IDENTIFYING EQUINE VETERINARIANS' CONTINUING EDUCATIONAL NEEDS IN EQUINE NUTRITION

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IN EQUINE NUTRITION

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Title of Study: IDENTIFYING EQUINE VETERINARIANS' CONTINUING EDUCATIONAL NEEDS IN EQUINE NUTRITION

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Abstract: A growing population of horses is suffering from nutrition-related disorders (Hoffman, Costa, & Freeman, 2009). Horse owners rely on equine veterinarians as their primary source of information regarding the health, disease prevention, and nutrition of their animals (AAHA, 2003; Bushell & Murray, 2016; Hartmann, et al., 2017; Laflamme et al., 2008; Martinson et al., 2006; Michel et al., 2008; Murray et al., 2015; Swirsley et al., 2017; USDA, 2015; USDA, 1998). After thorough review of the literature, it appears needs assessments of equine veterinarians in the United States is lacking in the area of equine nutrition. The aim of this study was to identify educational needs in equine nutrition of licensed veterinarians in the United States using the Borich (1980) needs assessment model. This study was framed by the human capital theory, which is centered on a person's acquisition of knowledge, skills, abilities, experiences, and education (Becker, 1964; Coff, 2002; Little, 2003; Shultz, 1971; Smith, 2010; Smylie, 1996). Results of this study found veterinarians rank themselves highly as a nutritional resource, outranking every source of equine nutrition except a PhD equine nutritionist. Veterinarians appear to have a lack of respect for university faculty and very little desire to participate in research related to equine nutrition. Veterinarians reported low confidence levels in equine nutrition when leaving veterinary school and have a lack of desire to pursue continuing education in the field of nutrition. Veterinarians are more likely to participate in continuing education offered online. Stakeholders should consider increasing veterinarians' awareness of the increase in human capital that will occur by improving a skill set such as equine nutrition knowledge. Curriculum should be enhanced regarding the role nutrition plays in the following categories: arthritis/joint pain, insulin resistance, equine gastric ulcer syndrome, equine metabolic syndrome, and performance horses. Veterinarians also should be taught how to assess nutritional status during a general wellness examination.

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CHAPTER I

INTRODUCTION

"Knowledge of nutrition is vital for veterinarians to inform owners about care of healthy animals and prevention and treatment of disease" (Becvarova, Prochazka, Chandler, & Meyer, 2016, p. 349). Horse owners rely on equine veterinarians (i.e., individuals practicing veterinary medicine on equine patients) as their primary source of information regarding the health, disease prevention, and nutrition of their horses (AAHA, 2003; Bushell & Murray, 2016; Hartmann, Liburt, & Malinowski, 2017; Laflamme et al., 2008; Martinson et al., 2006; Michel et al., 2008; Murray, Bloxham, Kulifay, Stevenson, & Roberts, 2015; Swirsley, Spooner, & Hoffman, 2017; USDA, 2015; USDA, 1998).

Veterinarians in the United States are expected to be lifelong learners who remain current on health and disease topics after graduation from veterinary school, which is why attendance of continuing education programs is a requirement for those who wish to maintain an active state veterinary license (DVM 360, 2013). Equine nutrition research is an evolving landscape as new information is added to the body of knowledge on a continual basis. This creates a challenge for veterinarians who wish to stay abreast of the most current technologies and advancements in the field of equine nutrition. To ensure

education received by equine veterinarians is effective and applicable to their daily role, routine needs assessments should be conducted (Barrick, Ladewig,& Hedges, 1983; Bennett & LeGrand, 1990; Grant, 2002; Mann & Chaytor, 1992). An effective learning-needs assessment allows a practitioner to identify current medical knowledge and skill areas in need of updating (Moore & Klingborg, 2007).

After thorough review of the literature, it appears needs assessment of equine veterinarians in the United States is lacking in the area of equine nutrition. Some researchers (Becvarova et al., 2016; Buffington & LaFlamme, 1996; Roberts & Murray, 2013) have evaluated veterinarians' perceptions, practices, and attitudes about nutrition, but these studies were restricted to a small geographic area (Roberts & Murray, 2013), occurred in a country other than the United States (Becarova et al., 2016), or did not target equine veterinarians, specifically (Becvarova et al., 2016; Buffington & LaFlamme, 1996). Because veterinarians are the assumed experts in animal nutrition (AAHA, 2003; Bushell & Murray, 2016; Hartmann, et al., 2017; Laflamme et al., 2008; Martinson et al., 2006; Michel et al., 2008; Murray et al., 2015; Swirsley et al., 2017; USDA, 2015; USDA, 1998), it is the responsibility of higher education programs and continuing education programs to provide them with the knowledge necessary for providing accurate nutritional advice.

In the context of educating students on nutrition during veterinary school, "limited human resources and an unsatisfactory number of nutrition teaching hours are the key barriers to improving graduate skills and performance" (Becvarova et al., 2016, p. 358). With limited resources available in the veterinary classroom to teach nutrition, it is imperative continuing education programs offer effective and applicable curriculum that improves and builds on the basic nutrition education received in veterinary school (Becvarova et al., 2016).

This research has the potential to identify gaps in equine nutrition knowledge and inform higher education and continuing education program instructors of the areas in need of curricular enhancement.

Theoretical Framework

This study was framed by the Human Capital Theory, which is centered on a person's acquisition of knowledge, skills, abilities, experiences, and education (Becker, 1964; Coff, 2002; Little, 2003; Shultz, 1971; Smith, 2010; Smylie, 1996). Human capital refers to "knowledge that is embodied in people" (Coff, 2002, p. 108). The most widely accepted measures of human capital are education and training (Becker, 1983; Mincer, 1974). Human capital theory suggests people who are deemed to be effective are able to respond to changes in characteristics and conditions of the workplace while developing practices that reflect expansion of knowledge and learning (Smylie, 1996). Rowan (1990) opined change and improvement are achieved best by developing the knowledge, skills, and commitments of people in the workplace. As people increase their human capital, they become more valuable, especially when it deals with learning new "sector-specific" skills (Smith, 2010, p. 42). To increase human capital, a person must be flexible, innovative, critically analytical, and reflective (Smylie, 1996). The main pillars for building human capital are learning, education, and training (Becker, 19864; Coff, 2002; Mincer, 1974; Smylie, 1996); therefore, lifelong learning is essential for increasing human capital.

To maintain a valid state license, veterinarians in the United States are required to participate in accredited continuing education programs at a rate determined by each individual state (DVM 360, 2013). This prerequisite ensures licensed veterinarians are lifelong learners, and consequently, increase their human capital on an annual basis (Smith,

2010). “Knowledge is one of the most promising sources of a sustainable advantage” (Coff, 2002, p. 107), so in a profession that competes for clients, investment in human capital can be a major advantage (Crook, Todd, Combs, Woehr, & Ketchen, 2011). Investing in human capital can yield positive performance outcomes at both the individual and organizational levels (Becker & Huselid, 2006; Bowen & Ostroff, 2004; Huselid, 1995; Le, Oh, Shaffer, & Schmidt, 2007; Subramony, Krause, Norton, & Burns, 2008). Researchers have highlighted developing additional human capital ensures a competitive advantage that allows some firms to outperform others (Acedo, Barroso, & Galan, 2006; Barney, 1991; Barney, Wright, & Ketchen, 2001; Coff, 1999). Human capital is a critical advantage for veterinarians because they operate in *human-asset-intensive* firms, meaning they rely more heavily on human assets (e.g., veterinarians themselves) than physical assets (Coff, 1999). Therefore, investments in human capital should be a major consideration for individual-, partner-, and corporate-owned veterinary practices since differences in firm performance are increasingly attributed to tacit knowledge (Barney, 1991; Peteraf, 1993; Reed & DeFillippi, 1990; Wernerfelt, 1984).

What are the needs of equine veterinarians regarding skill development around nutrition and health? Due to the perception by society that veterinarians are the expert resource for animal nutrition advice (AAHA, 2003; Bushell & Murray, 2016; Hartmann, et al., 2017; Laflamme et al., 2008; Martinson et al., 2006; Michel et al., 2008; Murray et al., 2015; Swirsley et al., 2017; USDA, 2015; USDA, 1998), there is a need to identify potential knowledge gaps so that higher education and continuing education can adapt and enhance curriculum to meet the evolving needs of veterinarians. The aim of the study was to identify the educational needs in equine nutrition of licensed veterinarians in the United States using

the Borich (1980) needs assessment model (see Figure 1). Results of this study will assist instructors with developing and refining pertinent, relevant, and timely equine nutrition education courses. Veterinarians participating in improved nutrition education programs benefit by gaining *sector-specific* knowledge and training, which increases their human capital (Smith, 2010). As prior research suggests, increased human capital may then improve performance outcomes of the independent veterinarian or firm in which they are employed.

