlled substances. Questions asked whether staff were knowledgeable about the potential for diversion, whether or not they were aware of any misuse within their practice or have observed any of the common warning signs of potential opioid abuse. Respondents were asked whether their opioid

prescribing practices had changed based on the recent publicity about opioid misuse, and whether they felt veterinarians played a role in the opioid crisis.

Section V: Education and Training

The final section of the survey explored veterinarians' opioid education and training, such as whether survey respondents had received training in veterinary school for the safe use, storage, and disposal of opioids, the potential for controlled substance abuse, and best practices for controlled substances. Veterinarians were asked if training was in place for staff to recognize the signs of opioid abuse, and whether respondents knew where to report suspicions of controlled substance abuse. Survey respondents were asked if they were interested in additional opioid education opportunities. (See Appendix A for a copy of the survey tool).

Both anonymous and confidential, all survey components were approved by the Boise State Institutional Review board. Survey questions were programmed into Qualtrics survey software, then electronically mailed to eligible veterinarians. The survey was sent out in September of 2019 and remained open for two weeks. Respondents were eligible for 2 Continuing Education (CE) credits for survey completion.

Measures

The following section describes how key study variables were collected and measured (see Table 1.1 for more information).

Gender

For the independent variable *gender,* participants were asked to answer one of the following three options: "Female," "Male," or "Other (please specify)." To maintain a straightforward interpretation of the regression coefficient, the latter was removed from

analysis, with the remaining variables coded using a 0/1 binary scheme and calculated as a categorical variable.

Experience

For the independent variable *years of experience*, participants were asked to select one of five options: "Less than 5 years," "6-10 years," "11-20 years," "21-30 years," or "More than 30 years." Responses were scored quantitatively as continuous ratio data.

Age

Participant age was calculated as a continuous variable after removing all incomplete and non-integer responses. Respondents were provided with a free-form text entry for the independent variable *age.*

Opioid-related Education

For the independent variable *veterinary opioid education,* participants were asked to respond to the following two questions: "In veterinary school, I was instructed on best practices for safe use, safe storage, and safe disposal of controlled substances (including opioids)," and "In veterinary school, I received training on the potential for abuse/misuse of controlled substances (including opioids)." Opioid education was calculated using a 5-point Likert scale cumulative total of the following responses: "Strongly agree," "Somewhat agree," "Neither agree nor disagree," "Somewhat disagree," and "Strongly disagree."

Opioid Sum Score

To calculate the sum score of opioids (i.e. opioid prescribing rate), representing the dependent variable, quantitative ratio data was collected from responses to questions 12, 13, 14, 27, 28, and 29 (see Appendix A) asking participants to estimate the number of

times per week they administer or prescribe certain controlled substances. For the purpose of this study, only responses to the following opioid controlled substances were included: hydromorphone, morphine, fentanyl, codeine, hydrocodone, buprenorphine, and butorphanol. To create the sum score, all responses that selected "More than 20 times" were given 5 points, "11-19 times" were assigned 4 points, "6-10 times" was assigned 3 points, "Fewer than 5 times" was given 2 points, and “Never” was assigned 1 point. All these responses were then summed across items to create one continuous measure of opioid prescribing behavior.

Data Analysis

At the completion of the survey window, Qualtrics data were downloaded into a Statistical Package for the Social Sciences (SPSS version 26.0) to perform statistical analyses. Descriptive statistics were calculated for the data on demographics including mean age, number of years in practice, and gender distribution (see Table 1.1). To examine the research question, a hierarchical multiple regression model was conducted to assess whether veterinarians’ characteristics, including gender, age, experience, and opioid education, could predict opioid prescribing rates. Using hierarchical multiple regression provided a variance model of analysis between these independent factors and the sum score of opioids prescribed as the dependent variable. The regression model was calculated using the standard multiple linear regression equation: $y = b1*x1 + b2*x2 + b3*x3\ldots + c$, where y = opioid prescribing rate, b = the regression coefficients for linear effect, c = the random error for y in observation, and x = each independent veterinary provider characteristic. Independent variables were entered simultaneously into the model; an F-test in one-way ANOVA was used to assess the overall significance of the

regression model. The strength of the relationship between the multiple regression model and the dependent variable was assessed with a goodness of fit measure indicated by R^2 (the coefficient of multiple determination).