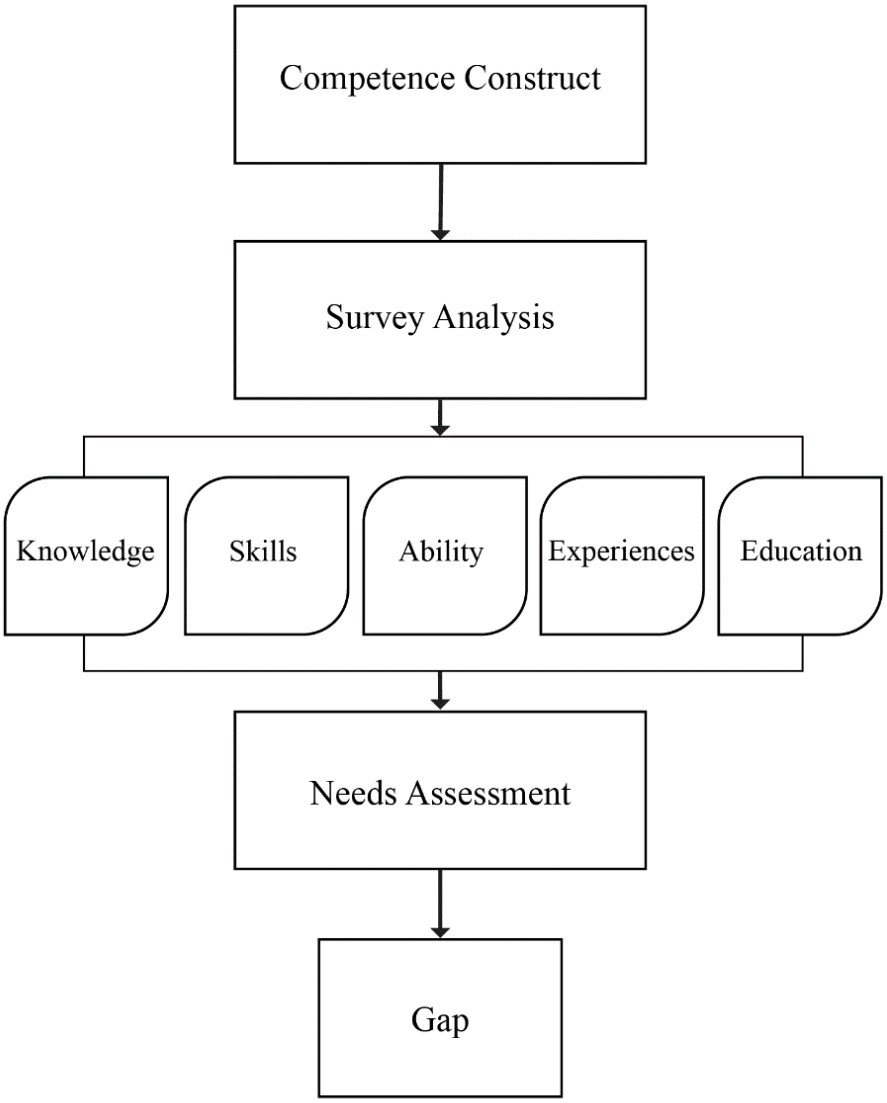

Figure 1. Needs Assessment Model adapted from Borich (1980).

Need for the Study

There are a number of equine ailments that are observed commonly by veterinarians which could be prevented if dietary rations were understood better by those who administer them (Leahy, Burk, Greene, & Williams, 2010). A growing population of horses are suffering from nutrition-related disorders such as obesity, colic, laminitis, and equine metabolic syndrome (Hoffman, Costa, & Freeman, 2009). Horse owners generally have a poor understanding of equine nutrition (Hoffman, Costa, & Freeman, 2009), and therefore rely on veterinarians for nutrition information (AAHA, 2003; Bushell & Murray, 2016; Hartmann, et al., 2017; Laflamme et al., 2008; Martinson et al., 2006; Michel et al., 2008; Murray et al., 2015; Swirsley et al., 2017; USDA, 2015; USDA, 1998).

Prior research on veterinarians' practices, perceptions, and attitudes about nutrition has been conducted (Becvarova et al., 2016; Buffington & LaFlamme, 1996; Roberts & Murray, 2013), but no study to date has targeted equine veterinarians, specifically, across the United States. Nutrition management for horses in the United States is of concern because a growing number of horses in the country suffer from nutrition-related diseases (Hoffman et al., 2009). Therefore, research is needed to identify the gaps in equine nutrition knowledge that may be present among equine veterinarians in the United States.

Statement of the Problem

The need to teach clinical nutrition to veterinary students and graduates has never been more imperative (Becvarova et al., 2016; Roberts & Murray, 2013). Greater than 40% of domestic horses are obese (Stephenson, Green, & Freeman 2011; Thatcher, Pleasant, Geor & Elvinger, 2012; Wyse, Mcnie, Tannahill, Murray & Love, 2008), hyperinsulinemia is found in 22 to 29% of susceptible equine populations (Morgan, McGowan & McGowan,

2014; Muno, Gallatin & Geor, 2009), and endocrinopathic laminitis has been shown to account for up to 89% of primary laminitis cases – 66% of those being diagnosed with equine metabolic syndrome (Karikoski, Horn, McGowan & McGowan, 2011). Nutritional imbalances compromise welfare of the horse, contribute to various clinical conditions, impact physiological homeostasis, reproduction, and growth; and can have adverse effects on the environment and athletic performance of the horse (Burk & Williams, 2008; Davidson & Harris, 2002; Hoffman et al., 2009; Honore & Uhlinger, 1994; Leahy et al., 2010; Martin, 2010; Owens, 2005; Westendorf, Puduri, Williams, Joshua, & Govindasamy, 2013).

For equine veterinarians, "knowledge of the key principles of equine nutrition is essential especially when dealing with clinical cases" (Harris & Dunnet, 2016, p. 486). Roberts and Murray (2013) reported 78 % of veterinarians provide nutritional counseling to their clients as an integral part of routine veterinary health checks, yet the majority (88%) had not attended a nutrition continuing education class in the last year. In this same study, veterinarians ranked the level of equine nutrition knowledge obtained during veterinary school as low (2 out of 5). These data support the theory horse owners may not be receiving appropriate nutritional advice from veterinarians.

According to Smith (2010), equine nutrition knowledge would be considered a "sector-specific" skill for veterinarians (p. 42). Minimal research attention has been directed toward evaluating or improving the nutrition skill-set of equine veterinarians in the United States. Like other professionals, as veterinarians develop and refine their skill sets, they become more competent at performing their trade (Heckman, 2000). Those with a robust set of skills, knowledge, experience, and education and who are competent at performing their trade, are considered to have increased human capital (Becker, 1964; Little, 2003; Shultz,

1971; Smith, 2010; and Smylie, 1996). Increased human capital results in increased profits within the job (Lepak & Snell, 1999); therefore, veterinarians should have an interest in improving sector-specific skill sets, such as equine nutrition, to improve economic gain.

Results of this study will provide insights into veterinarians' needs and preferences for improving their equine nutrition skill set. The findings of this study will be useful to instructors of higher education and continuing education programs when developing and updating curriculum on equine nutrition. Improving the nutrition skill set of equine veterinarians will enhance the quantity and accuracy of nutrition advice offered to clients. By improving the accuracy of nutrition advice offered to horse owners, the population of horses in the United States may be less likely to suffer the consequences of improper diets and nutrition-associated diseases.

Purpose of the Study

The purpose of this study was to assess equine veterinarians' practices, perceptions, and preferences associated with nutrition in horses. This study evaluated the congruence between *what is* and *what should be* as it relates to the educational needs of equine veterinarians on the topic of equine nutrition. Additionally, this study sought to describe veterinarians' preferred methods of acquiring continuing education hours in equine nutrition.

Research Objectives

1. Describe selected personal and professional characteristics of licensed equine veterinarians in the United States.
2. Describe self-perceived equine nutrition knowledge of licensed equine veterinarians.
3. Describe licensed equine veterinarians' equine nutrition training received during and after veterinary school.

4. Describe licensed equine veterinarians' preferences for using equine nutrition in their daily veterinary practice.
5. Describe licensed equine veterinarians' preferences for acquiring continuing educational knowledge in equine nutrition.
6. Prioritize nutrition-related conditions in need of curricular enhancement using the Borich (1980) needs assessment model.

Definition of Terms

American Association of Equine Practitioners (AAEP) is a professional organization headquartered in Lexington, Kentucky that represents an educated group of men and women who cover a broad range of equine disciplines, breeds, and associations. Nearly 9,300 veterinarians and veterinary students in 61 countries are members of the association (AAEP, 2018).

Colic in horses is a broad term used to describe a variety of conditions that cause the horse to exhibit clinical signs of abdominal pain (Kahn, 2005).

Equine Metabolic Syndrome is a collection of clinical signs and clinicopathologic changes in equids. Common signs are obesity, adiposity in the neck and tailhead regions, laminitis, and hyperinsulinemia (Kritchevsky, 2018).

Hyperinsulinemia (also known as insulin resistance) is a condition in which there is excess circulating insulin in the blood relative to blood glucose (Shanik et al., 2008).

Laminitis (also known as founder) is a crippling disease in horses in which the epidermal laminae connected to the hoof wall detach from the dermal laminae connected to the distal phalanx (Belknap, 2018).

Assumptions of the Study

For this study, the following assumptions were made:

1. Respondents were veterinarians who practice veterinary medicine on equine patients.
2. Respondents were currently licensed and practicing in the United States.
3. Respondents reported their perceptions, practices, knowledge, and preferences objectively as related to equine nutrition in their practice.
4. Respondents had a current and active email address on record with the American Association of Equine Practitioners.
5. Respondents were familiar with the use of the Internet as a means for responding to the questions.
6. Respondents read the directions thoroughly and selected the best responses possible, as written in the needs assessment.
7. Respondents refrained from discussing any aspect of the study among themselves prior to or during the completion of the study.
8. Respondents answered the questions truthfully and without bias.

Limitations of the Study

The following limitations of this study were noted:

1. The study was limited to data collected between April and May 2018.
2. Time and resources limited the study to veterinarians who had an active and current email address on file with the American Association of Equine Practitioners in April 2018 or in the 2013 print directory.
3. Results of this study may not be generalized to a larger population.
4. Self-selection bias could not be prevented.

5. Respondents were those individuals who felt comfortable using the Internet as a response mode for research.
6. It cannot be guaranteed that all respondents completed the study only one time.

CHAPTER II

REVIEW OF LITERATURE

Chapter 2 describes the need for developing veterinarians' skill set in equine nutrition, introduces the concept of human capital theory for veterinarians, and outlines nutrition knowledge as a skill set for equine veterinarians. This chapter also addresses veterinary graduates' satisfaction with equine nutrition education, describes the use of equine nutrition in veterinary practice, and the use of equine veterinarians by equine operations in the United States. Current feeding practices, development of a nutrition specialty board, trends in nutrition education for veterinarians, and preferences for acquiring continuing education are included. Finally, conditions influenced by equine nutrition and current horse populations in the United States are described.

The Need for Developing Veterinarians' Skill Set in Equine Nutrition

Equine nutrition is a science in its own as degree programs across the nation have been developed to include education specific to equine nutrition (Long & Morgan, 2010; Study, 2018; The Best Master's Degrees, 2018). Unfortunately, horse owners rarely rely on equine nutrition professionals who are equipped with knowledge and resources for nutrition advice (Murray et al., 2015). Instead, according to the United States Department

of Agriculture (1998), the majority of horse owners obtain nutrition information from veterinarians (57.9%), farriers (42.8%), and feed store personnel (30.3%). Another study reported the top ranked nutrition sources as veterinarians (53.7%) and trainers (40.3%), while nutritionists (9%) were behind feed stores, books, internet, and magazines (Hoffman et al., 2009). This presents a serious concern if the aforementioned sources do not have advanced degrees or any formal training in equine nutrition. Even veterinarians report they are not satisfied with the quality and amount of training in equine nutrition they received during veterinary school (Buffington & LaFlemme, 1996). The majority of veterinarians (65%) report taking only one nutrition class in veterinary school (Buffington & LaFlemme, 1996). What is more, these courses typically have a multi-specie focus and are not equine specific. Further, the majority of veterinarians are not pursuing continuing education opportunities in the field of equine nutrition after graduation from veterinary school (Roberts & Murray, 2013).

Human Capital Theory for Veterinarians

Human Capital Theory is centered on a person's acquisition of knowledge, skills, abilities, experiences, and education (Becker, 1964; Coff, 2002; Little, 2003; Shultz, 1971; Smith, 2010; Smylie, 1996). Human capital refers to "knowledge that is embodied in people" (Coff, 2002, p. 108). The most widely accepted measures of human capital are education and training (Becker, 1983; Mincer, 1974). In the context of this study, human capital theory would suggest veterinarians who are deemed to be effective are able to respond to changes in characteristics and conditions of the workplace while developing practices that reflect expansion of knowledge and learning (Smylie, 1996). Rowan (1990) opined change and improvement are achieved best by developing the knowledge, skills,

and commitments of people in the workplace. As veterinarians increase their own human capital, they become more valuable, especially when it deals with learning new "sector-specific" skills (Smith, 2010, p. 42). To increase human capital, a veterinarian must be flexible, innovative, critically analytical, and reflective (Smylie, 1996). The main pillars for building human capital are learning, education, and training (Becker, 19864; Coff, 2002; Mincer, 1974; Smylie, 1996); therefore, lifelong learning is essential for increasing veterinarians' human capital.

To maintain a valid state license in the United States, veterinarians are required to participate in accredited continuing education programs at a rate determined by each individual state (DVM 360, 2013). This prerequisite ensures licensed veterinarians are lifelong learners, and consequently, increase their human capital on an annual basis. "Knowledge is one of the most promising sources of a sustainable advantage" (Coff, 2002, p. 107), so in a profession that competes for clients, investment in human capital can be a major advantage (Crook, Todd, Combs, Woehr, & Ketchen, 2011). Investing in human capital can yield positive performance outcomes at both the individual and organizational levels (Becker & Huselid, 2006; Bowen & Ostroff, 2004; Huselid, 1995; Le, Oh, Shaffer, & Schmidt, 2007; Subramony, Krause, Norton, & Burns, 2008). Researchers have highlighted that developing additional human capital ensures a competitive advantage that allows some firms to outperform others (Acedo, Barroso, & Galan, 2006; Barney, 1991; Barney, Wright, & Ketchen, 2001; Coff, 1999). Therefore, acquiring necessary human capital is a critical advantage for veterinarians because they operate in *human-asset-intensive* firms, meaning they rely more heavily on human assets (e.g., veterinarians themselves) than physical assets (Coff, 1999). As such, investments in

human capital should be a major consideration for individual-, partner- and corporate-owned veterinary practices since differences in firm performance are increasingly attributed to tacit knowledge (Barney, 1991; Peteraf, 1993: Reed & DeFillippi, 1990: Wernerfelt, 1984). Veterinarians participating in improved nutrition education programs benefit by gaining *sector-specific* knowledge and training, which can increase their human capital as well as their earning potential (Smith, 2010).

Nutrition Knowledge as a Skill Set for Veterinarians

Specialization through sector-specific training plays a role in income earnings, which for self-employed veterinarians or those working in for-profit entities, is a motivating factor (Smith, 2010). Time and money spent acquiring education is considered an investment in human capital because once the knowledge is learned, it cannot be physically separated from the person (Becker, 1994). Human capital is a critical advantage for veterinarians because they operate in *human-asset-intensive* firms, meaning they rely more heavily on human assets (the veterinarians' knowledge) than physical assets (Coff, 1999). Differences among veterinarians' performance in their professional occupation may be attributed to the quantity and quality of sector-specific skills and knowledge that contribute to their human capital (Barney, 1991; Peteraf, 1993: Reed & DeFillippi, 1990: Wernerfelt, 1984). Researchers highlight the role of human capital as a key factor in competitive advantage, which helps explain why some equine veterinarians and equine veterinary clinics might outperform others (Acedo et al., 1991; Barney et al., 2001; Coff, 1999).

Equine nutrition is considered a "sector-specific" skill (Smith, 2010, p. 42) used in veterinary practice. Veterinarians who develop and refine their knowledge in equine

nutrition will become more competent at their trade (Heckman, 2000) because nutrition is associated with a number of clinical conditions, diseases, performance, and general well-being of the horse (Burk & Williams, 2008; Davidson & Harris, 2002; Hoffman, et al., 2009; Honore & Uhlinger, 1994; Leahy, et al., 2010; Martin, 2010; Owens, 2005; Westendorf, et al., 2013). In addition, veterinarians who invest in sector-specific skills, such as equine nutrition, may gain a competitive advantage (Acedo et al., 1991; Barney et al., 2001; Coff, 1999) when compared to other veterinarians, thereby resulting in the ability to influence a larger number of horses in the United States. The increase in veterinarians' human capital has the potential to improve their economic gain as well as the nutritional health of the overall horse population. Crook et al. (2011) concluded the acquisition of human capital is essential for achieving a high level of performance, which in this context is the ability to influence the nutritional management of a greater number of equine patients.

Veterinary Graduates' Efficacy in Equine Nutrition Education

Bandura's (1977) theory of self-efficacy suggests that efficacy may be most malleable early in learning (Hoy & Spero, 2005), thus, self-efficacy beliefs developed in veterinary school and during the first years in veterinary practice could be critical to the long-term development of veterinarians' efficacy in the nutrition skill set. In a survey of graduates of United States veterinary schools, 70% indicated time spent on nutrition education was inadequate, and 50% described the quality of nutrition education as inferior (Buffington & LaFlamme, 1996). In addition, the authors noted that 65% of respondents completed one nutrition course only as a veterinary student and 28% completed two courses. Finally, they reported perceived self-efficacy scores of equine

veterinarians on a scale of 1 (no confidence) to 10 (extremely confident). The reported perceived self-efficacy score of equine veterinarians was 7.2 ± 0.9, which was similar to the score (7.2 ± 0.8) of veterinarians across all practice types, meaning graduating veterinary students are only 72% confident in their abilities to make nutrition recommendations (Buffington & LaFlamme, 1996). In a more recent study by Roberts and Murray (2013), veterinarians ranked their satisfaction level of equine nutrition knowledge obtained during veterinary school as *low* (2 out of 5). According to self-efficacy data reported by Riggs (1995), individuals tend to avoid subjects when their self-efficacy score is lower; therefore, veterinarians with a low self-efficacy score in the nutrition skill set may be less likely to include nutrition to their overall practice philosophy.

Veterinary graduates reported curricula during their education program offered inadequate time for nutrition education (Buffington & Laflamme, 1996). "Limited human resources and an unsatisfactory number of nutrition teaching hours are the key barriers to improving graduate skills and performance" (Becvarova et al., 2016, p. 358). Inadequacies in nutrition education are compounded by the fact that few faculty in veterinary medical education have had formal training in teaching or educational theories (Moore et al., 2002). Staying abreast of the latest advancements in the field can be challenging for program instructors because change is more rapid than ever before due to globalization and technology (Sweat, 2010). Additionally, 21st century program instructors are faced with even greater expectations because of changes in society and technology (Moeini, 2008).

With limited resources available in the veterinary classroom to teach nutrition (Becvarova et al., 2016), perhaps continuing education programs should offer curriculum that improves and builds upon the basic nutrition education received in veterinary school. One such way to ensure successful transfer of knowledge to veterinary graduates is by applying concepts of adult learning theory to continuing education programs. Andragogic theorist, Malcom Knowles (1980) advocated that adults have the best learning experience when they have a *need* for knowledge, are *motivated* to learn, are able to use their *experience,* are allowed *self-direction*, and when the learning experiences are *oriented* in a way that allows immediate use of the knowledge. Program instructors should strive to apply these basic principles during continuing education programs in equine nutrition. Further, routine educational needs assessment are critical for identifying relevant topics for continuing professional development of veterinarians around the nutrition skill set (Barrick, Ladewig, & Hedges, 1983; Bennett & LeGrand, 1990; Grant, 2002; Mann & Chaytor, 1992).