CHAPTER IV: RESULTS

The purpose of this study was to assess whether variations in provider characteristics influence veterinary opioid prescribing behaviors. To predict opioid prescribing rate, a hierarchical multiple regression model was carried out. Gender, age, years of experience, and opioid education were chosen as independent predictors in the veterinary model. The multiple regression model representing age, gender, and experience predicted R^2 =.05, $F(3, 356) = 6.76$, $p < 0.05$. The variance model with all four predictors including opioid education produced R^2 =.09, $F(4, 352) = 8.52$, $p < 0.05$. Table 1.1 summarizes the descriptive statistics and analysis results for provider characteristics.

Table 1.1 Descriptive Statistics for Veterinary Provider Characteristics

		Gender	Age	Experience	Opioid Education
N	Valid	403	399	402	363
	Missing	25	29	26	65
Mean			47.79	3.21	13.3774
Median			47.00	3.00	13.0000
Std. Deviation			12.790	1.364	4.55515
Minimum			24	1	2.00
Maximum			79	5	30.00

The results of the regression indicated that 5.4% of the variance in opioid prescribing rate can be explained by veterinary provider characteristics. When including opioid education during veterinary school, the model improves slightly to predict 9% of

the variance. Both variance models met the F-test for overall significance. In the first variance model, two of the four independent variables were statistically significant, with younger age and male gender predicting higher opioid prescribing rates (see Table 1.2 for results).

Table 1.2 Multiple Regression Model for Gender, Age and Experience

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
(Constant)	15.853	1.217		13.025	.000
Age	-.113	.049	-.314	-2.317	.021
Gender	1.393	.477	.153	2.918	.004
Experience	.647	.447	.196	1.448	.148

Dependent variable Opioid prescribing rate
R^2= .054

In the second regression model, opioid education was included as an additional independent predictor and found to be significant ($p < 0.05$). Gender remained statistically significant in this analysis, with male gender predicting higher opioid prescribing than female gender, though age was no longer associated with a higher opioid prescribing rate. In both regression models, years of experience was not a significant predictor of opioid prescribing behavior. See Table 1.3 for a summary of multiple regression data including opioid education.

Table 1.3 Multiple Regression Model for Gender, Age, Experience and Education

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
(Constant)	15.632	1.198		13.045	.000
Age	-.087	.048	-.241	-1.787	.075
Gender	1.230	.471	.135	2.608	.009
Experience	.395	.445	.120	.889	.375
Opioid education	.035	.010	.187	3.615	.000

Dependent variable Opioid prescribing rate
R^2= .088

CHAPTER V: DISCUSSION

Researchers often select provider characteristics as a tool for outcome measures because attributes such as age or gender can influence behaviors in measurable and meaningful ways; exploring the degree of association between demographic variables and outcomes has a long historical presence in research studies (Goldberg, Sweeney, Merenda & Edward Hughes, Jr., 1998). Studying opioid prescribing behavior in association with provider characteristics has allowed researchers to conclude that the decision to prescribe an opioid may in some ways be influenced by age, gender, years of experience, or other provider characteristics (Lebovits et al., 1997). This is important considering that the decision to prescribe an opioid should follow evidence-based guidelines and not be influenced by provider characteristics (Lazkani et al., 2015).

This research was undertaken to examine whether variations in veterinary provider characteristics such as gender, age, experience and opioid education can predict opioid prescribing behaviors. These same provider characteristics have been shown to impact the opioid prescribing rate of human physicians, raising questions as to whether a similar pattern exists in veterinary medicine.

One significant predictor in our model was gender. Females tended to have slightly higher opioid prescribing rates as compared to male veterinarians. A possible reason for this may be because in general, female veterinarians score higher on empathy toward animals than their male colleagues, and female gender more positively correlates with issues of animal welfare (Colombo, Crippa, Calderari & Prato-Previde, 2017;

Apostol, Rebega & Miclea, 2013). Empathetic veterinarians have been shown to score animals' pain higher and have greater perception toward pain in animals (Colombo et al., 2017). This may result in the higher opioid prescribing behavior seen by female veterinarians in this study.

Another significant predictor in veterinarian prescribing behavior was age. Younger participants were associated with slightly higher prescribing rates, while studies of human physicians trended in the opposite direction, showing older physicians to be associated with higher prescribing rates (Varney et al., 2016). Notably, when the education variable was added into the model, age was no longer a significant predictor. This could be promising as education could be an effective route to intervention. This may also be why age was no longer significant when opioid education was introduced as a variable: pain management is not new to the veterinary curriculum, so veterinarians, regardless of age, would have experienced hours of training during medical school (Firth, 2016).

Finally, opioid education was significantly predictive of prescribing behavior in veterinarians. Interestingly, receiving more opioid education during veterinary school was associated with slightly increased opioid prescribing behavior. While this may seem contradictory, increased confidence has been found to be an important outcome of medical education regarding opioid prescribing practices (Pearson, Moman, Moeschler, Eldrige & Hooten, 2017). Providers who reported confidence in pain management were more likely to use a consistent approach when prescribing opioids and follow recommended protocols (Pearson et al., 2017). Perhaps not unrelatedly, veterinarians receive more education on pain management than other medical fields (Briggs, Carr, &

Whittaker, 2011; Miró, Castarlenas, Solé, *et al.*, 2019). On average, veterinary students receive 87 hours of pain education (Foreman, 2014). In addition, the American Veterinary Medical Association requires graduating students from accredited universities to have fulfilled nine competency areas, one of which is pain management (American Veterinary Medical Association, 2017). By contrast, medical students receive substantially less pain education than their veterinary colleagues. In the U.S., the American Association of Medical Colleges reported an average of only 8 to 16 hours of pain education across a 4-year medical education, and of the eight core competency areas laid out for graduating physicians by the AAMC-HHMI Scientific Foundations for Future Physicians Committee, none mention pain (Foreman, 2014; Association of American Medical Colleges, 2009). The relationship between veterinary education and opioid prescribing seen in this study may help inform interventions targeting prescribing behaviors, as findings from human medical literature consistently demonstrates a lack of physician confidence in prescribing opioids (Pearson et al., 2017; Jamison, Scanlan, Matthews, Jurcik & Ross, 2016).

Limitations

While there is value in the findings of the current study, this research has potential limitations due to the challenges of the survey tool. Although the questions in this pilot survey were guided by a review of comparable veterinary questionnaires and thoroughly evaluated by content-experts from three different veterinary stakeholder groups, time and scope allowed for only a preliminary validation of the survey tool. For example, the data analysis phase revealed some unanticipated question interpretation discrepancies that were not identified during the original content assessment. Additionally, survey questions

were not always measured in meaningful ways that reflected real clinical practice outcomes. For instance, *years of experience* was grouped into categories not necessarily reflective of meaningful experience thresholds in practice. In future iterations of this study, additional questions with refined measurement would allow for additional predictors to be tested in the model; better developed questions would be able to capture clinical use differences across specialty and how those variables reflect prescribing behaviors. The current survey questions did not make such an investigation possible.