Use of Equine Nutrition in Veterinary Practice

According to the USDA (2015) equine study, nutrition consultation service is an area with growth opportunity for practicing veterinarians. The USDA (2015) reported 79.8% of equine owners or operators use veterinarians as a source of information for equine health care decisions. Roberts and Murray (2014) reported 78% of veterinarians provide nutritional counseling to their clients as an integral part of routine veterinary health checks; yet, the majority (88%) had not attended a nutrition continuing education class in the last year.

For equine veterinarians, “knowledge of the key principles of equine nutrition is essential especially when dealing with clinical cases” (Harris & Dunnet, 2016, p. 486). It is alarming veterinarians may be providing nutrition counsel when they are not adequately equipped to do so, as research suggests there is a knowledge gap in nutrition for students graduating from veterinary school (Buffington & LaFlamme, 1996; Roberts & Murray, 2014); therefore, it is imperative for graduates to pursue a journey of lifelong learning to close this gap.

Use of Equine Veterinarians

According to the USDA (2015), private practice veterinarians are the primary health care resource for equine operations. This assertion is supported by a body of evidence from other researchers who report veterinarians as the primary source of information regarding health and nutrition of horses (AAHA, 2003; Bushell & Murray, 2016; Hartmann, et al., 2017; Laflamme et al., 2008; Martinson et al., 2006; Michel et al., 2008; Murray, et al., 2015; Swirsley et al., 2017; USDA, 2015; USDA, 1998). In a 12-month period, 78% of equine operations reported the use of veterinary services, and 59% required an on-farm visit from a veterinarian (USDA, 2015).

Approximately 12% of operations spent no money for veterinary services in the prior 12 months; however, the majority of operations spent from $50 to $350 per horse on veterinary services (USDA, 2015). The USDA (2015) reported one-half of equine operations depend on a veterinarian for services such as routine dental maintenance (47.4%), vaccine administration (46.5%), vaccine consultation (45%), and individual diagnosis (41.6%).

Current Nutrition Practices for Horses

Horse owners have an "inaccurate understanding of equine nutrition" (Hoffman et al., 2009, p. 723) and decisions for feeding their horse are often based on "folklore, tradition, and misinformation" (Martin, 2010, p. 127). Equine nutritionists with advanced degrees are arguably the most qualified individuals for providing nutrition advice to horse owners; yet, a survey of over 6,500 horse owners listed nutritionists as the sixth most important resource behind veterinarians, magazines/books, other horse owners, feed reps, and riding instructors (Murray et al., 2015).

Despite the growing body of research associating the importance of nutrition to diseases in the horse, inappropriate feeding practices remain in place (Burk & Williams, 2008; Hoffman et al., 2009; Honore & Uhlinger, 1994; Leahy, Burk, Greene, & Williams, 2010; Martin, 2010; Owens, 2005; Pratt-Phillips, 2016). A study by Honore and Uhlinger (1994) found 62% of rations exceeded requirements established by the National Research Council (NRC) by more than 10% in four or more nutrient categories. Specifically, 72% of horses were excessive in crude protein, 44% in digestible energy, 80% in calcium, and 78% in phosphorus. The study also found only 60% of horses received the amount of grain their owners intended to feed, and only 34% of horses received the weight of hay the owners thought they were feeding, which supports the notion that horses in the United States are not being fed appropriately. A study conducted by Pratt-Phillips (2016) on elite show jumping horses found digestible energy was fed at 119% over NRC requirements for heavy work, calcium was offered at more than two times the recommended rate, and phosphorus was provided at 13% under NRC requirements.

In a survey of 6,538 horse owners enrolled in a massive open online course in equine nutrition, 60% stated they monitored their horse's weight on a regular basis with weight tapes cited as the most common tool for measurement (Murray et al., 2015). Less than two percent of respondents in the survey used body condition scoring as a means for monitoring their horse's condition. Grass hay and pasture were reported as the most frequently used sources of fiber making up 84% of the diet. The majority of owners (87%) fed some type of concentrate such as commercial premixed feed or rations mixed on their own. Sixty-eight percent of respondents admitted to feeding concentrate by "scoops, cans, cups, a handful, or by eye" (Murray et al., 2015, p. 512). In excess of 80% of owners in the study fed at least one supplement, with 60% doing so because they think their horse needs it and 24% doing so per veterinary recommendation. The remaining respondents fed supplements at the advice of their trainer or some other influencer.

A more recent survey of horse owners in the United States found 84% of respondents feed their horse nutritional supplements, and veterinarians were identified as the most important source for information on nutritional supplements (Swirsley et al., 2017). The five most common nutritional concerns of horse owners are hoof condition, joint longevity, colic, care of the senior horse, and laminitis (Murray et al., 2015). Given the results of the aforementioned studies, it is prudent for veterinarians to be knowledgeable enough in equine nutrition to properly assess nutritional products and diets when asked.

Development of a Nutrition Specialty Board

In 1984, the American Academy of Veterinary Nutrition (AAVN) voted to support efforts to develop a nutrition specialty board, and thus the American College of

Veterinary Nutrition (ACVN) was conceived. The mission of the ACVN was to promote the importance of nutrition education among veterinarians to improve veterinary services and health of animals by the following means:

1. Assuring that experts in veterinary nutrition are highly qualified.
2. Improving how graduate veterinarians practice nutrition, i.e. increasing the availability of continuing education in nutrition to veterinarians through presentations, publications, and newer forms of information technology.
3. Improving the quality of nutrition education for veterinary students, working with industry and academia to increase the number of faculty positions in veterinary nutrition in the United States and Canada.
4. Improving the nutritional adequacy and safety of commercial foods/feeds.
5. Providing accurate nutritional information to the public.
6. Promoting and supporting research in veterinary nutrition for the benefit of animals and their owners. (American College of Veterinary Nutrition, 2018)

The AVMA granted provisional recognition to the new group in 1988, and full recognition was granted in 1997 with 49 registered diplomates. Over the last 30 years, colleges have progressed in the ability to provide animal nutrition education. In the early 1980's, only five colleges in the United States had post-graduate nutrition programs, and only three colleges had board certified nutrition diplomates. However, by 1997, 12

United States veterinary colleges offered residency training in veterinary clinical nutrition. The current mission statement of the ACVN is written as:

> The primary objective of the American College of Veterinary Nutrition is to advance the specialty area of veterinary nutrition and increase the competence of those who practice in this field by establishing requirements for certification in veterinary nutrition, encouraging continuing professional education, promoting research, and enhancing the dissemination of new knowledge of veterinary nutrition through didactic teaching and postgraduate programs. (American College of Veterinary Nutrition, 2018)

The American College of Veterinary Nutrition (2018) offers veterinary nutrition certification in three focus tracks – small animal nutrition, large animal nutrition, and comparative nutrition (mixed animal) and has a membership base of just under 100 diplomates as of May 25, 2018. Seventy-nine diplomates were registered with a United States address (American College of Veterinary Nutrition, 2018); however, information was not available on the focus area for each diplomate. The ACVN website lists nine colleges with standard residency programs. These colleges included University of California, University of Florida, University of Georgia, University of Missouri, North Carolina State University, University of Tennessee, Tufts University, Virginia Maryland College of Veterinary Medicine, and Massey University of New Zealand. Eight programs offered small animal nutrition as the exclusive focus track, while only Virginia Maryland College of Veterinary Medicine in Blacksburg, VA offered large animal nutrition and

comparative nutrition in addition to small animal nutrition (American College of Veterinary Nutrition, 2018).

Trends in Nutrition Education for Veterinarians

Nutritional assessment was adopted by the American Animal Hospital Association (AAHA) in 2010 and by the World Small Animal Veterinary Association (WSAVA) in 2011 as a "fifth vital sign" or something that should be assessed every time an animal is evaluated by a veterinarian; however, numerous veterinarians are not performing nutrition assessments (Baldwin et al., 2010; LaFlamme et al., 2008).

In the United States, nutrition is taught in most veterinary schools; although, only about one-half employ a diplomate in veterinary nutrition (Becvarova et al., 2016). This is less than what was reported in 2005 where 60% of schools had a diplomate on staff, and since then at least one school has had its introductory nutrition course reduced by one-half (Kirk & Bartges, 2005). In a study of European veterinary schools, nearly one-half of the schools had neither rounds nor rotations in nutrition for final-year students (Becvarova et al., 2016). In addition, nearly one-half of the schools failed to have a nutrition residency program, and 28% failed to offer a nutrition consultation service either for in-house or referring veterinarians.

One veterinarian opined, "as a veterinarian, most of what you know about equine nutrition is either self-learned or spoon-fed to you by [for-profit] companies" (P. Young, personal communication, September 6, 2018). Interestingly, over three-quarters (76%) of veterinary schools participate in some type of feeding program for pets of staff and students that is sponsored by a pet food company (Becvarova et al., 2016).