Second, this study utilized the sum score of opioids to calculate opioid prescribing behavior. This grouped prescribing behavior into frequency categories which may not have accurately reflected the full range and nuance of opioid prescribing behaviors. Improving upon opioid surveillance measures would eliminate the limitations of creating one continuous measure of opioid prescribing behavior as was calculated by the opioid sum score in this study. For example, a more robust measurement of opioid prescribing rate would be beneficial, such as the value of morphine milligram equivalents (MME) commonly used to measure trends in opioid prescribing behavior. The questions used to calculate the opioid sum score also required participants to estimate how many times a week they used a particular drug, which could be challenging to remember and invites the potential for recall bias.

Suggestions for Future Research

The results of this study indicate that provider characteristics do not account for a large percentage of the variance in veterinary opioid prescribing behavior as predicted by the opioid prescribing patterns of human physicians. This suggests that given the unique complexities of the veterinary profession, additional population-specific research is

needed to understand what factors do influence veterinary prescribing behavior. Unfortunately, there is not a lot of information available about veterinary prescribing behavior, and even fewer veterinary studies exploring opioid prescribing behavior. One previous study conducted open interviews of veterinarians (n=5) to gain information on veterinary prescribing and dispensing processes, but this kind of research is labor intensive and not feasible for large-scale data collection (McDowell et al., 2011). Another study by Clarke et al. (2019) obtained pharmacy records and conducted a retrospective (11 year) cross-sectional review of all opioid prescriptions dispensed or prescribed within the setting of a large, acute-care veterinary teaching hospital. While this kind of study offers a more precise measurement of opioid prescribing behavior by removing the limitations of self-reporting or potential recall bias, the results of this study were restricted to one facility in one state, limiting generalizability for veterinarians in general practices and hospitals in other states. Research would benefit from a measurement tool with the ability to capture similar opioid prescribing data across different practice types and locations.

Future veterinary studies exploring opioid prescribing behavior should also consider a deeper investigation into what constitutes risky opioid prescribing behavior by veterinarians. This study did not measure risky prescribing behaviors as data were captured in a way that made it hard to identify risk thresholds. For example, while the results of this study suggest provider confidence may potentially be the result of opioid training received during medical school, it is unknown whether this is associated with safe or risky opioid prescribing behavior. There are a number of assessment tools designed to measure opioid prescribing risk available to providers. These instruments rely

on stratification of the dangers associated with patient addiction and misuse potential, however, many of these assessments are self-administered by patients or otherwise have no application to animal patients in a veterinary setting. Future research would benefit from a targeted measurement of risky opioid prescribing behavior developed from clinical guidelines and opioid-prescribing protocols, applicable to veterinary providers.

Conclusions

The high overdose mortality of the opioid crisis has led public health agencies such as the CDC, the DEA and the NIH to identify opioid over-prescribing behavior as a primary driver in the opioid epidemic. Veterinarians are a subset of opioid prescribers, so from a public health perspective, it is important to explore the potential connection between veterinary medicine and the opioid epidemic. While veterinarians and physicians share many common factors as medical providers, this study offers some evidence that although provider attributes such as gender, age or experience can predict higher opioid prescribing rates for human physicians, these characteristics are less likely to influence opioid prescribing for veterinarians.

While the limits of this study cannot explain what factors cause variance in veterinary opioid prescribing, these findings support the conclusion that they are different from the factors influencing opioid prescribing behavior for human providers. Because veterinary provider characteristics are not highly predictive of opioid prescribing behavior, these findings could help inform and prioritize public health interventions, time, and resources targeting veterinary opioid practices.

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APPENDIX A

Idaho Veterinary Opioid Survey

Default Question Block

The Idaho Board of Veterinary Medicine (IBVM), the Idaho Veterinary Medical Association (IVMA), and the Idaho Department of Health and Welfare (IDHW) would like to develop a more detailed understanding of how veterinarians in Idaho are impacted by the current opioid epidemic. The IBVM, IVMA, and IDHW have partnered with the Department of Community and Environmental Health at Boise State University in an attempt to understand how veterinarians are using and prescribing opioids, assess awareness/knowledge of opioid misuse, and determine the educational and resource needs of veterinarians in Idaho.

Participation in this survey is voluntary. The survey should take approximately 20 minutes or less to complete. We ask that you try to answer all questions, however, you are free to skip any questions that you may prefer not to answer. **Even if you do not prescribe opioids, please let us know by taking the first few questions of the survey.** All information provided will be kept confidential and will not be linked to the responder. Survey results will be combined and summarized to ensure anonymity.

Survey participants will be eligible for 2 hours of continuing education (CE) credit. If you choose to complete the survey and click submit, you will be prompted to follow a separate link that will ask you for your information. This will allow CE credits to be applied without linking your identity to survey responses.

If you have any questions about this survey, or would like more information about this project, please contact Dr. Megan L. Smith at mlsmith@boisestate.edu or by phone at 208-426-3335 who is supervising this graduate thesis project. If you have questions about your rights as a research participant, or would like to talk to someone other than the researcher, you may contact the Boise State Institutional Review Board between 8:00 AM and 5:00 PM, Monday through Friday, by calling (208) 426-5401, or by writing: Institutional Review Board, Office of Research Compliance, Boise State University, 1910 University Drive, Boise, ID, 83725-1138.

By proceeding with the survey, you consent to have read this form and to participate in the project described above.

Are you currently a practicing veterinarian?

Yes

No

How many years have you been practicing veterinary medicine?

Less than 5 years
6 - 10 years
11- 20 years
21 -30 years
More than 30 years

Which best describes your veterinary specialty?

Small animal practice
Large animal practice
Mixed animal practice
Equine practice
Shelter veterinarian
Emergency/Specialty
Government
Education/Research
Industry
Other

In your practice, how many patients do you see, on average, per month?

How many veterinarians including yourself, work at your practice?

How many staff (excluding veterinarians) work at your practice?

Which gender do you identify as?

Female

Male

Other (please specify):

What is your ethnicity?

White
Black or African American
American Indian or Alaska Native
Asian
Native Hawaiian or Pacific Islander
Other

What is your age (in years)?

Do you currently have a DEA license?

Yes
No

Do you currently **administer** (on-site at your practice) OR **prescribe/dispense** (to be taken at home) any controlled substances to your patients?

I only **administer** on-site. (I do not prescribe for at-home patient use.)
I only **prescribe/dispense** for at-home patient use. (I do not administer on-site).
Yes, I both **administer** on-site and **prescribe/dispense** for at-home patient use.
No

The following questions will pertain to your practices regarding **administration** of controlled substances.

Administration refers to on-site utilization only at your practice, and does not include drugs dispensed or prescribed for at-home patient use.

Identify which Schedule II controlled substances you **administer** to your patients and estimate the number of times per week they are administered:

	Schedule II				
	Never	Fewer than 5 times	6 - 10 times	11 - 19 times	More than
Hydromorphone (Dilaudid)	○	○	○	○	○
Morphine	○	○	○	○	○
Fentanyl (Duragesic, Sublimaze)	○	○	○	○	○
Codeine	○	○	○	○	○
Hydrocodone (Tussigon, Hycodan)	○	○	○	○	○

Identify which Schedule III controlled substances you **administer** to your patients and estimate the number of times per week they are administered:

	Schedule III				
	Never	Fewer than 5 times	6 - 10 times	11 - 19 times	More than 20
Ketamine	○	○	○	○	○
Tiletamine/ Zolazepam (Telazol)	○	○	○	○	○
Pentobarbital/ Phenytoin (Beuthanasia, Euthasol)	○	○	○	○	○
Buprenorphine (Buprenex, Simbadol, Suboxone)	○	○	○	○	○

Identify which Schedule IV controlled substances you **administer** to your patients and estimate the number of times per week they are administered:

	Schedule IV				
	Never	Fewer than 5 times	6 - 10 times	11 - 19 times	More than 2(
Alfaxalone (Alfaxan)	O	O	O	O	O
Alprazolam (Xanax)	O	O	O	O	O
Butorphanol (Torbugesic, Torbutrol, Stadol)	O	O	O	O	O
Midazolam (Versed)	O	O	O	O	O
Diazepam (Valium)	O	O	O	O	O
Phenobarbital	O	O	O	O	O
Tramadol (Ultram)	O	O	O	O	O

In which of the following circumstances do you **administer** controlled substances on-site in your practice (**select all that apply**)?