Continuing Education in Equine Nutrition

The 2018 American Veterinary Medical Association (AVMA) convention held in Denver, Colorado July 13-17, 2018 promoted a robust schedule of 1,476 continuing education events; however, only 18 were equine focused, and none were offered in equine nutrition. The primitive offering of equine-focused education opportunities from the AVMA may be one reason that equine-focused veterinarians choose to become members of the American Association of Equine Practitioners (AAEP) which has a membership base of nearly 9,300 veterinarians and veterinary students in 61 countries (AAEP, 2018). This association holds an annual five-day conference each year that is focused solely on the equine practice, and as an organization, is devoted to the equine veterinarian. The mission statement of AAEP is as follows:

> The AAEP's mission is to improve the health and welfare of the horse, to further the professional development of its members, and to provide resources and leadership for the benefit of the equine industry. These principles have guided the AAEP for more than six decades in the activities and services it provides. (AAEP, 2018)

Even though organizations such as AAEP are devoted to equine veterinarians and offer continuing education hours, Roberts and Murray (2013) found the majority of veterinarians are not choosing to devote continuing education hours to the topic of nutrition. Rapid advancements in equine nutrition research make it difficult for veterinarians to stay abreast of current guidelines and best practices; however, it is a skill set that horse owners clearly expect veterinarians to possess.

Conditions Influenced by Equine Nutrition

There is an ever-growing body of research identifying a need for nutrition programs of horses to be evaluated more critically (Burk & Williams, 2008; Davidson & Harris, 2002; Hoffman et al., 2009; Honore & Uhlinger, 1994; Leahy et al., 2010; Martin, 2010; Owens, 2005; Westendorf et al., 2013). Adequate knowledge of equine nutritional requirements and metabolic processes are needed to appropriately address nutritional rations for different life-stages, varying activity level, obesity, insulin resistance, laminitis, colic, diarrhea, hyperkalemic periodic paralysis, equine pituitary pars intermedia dysfunction, equine polysaccharide storage myopathy, developmental orthopedic disease, equine gastric ulceration syndrome, and equine protozoal myeloencephalitis (Burk & Williams, 2008; Davidson & Harris, 2002; Hoffman et al., 2009; Honore & Uhlinger, 1994; Leahy et al., 2010; Martin, 2010; Owens, 2005; Roberts & Murray, 2013; Westendorf et al., 2013). The following provides a brief description of several conditions related to the importance of nutrition in the horse. This list is not intended to be inclusive of all research on the subject or of all possible conditions that may have nutritional ties.

Life Stage and Activity Level

Horses require nutrition programs specific to their life stage and activity level (NRC, 2007). Examples of life stages that require specific formulation adjustments have been established by the National Research Council (2007) and include maintenance, growing, pregnant, lactating, and working stages. The role of diet in physiological homeostasis, reproduction, growth, and disease regulation in horses has been examined extensively (Hintz, 1985).

Endocrinopathic Laminitis

Diet, obesity, and insulin resistance are all interrelated in the cause of hyperinsulinemia in horses, which is involved in the pathogenesis of laminitis (Asplin, Sillence, Pollitt, & McGowan, 2007; de Latt, McGowan, Sillence, & Pollitt, 2010; McGowan, 2008; Nourian, Asplin, McGowan, Sillence, & Pollitt, 2009; Sillence, Pollitt, & McGowan, 2007). A 2007 report indicated approximately 10% of horses in the United States suffer from hyperinsulinemia (Geor, Thatcher, Pleasant, Elvinger, Gay, & Were, 2007). Hyperinsulinemia, insulin resistance, and obesity are interlinked strongly, each exacerbating the other increasing the likelihood of laminitis (Geor, 2008; Frank, Elliot, Brandt, & Keisler, 2006). Laminitis is a painful and potentially career-ending condition in horses. Through proper management of the diet to reduce postprandial blood glucose and insulin concentrations, it is possible to prevent the cascade of events that ultimately cause endocrinopathic laminitis in horses (Moreaux, Nichols, Bowman, & Hatfield, 2011).

Colic

Colic costs the United States horse industry in excess of $115 million annually with 5% of horses suffering from colic each year and 11% of those cases ending in fatality (Traub-Dargatz, Kopral, Seitzinger, Garber, Forde & White, 2001). Feeding practices, type of forage, maturity of forage, type of concentrate, and volume of concentrate are all factors of the equine nutrition program that can be directly related to instances of colic (Archer & Proudman, 2006).

Diarrhea

Diarrhea presents itself commonly in horses that have undergone colic surgery and had a segment of their digestive tract removed. Diarrhea is common in horses with inflammatory bowel disease, colitis, and antibiotic-associated microbial disruption; therefore, "nutritional intervention should be an early part of therapeutic management of these cases" (Magdesian, 2003, p. 640)

Hyperkalemic Periodic Paralysis

Symptoms of the genetic disorder, hyperkalemic periodic paralysis (HYPP), in horses include repeated yawning, muscle twitching, temporary paralysis, irregular movement, and involuntary recumbence (Reynolds et al., 1997). Horses carrying the genetic traits linked to HYPP can be managed through nutrition by ensuring total diet potassium concentration is less than 1.5%, and avoiding feedstuffs high in potassium (Magdesian, 2003).

Equine Pituitary Pars Intermedia Dysfunction

Equine pituitary pars intermedia dysfunction (PPID), also known as Cushing's syndrome, is an ageing-related neurodegenerative disorder resulting from a loss of dopaminergic inhibition of the pars intermedia of the pituitary (McGowan, Pinchbeck, & McGowan, 2013). A study of horses in southeast Queensland, Australia found approximately 21% of horses aged 15 years or older tested positive for PPID (McGowan et al., 2013). Approximately 22% of geriatric horses in the United Kingdom displayed signs of abnormal coat shedding which is a classic sign of PPID (Ireland et al., 2012). Cushing's syndrome often is characterized by delayed shedding or long hair coat, depression, weight loss, increased muscle catabolism resulting in a poor topline,

disproportional fat deposits along the neck, tail head, and in the sheath of male horses, a pot-bellied appearance, delayed wound healing and infections, and onset of laminitis (Ireland et al., 2012; Johnson, 2002; McCue, 2002; McGowan et al., 2013; Schott, 2002). Proper plane of nutrition is critical to horses with PPID (Schott, 2002), and diets should be managed to prevent obesity and provide a low glycemic index (Johnson, 2002; McCue, 2002).

Equine Polysaccharide Storage Myopathy

Equine polysaccharide storage myopathy (PSSM) is an inherited metabolic disorder affecting various breeds and is the cause of recurrent exertional rhabdomyolysis, also known as *tying up*. The disorder is characterized by a dysfunction of carbohydrate metabolism in the muscle (Annandale, Valberg, Mickelson, & Seaquist, 2004; Valentine, 2005). Horses with EPSM should be managed with a nutritional program that is low in sugar, low in starch, high in fiber, and high in fat along with adequate levels of selenium and vitamin E (Magdesian, 2003; Valentine, 2005).

Developmental Orthopedic Disease

Developmental orthopedic disease (DOD) consists of several skeletal conditions in growing horses that have multiple etiologies, but converge into a single primary focus – the abnormal conversion of cartilage to bone (Kronfeld, Thomas, & Donoghue, 1990). The etiologies of DOD involve numerous factors such as genetics, hormones, metabolism, and mechanics, and nutrition. During the 1970s, protein fed at high levels was thought to cause DOD, but researchers in the 1990's were not able to identify a direct relationship between high protein rations and DOD (Lewis, 1995). It has been shown that high calorie/carbohydrate diets (130% NRC recommendations) without added

minerals increase the incidence of OCD lesions in young foals, and there is a correlation between OCD and glucose intolerance in Standardbred colts (Ralston, 1996; Ralston, 1997). Therefore, properly formulated nutrition programs may play a role in preventing DOD in growing horses.

Equine Gastric Ulceration Syndrome

Equine gastric ulcer syndrome (EGUS) in horses is characterized as ulcers in the terminal esophagus, proximal (squamous) stomach, distal (glandular) stomach, and proximal duodenum (Reese & Andrews, 2009). Horses in training are at high risk to develop gastric ulcers, and approximately 60% to 90% of performance horses have EGUS (Reese & Andrews, 2009). Nutritional regimen of a horse's diet, such as concentrate type and volume, forage type and volume, as well as specific nutraceuticals and pharmaceuticals, can all play a role in either promoting or preventing ulcers in horses (McClure, Campbell, Polo, & Lognion, 2016; Pagan, 2009; Sykes, Hewetson, Hepburn, Luthersson, & Tamzali, 2015).

Equine Protozoal Myeloencephalitis

Equine protozoal myeloencephalitis (EPM) is a disease in horses the affects the neurologic system. Horses contract EPM by ingesting the protozoan, *Sarcocystis neurona*, which is present in opossum feces (Dubey et al., 2001). Nutritional recommendations for prevention of this disease align mostly in removing any chance of opossum feces coming in contact with the forage, concentrate, or water source of the horse (USDA, 2015).

Horses in the United States

According to the American Horse Council (2017), there are approximately 7.2 million horses in the United States. The USDA (2015) categorized horse operations as small (5 to 9 horses), medium (10 to 19 horses), and large (20 or more horses). The census found small operations accounted for 67.3% of all horse farm operations in the United States while medium and large operations accounted for 21.6% and 11.1%, respectively. It also found large operations housed 41.9% of the equine population in the United States while medium and small operations housed 26% and 32.1%, respectively.

According to the USDA (2015) equine study, operation owners identified the primary function of their operation as farm/ranch (39.5%), residence with equids for personal use (38.8%), boarding/training (9.3%), breeding farm (7.6%), riding stable (2.2%), and other (2.5%). The primary use of horses on these operations was identified as pleasure (47.2%), working on farm/ranch (25%), breeding (8.5%), showing/competition not betting (8.1%), retired/not in use (4.7%), lessons/school (3.2%), other (1.8%), and racing (1.6%).

The majority (65.6%) of horses in the United States are between 5 - 20 years of age, followed by 1 - 4 years (16.5%), 21 - 29 years (9.9%), 30 years or older (1.5%). The remaining 6.4% were less than one year of age (USDA, 2015). Quarter Horses are the most commonly reported breed in the United States at 42.1% of the population (USDA, 2015).

Summary

Equine nutrition research is an evolving landscape as new information is added to the body of knowledge on a continual basis. This creates a challenge for veterinarians

who wish to sharpen their nutrition skill set by staying abreast of the most current technologies and advancements in the field. After a thorough review of the literature, it appears that equine veterinarians trump all other professionals and resources in the eyes of horse owners when it comes to being a nutritional resource. Therefore, needs assessment of equine veterinarians is imperative in the area of equine nutrition so that curriculum can be developed and enhanced so that veterinarians can provide the expert nutritional advice that is expected of them.

CHAPTER III

METHODOLOGY

Chapter 3 describes the methodology of the study. The chapter includes approval by the Institutional Review Board, the study purpose, research objectives, research design, study population, instrumentation, data collection, data analysis, and a summary of the methodology.

Institutional Review Board Approval

United States' federal regulations and Oklahoma State University (OSU) policies require all research involving human subjects to be reviewed and approved by the OSU Institutional Review Board (IRB). As such, a research proposal, which included the purpose statement, survey instrument, recruitment script, and consent form (see Appendix A), was submitted to IRB for approval. The proposal was reviewed by IRB and met all guidelines required for research involving human subjects. Permission for the investigation was granted on March 27, 2018, and the study's IRB number was designated AG-18-18.

Research Design

The study design was descriptive survey research through the use of a researcher-developed instrument. Descriptive research is "aimed at casting light on current issues or

problems through a process of data collection that enables them to describe the situation more completely than was possible without employing this method" (Fox & Bayat, 2007, p. 45). Survey research provides a snapshot of how things are at a specific time (Denscombe, 1998).The purpose of survey research is to gather data from people through questionnaires, instruments, or interviews (Ary, Jacobs, Razavieh, & Sorenson, 2006). Gall, Gall, and Borg (2003) stated, "the purpose of a survey is to use questionnaires or interviews to collect data from a sample that has been selected to represent a population to which the findings of the data analysis can be generalized" (p. 223).

Survey research can be useful for assessing needs. Needs assessment provides the basis for effective and efficient training programs (Ulschak, 1983). Kaufman and English (1979) described needs assessment as "determining valid and useful problems which are philosophically as well as practically sound" (p. 31). Gall et al. (2003) stated that needs assessment research is used to "measure the precise extent of discrepancy between an existing state and a desired state" (p. 558).

Pettifor (2009) outlined three steps for needs identification. These steps are: (a) identification of skills, knowledge and ability necessary for someone to do the expected job well; (b) determining the current level of skills, knowledge, and behaviors he/she has; and (c) comparing the current level of skills and knowledge with required level for determining the gap. In consideration of Pettifor's (2009) steps, this study measured the *frequency* of encountering clinical categories to identify what was needed for veterinarians to do their job well, and their level of *confidence* in providing nutrition council for each clinical category to determine the current level of skills and knowledge. *Frequency* and *confidence* were then compared using a discrepancy model

conceptualized by Borich (1980) to determine the gap. The Borich (1980) needs assessment model utilized survey research methodology and a system of weighting and ranking data from respondents to establish areas of priority.

Study Population

The population for the study was veterinarians in the United States who identify themselves as equine veterinarians (N = 4,043). This population was based on a report by the American Veterinary Medical Association (2017). The frame for the veterinarians was an email list belonging to the American Association of Equine Practitioners.

Due to privacy laws upheld by the American Association of Equine Practitioners, direct access to the email list of veterinarians was not provided to me; rather, I was only allowed to access members through a designated placement in a routine email sent by the organization. As a result of these restrictions, I used non-probability sampling. There have been a number of reported instances where non-probability samples have yielded results as good as or even better than probability-based survey instruments when measured against an external criterion (Baker et al., 2003). Baker et al (2003) stated, "In theory, if the assumptions are fully met – as with probability-based methods – the resulting estimates are expected to be unbiased" (p. 13).

I was not allowed direct access to *The Spur* e-newsletter recipient list, I had no control over the names on the list or the accuracy of email addresses, and I was not allowed to have any contact with recipients of this e-newsletter. Due to these limitations, the potential for frame error exists. Of the 7,181 emails sent by staff of *The Spur*, approximately one-third (N = 2,479) were opened. Due to the aforementioned limitations, the total number of *opened* emails served as the denominator for calculating response

rate. The instrument contained questions that filtered out respondents who were not in the target population, and respondents were given the option of not responding to questions throughout the entire instrument. The total number of completed instruments was used as the numerator in calculating response rate, and an instrument was considered complete if the respondent answered at least the first one-half (15) of the 30 questions, which resulted in 531 completed instruments and a response rate of 21.4%. Contact information for those in the sample frame was not available to me, which prevented individual follow up with non-respondents.

The variable *sex* was evaluated to check reliability of the study. Among respondents in this study, 48% male, 51% female, and 1% preferring not to answer. This distribution compares favorably to the target population of 47% male and 53% female (American Veterinary Medical Association, 2017).

Instrumentation

Survey instruments are cost effective, efficient, and useful in collecting data from large samples in a short period of time (Ary et al., 2006; Gay et al., 2009; Wright, 2016). Therefore, after an extensive review of the literature, an online survey instrument (see Appendix B) was developed by the researcher to assess the practices, perceptions, and preferences of equine veterinarians in the United States. An instrument established by Roberts and Murray (2013) provided the foundation for instrumentation in this study, however it was not comprehensive enough to cover all research objectives. Therefore, this study modified the Roberts and Murray (2013) instrument to provide more robust information in the following areas: respondent demographics, classification of equine patients, number of clinical categories, number of preferred educational resources,

preferred methods of obtaining nutrition continuing education, and reasons for not participating in continuing education. Development decisions were based on instrumentation technique, results, and recommendations of published works in the fields of survey design, equine nutrition, and veterinary medicine (Beckvarova et al., 2016; Bushell & Murray, 2016; Dillman et al., 2014; Hartmann et al., 2017; Hoffman et al., 2009; Kaya-Karasu, Huntington, Iben, & Murray, 2018; Mastellar, Rosenthal, Carroll, & Bott-Knutson, 2018; Murray et al., 2015; Roberts & Murray, 2014; Swirsley et al., 2017).

The instrument consisted of five parts, each addressing different aspects of the study. In the first section, respondents were asked to identify their age, sex, number of years in practice, and then answer questions which defined their role as a veterinarian. Personal and professional characteristic information was collected; however, no identity-specific questions were asked. Respondents were excluded from the study if they were not a veterinarian, did not have equine patients, or were not licensed to practice in the United States. These exclusions ensured the final data set was reflective only of equine veterinarians practicing in the United States. In the second section, respondents were asked questions related to their level of knowledge in equine nutrition and the amount of continuing education hours that have been devoted to equine nutrition. The third section of questions evaluated veterinarians' current practices and perceptions related to equine nutrition in daily practice. The fourth section focused on identifying areas of need by defining the types of horses and conditions veterinarians encountered. The fifth and final section determined what resources veterinarians prefer for obtaining information regarding equine nutrition.

Likert-type scale items measured the frequency in which respondents encountered 19 clinical categories and how confident they were in providing nutritional advice. Categories were selected based on their appearance in published works in the field of equine nutrition and veterinary medicine (Brosnahan & Paradis, 2003; Bushell & Murray, 2016; Cheeke, 2000; Dubey et al., 2001; Hoffman et al., 2009; Magdesian, 2003; Murray et al., 2015; NRC, 2007; Roberts & Murray, 2013; Stoneham, Morresey, & Ousey, 2016; Swirsley et al., 2017). The five-point response scale used for frequency was:

1 – never,

2 – yearly basis,

3 – monthly basis,

4 – weekly basis, and

5 – daily basis.

The five-point response scale used for confidence was:

1 – not confident at all,

2 – slightly confident,

3 – moderately confident,

4 – very confident, and

5 – extremely confident.

The frequency and confidence constructs were analyzed further using the Borich (1980) needs assessment model. This model was designed to determine if and where discrepancies exist by calculating a discrepancy score, weighted discrepancy score, and a mean weighted discrepancy score to emphasize areas in need of curricular enhancement. The Borich needs assessment model relies on self-evaluation as participants make

judgments about themselves. Borich (1980) explained, "the assumption underlying the needs model is that the performer can best judge his or her own performance and, when explicitly asked to do so, can make an objective judgment" (p. 42). The Borich (1980) model can be implemented with relatively few resources and provides immediate feedback on the effectiveness of program experiences and learning material to evaluate potential gaps in education.

Validity and Reliability

Validity is defined as an instrument's ability to measure what it intends to measure (Ary et al., 2002). Content and face validity are important aspects of instrument design. Content validity assesses whether or not the items in the questionnaire represent what the objectives dictate (Gall et al., 2003). Face validity ensures the questionnaire is aesthetically pleasing and that it "appears valid for its intended purpose" (Ary et al., 2002, p. 409). Content and face validity were established for the study by a panel of experts consisting of Oklahoma State University faculty in the College of Agricultural Sciences and Natural Resources. Specifically, faculty members in agricultural education and animal science assessed and made changes to the instrument. Altogether, the panelists had multiple years of professional experience with conducting social science research and working and teaching in the equine industry, respectively. Modifications were made to the instrument based on their recommendations.