Routine surgery
Orthopedic surgery
Neurologic surgery
Soft tissue surgery
Invasive diagnostic procedures
Acute traumatic pain
Chronic non-cancer pain
Chronic cancer pain
Seizures
Coughing
Anxiety
Euthanasia
Other

In the past 12 months, have you had difficulty obtaining the supply you require of controlled substances?

If yes, which product(s):

No

If you have experienced a shortage of any controlled substance in the past year, please indicate how you believe that this shortage has influenced heath outcomes in your patients (**select all that apply**):

Patient deaths likely occurred
Patient suffering increased
Procedures were postponed
Non-narcotic pain relief strategies had to be employed
A local anesthetic was used instead
No change in practice
Other

In your practice, who has access to controlled substances?

Just veterinarians
Veterinarians and other staff

How are controlled substances typically stored in your practice?

Locked drawer
Locked closet or cabinet
Individual locked boxes for each veterinarian
Narcotic safe
Portable lock box
Automated Dispensing Cabinet (e.g. Omnicell, Cubex, etc.)

Other

In the past 5 years, my practice has taken additional precautions to secure our controlled substances.

Strongly agree
Somewhat agree
Neither agree nor disagree
Somewhat disagree
Strongly disagree

The following questions will pertain to your practices regarding **prescribing** of controlled substances.

*Prescribing refers to drugs **dispensed or prescribed for at-home patient use,** and does not include drugs used on-site in your practice. Prescribed drugs may be dispensed from your practice, from a human pharmacy, from an online veterinary pharmacy, etc.*

Do you prescribe any of your controlled substances through a human pharmacy for pick-up?

Yes
No

Approximately what percentage of your total controlled substance prescriptions do you estimate you send to a human pharmacy for dispensing?

Do you prescribe any of your controlled substances though an online veterinary pharmacy?

Yes
No

Approximately what percentage of your total controlled substance prescriptions do you estimate you send to an online veterinary pharmacy for dispensing?

Does your practice dispense controlled substance prescriptions directly to the client (from practice inventory)?

Yes
No

What percentage of total controlled substances prescriptions do you estimate your practice dispenses directly to the client?

In which of the following circumstances do you **prescribe or dispense** controlled substances (**select all that apply**)?

Routine surgery
Orthopedic surgery
Neurologic surgery
Soft tissue surgery
Invasive diagnostic procedures
Acute traumatic pain
Chronic non-cancer pain
Cancer pain
Seizures

Coughing

Anxiety

Other

Identify which Schedule II controlled substances you **prescribe/dispense** to your patients and estimate the number of times per week they are prescribed:

	Schedule II				
	Never	Fewer than 5 times	6 - 10 times	11 - 19 times	More than
Hydromorphone (Dilaudid)	○	○	○	○	C
Morphine	○	○	○	○	C
Fentanyl (Duragesic, Sublimaze)	○	○	○	○	C
Codeine	○	○	○	○	C
Hydrocodone (Tussigon, Hycodan)	○	○	○	○	C

Identify which Schedule III controlled substances you **prescribe/dispense** to your patients and estimate the number of times per week they are prescribed:

	Schedule III				
	Never	Fewer than 5 times	6 - 10 times	11 - 19 times	More than 20
Ketamine	○	○	○	○	○
Tiletamine/ Zolazepam (Telazol)	○	○	○	○	○
Buprenorphine (Buprenex, Simbadol, Suboxone)	○	○	○	○	○