Reliability of the instrument also was considered. When using self-administered instruments, it is recommended that they be pilot tested prior to administration to a similar subset to the target audience (Ary et al., 2006; Borg & Gall, 1983; Bryman, 2004; Creswell, 2012; Gay et al., 2009). Pilot testing ensures the instrument is designed in a

manner that respondents are capable of understanding and completing (Ary et al., 2006; Borg & Gall, 1983; Bryman, 2004; Creswell, 2012; Gay et al., 2009). In addition, pilot testing an instrument allows the researcher to make adjustments to the semantics of questions and instructions, conduct preliminary data analysis, evaluate the study's feasibility, and make changes to the instrument as necessary (Borg & Gall, 1983; Bryman, 2004; Creswell, 2012; Gay et al., 2009).

To assess and ensure reliability, the instrument for this study was pilot-tested with 30 veterinarians who were considered similar to the target population of the final study, but were not members of the American Association of Equine Practitioners or were not licensed to practice in the United States. These qualifying characteristics ensured pilot participants would not be included in the final study results. The pilot study resulted in a Cronbach's alpha of 0.94 and 0.98 for frequency and confidence constructs, respectively, which indicated internal consistency in measuring the variables of interest. An alpha of at least .70 is considered to be acceptable for this type of research (Nunnally & Burnstein, 1994).

All pilot study responses, with the exception of one, were completed on a mobile device. Therefore, the final instrument was designed to be user-friendly on mobile devices, as suggested by Dillman, Smyth, and Christian (2014). The final instrument was deemed to be clear, concise, and comprehendible, and that it could be completed by participants with aptitudes similar to those who participated in the pilot test.

Data Collection

The instrument was hosted on a third-party data collection website (Qualtrics, LLC, Provo, UT). At the time of this study, 97% of adults with a college degree used the

Internet (Pew, 2018); thus, an instrument administered over the Internet was deemed to be a suitable means of reaching a large majority of degree-holding equine veterinarians. All consenting members with a valid email address (N = 7,181) received the American Association of Equine Practitioners' monthly electronic newsletter, *The Spur*, on April 9th which contained a link to the study's instrument (see Appendix C). The instrument remained open for six weeks in April and May 2018.

The power of survey research is its ability to enable a small number of people to accurately describe the target population with a great deal of precision (Dillman et al., 2014). Understanding coverage and non-response error is critical for conducting quality survey research; therefore, mixed-mode methods, as defined by Dillman et al. (2014), were used. These methods are described below in three overarching strategies:

1. Use of multiple contact modes to encourage response for data to be collected by a single response mode.
2. Use of multiple response modes to collect respondent answers, while using only one mode of contact.
3. Use of multiple contact and response modes for the same study. (p. 467)

The first contact mode was to include the link to the study's instrument in an electronic newsletter, *The Spur*. The secondary contact mode consisted of contacting members in a stand-alone email. Because affiliation with a reputable sponsor is one way to increase response rates in survey research (Dillman et al., 2004), emails were sent from the researcher showing affiliation with Oklahoma State University. Email addresses were obtained from a hard copy of the 2013 directory printed by the American Association of Equine Practitioners (AAEP). In total, 5,606 emails populated the list, which was

obtained at the AAEP annual conference held in Nashville, TN in December 2013. At the time of inquiry, AAEP directories were available for a fee in print format only. The 2013 directory was transcribed by the researcher into digital format, and was the most recent version available at the time of transcription.

Sending multiple contacts to potential respondents is one of the most effective ways to increase response rates (Cook, Heath, & Thompson, 2000), so reminder prompts were sent by email on April 20, May 4, and May 16, 2018 (see Appendices D, E, and F, respectively) to inform recipients of the specific edition of *The Spur* where the link was offered originally, and also to provide a direct link to the instrument in the event that the participants had misplaced their earlier edition of *The Spur*. These emails were sent at varying times of the day, on varying days of the week, and with varying content to reach a wider range of potential respondents (Dillman et al., 2014).

Dillman et al. (2014) suggested the best response rates come from recruitment emails with positive and respectful wording, show a connection to peers or to an association in which they are committed already, ask for participants' expertise, use a visually appealing layout, have a concise description, and provide a request to participate. I included all of these practices when creating the prompt emails used in the second contact mode. In addition, contact information for the primary investigator was provided, as suggested by Dillman et al. (2014), to ensure participants' confidence and trust that the link was credible.

The primary contact mode, the American Association of Equine Practitioners' electronic newsletter, *The Spur*, resulted in 42 completed survey instruments. The secondary contact mode, which consisted of three reminder prompt emails showing

affiliation with Oklahoma State University, yielded the highest amount of responses. Email one (see Appendix D), sent Friday, April 20, 2018 at 10:31 PM, resulted in 327 completed survey instruments. Email two (see Appendix E), sent Friday, May 4, 2018 at 11:55 AM, resulted in 215 completed survey instruments. Email three (see Appendix F), sent Wednesday, May 16, 2018 at 5:02 PM, resulted in 171 completed survey instruments. Recipients of the reminder prompt emails were provided the option to stop receiving emails from the researcher, and some individuals (n = 78) exercised this right.

The potential exists for frame error because details and contact information for people receiving *The Spur* e-newsletter was not available to me. Due to this limitation, the total number of opened e-newsletters (N = 2,479) served as the denominator for calculating response rate. After filtering out respondents who did not fit the criteria of being a licensed equine veterinarian in the United States, and those who completed less than 15 of 30 questions, 531 usable questionnaires were received. This resulted in a response rate of 21.4%. A limitation of this study was the inability to send personalize emails to non-respondents.

Data Analysis

Survey research uses descriptive statistics to describe data in a quantitative manner. Descriptive statistics consist of measures of central tendency and variability (Ary et al., 2002) and seek to "describe and summarize the data" (p. 154). Measures of central tendency consist of means, medians, and modes. The mean is used to describe the average of the scores. The median assesses the middle score in a distribution and is ordinal in nature. The mode is a nominal statistic and describes the score or value that appears in a distribution most frequently.

Objectives 1, 2, 3, 4, and 5 were addressed by assessing frequencies, percentages, means, and standard deviations. To address Objective 6, the Borich (1980) needs assessment model was implemented. Borich (1980) explained that the "needs assessment model can be extended and adapted to meet a variety of institutional needs" with the goal of identifying the positions of *what is* and *what should be* (p. 41). Therefore, this study used Borich's (1980) model to assess the discrepancy between the frequency in which veterinarians encounter 19 clinical categories and their confidence in making nutritional recommendations for the same 19 clinical categories, which were selected based on prior research (Brosnahan & Paradis, 2003; Bushell & Murray, 2016; Cheeke, 2000; Dubey et al., 2001; Hoffman et al., 2009; Magdesian, 2003; Murray et al., 2015; NRC, 2007; Roberts & Murray, 2013; Stoneham, Morresey, & Ousey, 2016; Swirsley et al., 2017). Veterinarians were asked to rate, using a five-point Likert-type scale, the frequency in which they encounter patients in each clinical category. The response scale consisted of: 1 = *never*, 2 = *yearly basis*, 3 = *monthly basis*, 4 = *weekly basis*, and 5 = *daily basis*. Veterinarians also were asked to rate their level of *confidence* in providing nutritional advice for patients in the same clinical categories. Again, a five-point Likert-type scale was used with options being: 1 = *not confident at all*, 2 = *slightly confident*, 3 = *moderately confident*, 4 = *very confident*, and 5 = *extremely confident*.

Borich (1980) noted the importance of calculating a discrepancy score, weighted discrepancy score, and a mean weighted discrepancy score to determine where discrepancies exist. For this study, a discrepancy score for each clinical category was calculated by subtracting the mean confidence rating from the mean frequency rating. A weighted discrepancy score was calculated for each clinical category by multiplying the

discrepancy score by the mean frequency rating. Lastly, a mean weighted discrepancy score (MWDS) for each clinical category was calculated by taking the sum of the weighted discrepancy scores divided by the number of respondents. The 19 clinical categories were then ranked, from high to low, using the mean weighted discrepancy scores. Clinical categories with positive discrepancy scores indicated areas in need of curricular enhancement for equine veterinarians. According to McKim and Saucier (2011), Microsoft Excel is an acceptable program for calculating MWDS; thus, data analysis relied on Microsoft Excel, version 15.0.5049.1000.

Summary

The study was conducted to assess equine veterinarians' practices, perceptions and preferences related to the use of nutrition during daily veterinary practice from April 2018 through May 2018, and consisted of a descriptive survey instrument. The study sought to determine veterinarians' perceptions of the frequency in which they encounter clinical situations and their level of confidence in providing nutritional advice for these clinical situations. This study evaluated the congruence between *what is* and *what should be* as it relates to the educational needs of equine veterinarians on the topic of equine nutrition. This study also described veterinarians' preferred methods of acquiring continuing education hours in equine nutrition.

CHAPTER IV

FINDINGS

Chapter 4 describes the findings associate with each research objective. Objective 1 describes personal and professional characteristics of equine veterinarians, objective 2 describes self-perceived equine nutrition knowledge of veterinarians, objective 3 describes veterinarians' equine nutrition training received during veterinary school, objective 4 describe veterinarians' preferences for using equine nutrition in their daily veterinary practice, objective 5 describes veterinarians' preferences for acquiring continuing educational knowledge in equine nutrition, and objective 6 ranked nutrition-related conditions in need of curricular enhancement using the Borich (1980) needs assessment model.

Findings Associated with Objective 1

Objective 1 sought to describe selected personal and professional characteristics of the veterinarians who responded to the instrument. These characteristics included veterinary position, species category and contact time, board certification, age, sex, years in practice, number of equine patients consulted per week, licensure by state, and typical patient profile. Of the 755 instruments started, 531 were completed for a completion rate of 70%. Respondents were provided the option of not responding to questions, so an

instrument was considered complete if the respondent answered at least the first one-half (15 of 30) of the questions.