Identify which Schedule IV controlled substances you **prescribe/dispense** to your patients and estimate the number of times per week they are prescribed:

	Schedule IV				
	Never	Fewer than 5 times	6 - 10 times	11 - 19 times	More than 2(
Alfaxalone (Alfaxan)	O	O	O	O	O
Alprazolam (Xanax)	O	O	O	O	O
Butorphanol (Torbugesic, Torbutrol, Stadol)	O	O	O	O	O
Midazolam (Versed)	O	O	O	O	O
Diazepam (Valium)	O	O	O	O	O
Phenobarbital	O	O	O	O	O
Tramadol (Ultram)	O	O	O	O	O

How important is the schedule/class of drug when you are making decisions about controlled substances for the client to administer at home?

Extremely important

Very important

Moderately important

Slightly important

Not at all important

When you prescribe opioid medications for your patients for at-home use, do you or your staff take time to educate owners on:

	Always	Most of the time	About half the time	Sometimes	Never
Safe use?	O	O	O	O	O
Safe storage?	O	O	O	O	O
Safe disposal?	O	O	O	O	O
The class of drug and its potential for abuse/misuse?	O	O	O	O	O

	Always	Most of the time	About half the time	Sometimes	Never
What to do in the event of a suspected/known overdose?	○	○	○	○	○

The following questions pertain to **drug diversion**.

Drug diversion is the illicit transfer or use of any legally prescribed controlled substance from the patient for whom it was prescribed to another person.

In general, do you consider drug diversion of controlled substances (including opioids) by veterinary personnel or clients to be a common problem?

Yes

No

In the past 5 years, do you believe that the opioid drug abuse/misuse problem has gotten better, worse, or remained the same?

Gotten better

Gotten worse

Remained the same

The DEA suggests four (4) warning signs that a client is potentially abusing/misusing a controlled substance, including opioids.
(1) Suspicious injuries to an established or new patient
(2) Asking for a specific medication by name
(3) Asking for refills for lost or stolen medication
(4) The pet owner is insistent in their request

How frequently do you believe you have observed any of these warning signs displayed by your practice clientele during the past 12 months?

Never Sometimes Often

	Never	Sometimes	Often
Suspicious injuries to an established or new patient	○	○	○
Asking for a specific medication by name	○	○	○
Asking for refills for lost or stolen medication	○	○	○
The pet owner is insistent in their request	○	○	○

Since you have been in practice, have you been aware of any abuse/misuse of opioids in your practice? **(Select all that apply)**

Yes, I am aware of some clients diverting opioids for their own use.

Yes, I am aware of some staff in my practice diverting opioids for their own use.

No, I am not aware of any clients or staff diverting opioids for their own use.

Have there been any break-ins/burglaries of controlled substances (including opioids) at your practice in the last 5 years?

Yes

No

Have your prescribing practices regarding controlled substances (including opioids) changed based on recent publicity about opioid abuse/misuse?

Yes

No

As a veterinarian, do you feel that veterinarians play a role in the current opioid crisis?

Yes

No

In veterinary school, I was instructed on best practices for safe use, safe storage, and safe disposal of controlled substances (including opioids).

Strongly agree
Somewhat agree
Neither agree nor disagree
Somewhat disagree
Strongly disagree

In veterinary school, I received training on the potential for abuse/misuse of controlled substances (including opioids).

Strongly agree
Somewhat agree
Neither agree nor disagree
Somewhat disagree
Strongly disagree

Do you have training and/or procedures in place for veterinary staff in your practice to recognize the signs of opioid abuse/misuse?

Yes
No

Do you know where to report suspected diversion of controlled substances (including opioids) by clients or staff?

Yes
No

I would be interested in receiving training on opioid abuse/misuse through continuing education.

Yes
No