Respondents held veterinary positions in private clinical practice (n = 585), government employment (n = 10), academic employment (n = 79), and corporate employment (n = 15). The majority (n = 516) of respondents identified themselves as either equine exclusive (54.31%) or equine predominant (17.36%) practitioners, while 198 (27.5%) respondents interacted with equine patients but did not consider them to be a predominant aspect of their practice (see Table 1). Those respondents who did not categorize themselves as interacting with equine patients were eliminated from the study.

Table 1

Veterinary Respondents by Species Category

Practice Category	*f*	%
Equine Exclusive	391	54.31
Equine Predominant	125	17.36
Equine and Food Animal	40	5.56
Equine and Companion Animal	78	10.83
Equine, Food Animal, and Companion Animal	80	11.11
Food Animal	0	0.01
Companion Animal	6	0.83

Table 2 displays the type of animal in which respondents spend the majority of their time. Five hundred sixty-one (82.30%) report spending 50% or more of their time with horses, 65 (25.30%) with companion animals, and 12 (5.10%) with food animals. The reported high rate of contact time with equine patients supports credibility and authenticity of this study. The majority of veterinarians (510) were not board certified, but those who were board certified held certification in dentistry (6), emergency and critical care (5), internal medicine (35), microbiology (2), nutrition (2), ophthalmology

(3), pharmacology (1), preventative medicine (1), radiology (3), sports medicine and rehabilitation (29), surgery (62), reproduction (18), and toxicology (1).

Table 2

Species Contact Time

Field	*f*	%
≥ 50% of contact time with equine	561	82.30
≥ 50% of contact time with companion animal	65	25.30
≥ 50% of contact time with food animal	12	5.10

The mean age of respondents was 51 (*SD* = 13) years, and the mean number of years in practice was 23.7 (*SD* = 13.6) years (see Table 3). Regarding sex of the respondents, 48% of respondents were male, 51% were female, and 1% preferred not to answer. These percentages are consistent with those reported by the United States Census (Howden & Meyer, 2011) and the American Veterinary Medical Association (2017), thereby supporting reliability of this study.

Table 3

Veterinarians' Mean Age and Number of Years in Practice

Field	*M*	*SD*	*N*
Age	51	13.0	625
Years in Veterinary Practice	23.7	13.6	659

Veterinarians who participated in this study (*n* = 621) reported the average number of equine patients they consult on a weekly basis was 46 (*SD* =102.7); therefore, they interact with approximately 28,610 horses on an average week. The three states with the highest representation of licensed equine veterinarians were California (*n* = 85), Texas (*n* = 64), and Florida (*n* = 58). These data are displayed in Table 4. Authenticity of

these data is supported by a report from the American Horse Council (2017), which cites Texas, Florida, and California as the top three states in horse numbers.

Table 4

Percent of Respondents Licensed per State

State	*f*	*%*
California	85	7.85
Texas	64	5.91
Florida	58	5.36
Kentucky	47	4.34
New York	47	4.34
Oklahoma	38	3.51
Colorado	37	3.42
Pennsylvania	35	3.23
Virginia	31	2.86
Ohio	28	2.59
Illinois	25	2.31
North Carolina	24	2.22
Oregon	24	2.22
Maryland	22	2.03
Arizona	21	1.94
New Jersey	21	1.94
Washington	21	1.94
Massachusetts	20	1.85
Wisconsin	20	1.85
Georgia	19	1.75
Tennessee	19	1.75
Michigan	18	1.66
Missouri	18	1.66
Indiana	17	1.57
Kansas	17	1.57
New Mexico	17	1.57
Minnesota	16	1.48
South Carolina	16	1.48
Connecticut	15	1.39
Louisiana	15	1.39
Alabama	14	1.29
Montana	14	1.29
Arkansas	13	1.20

Mississippi	13	1.20
Idaho	10	0.92
Alaska	9	0.83
Iowa	9	0.83
Nevada	9	0.83
Delaware	8	0.74
Nebraska	8	0.74
Maine	7	0.65
Utah	7	0.65
New Hampshire	5	0.46
Rhode Island	5	0.46
South Dakota	5	0.46
Vermont	5	0.46
Wyoming	5	0.46
North Dakota	3	0.28
Hawaii	2	0.18
West Virginia	1	0.09

Veterinarians were asked to report the frequency (1 = *never*, 2 = *yearly*, 3 = *monthly*, 4 = *weekly*, 5 = *daily*) in which they encounter 19 different clinical categories of equine patients, and mean frequency scores were ranked for each clinical category from most to least frequently encountered (see Table 5). The top five most frequently encountered categories were arthritis/joint pain, senior horses, general wellness exams, colic, and obese horses; and the four categories encountered least often were hyperkalemic periodic paralysis (HYPP), orphan foals, equine polysaccharide storage myopathy (EPSM/PSSM), and recurrent equine rhabdomyolysis (RER), as shown in Table 5.

Table 5

Mean Frequency Rating for Encountering Clinical Conditions

Clinical Category	*M*	*SD*	*N*
Arthritis/Joint Pain	4.0	0.9	534
Senior Horse	3.6	1.0	526
General Wellness Exam	3.6	1.3	530

Colic	3.4	0.9	526
Obese Horse	3.3	1.0	528
Equine gastric ulceration syndrome (EGUS)	3.0	0.9	530
Insulin Resistance (IR)	2.9	1.0	527
Equine pituitary pars intermedia dysfunction (PPID)	2.9	1.0	529
Equine metabolic syndrome (EMS)	2.9	1.0	526
Horse with Laminitis	2.8	0.7	527
Horse with Diarrhea	2.6	0.7	525
Recurrent airway obstruction (RAO)	2.5	0.9	527
Developmental Orthopedic Disease (DOD)	2.4	1.0	531
Malnourished Horse	2.2	0.8	527
Equine protozoal myeloencephalitis (EPM)	2.2	0.9	529
Recurrent equine rhabdomyolysis (RER)	2.0	0.8	530
Equine polysaccharide storage myopathy (EPSM/PSSM)	1.9	0.7	526
Orphan Foal	1.7	0.6	526
Hyperkalemic periodic paralysis (HYPP)	1.6	0.6	525

Findings Associated with Objective 2

Objective 2 sought to describe self-perceived equine nutrition knowledge of veterinarians on a five-point Likert-type scale (1 = *unsatisfactory*, 2 = *poor*, 3 = *average*, 4 = *good*, and 5 = *excellent*). When asked to rate initial level of knowledge in equine nutrition after graduating veterinary school, 111 (20.91%) veterinarians rated their education as either *good* (17.33%) or *excellent* (3.58%). The remaining 420 (79.10%) rated the experience as *average* (41.05%), *poor* (29.76%), or *unsatisfactory* (8.29%), as seen in Table 6.

Table 6

Equine Veterinarians' Self-Perceived Knowledge in Equine Nutrition

	Unsatisfactory		Poor		Average		Good		Excellent		
Question	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*n*
Knowledge of equine nutrition after graduating	44	8.29	158	29.76	218	41.05	92	17.33	19	3.58	531

with a veterinary degree											
Current knowledge of equine nutrition	7	1.32	35	6.60	213	40.19	224	42.26	51	9.62	530

When asked to rate current level of knowledge in equine nutrition, 51 (9.62%) rated themselves as *excellent*, 224 (42.26%) *good*, 213 (40.19%) *average*, 35 (6.60%) *poor*, and 7 (1.32%) *unsatisfactory* (see Table 6). Mean response rating of self-perceived knowledge shifted from just below *average* (2.78) to just above *average* (3.52) between graduation from veterinary school and the time of instrument completion (see Table 7).

Table 7

Veterinarians' Mean Response Rating of Self-Perceived Knowledge in Equine Nutrition

Question	*M*	*SD*	*N*
My initial level of knowledge in equine nutrition after graduating with a veterinary degree	2.78	0.95	531
My current level of knowledge in equine nutrition	3.52	0.81	530

Veterinarians were asked to rate their self-perceived level of confidence in providing nutritional advice for 19 clinical situations using a five-point Likert-type scale (1 = *not at all confident*, 2 = *slightly confident*, 3 = *moderately confident*, 4 = *very confident*, and 5 = *extremely confident*). Veterinarians were most confident in providing nutritional advice for colic (*M* = 3.86; *SD* = .85), senior horses (*M* = 3.83; *SD* = .93), and general wellness exams (*M* = 3.78; *SD* = .89), and were least confident in their ability to provide nutritional advice for horses with equine protozoal myeloencephalitis (EPM) (*M* = 2.96; *SD* = 1.20), orphan foals (*M* = 2.92; *SD* = 1.97), and hyperkalemic periodic paralysis (HYPP) (*M* = 2.78; *SD* = 1.16), as reported in Table 8.

Table 8

Veterinarians' Mean Confidence Level for Providing Nutrition Recommendations

Clinical Category	*M*	*SD*	*N*
Colic	3.86	0.85	501
Senior Horse	3.83	0.93	500
General Wellness Exam	3.78	0.89	497
Obese Horse	3.75	0.94	499
Horse with Laminitis	3.72	0.97	498
Arthritis/Joint Pain	3.55	1.00	496
Equine gastric ulceration syndrome (EGUS)	3.52	0.97	496
Insulin Resistance (IR)	3.44	1.09	497
Equine metabolic syndrome (EMS)	3.42	1.11	497
Malnourished Horse	3.40	1.05	497
Equine pituitary pars intermedia dysfunction (PPID)	3.40	1.10	497
Horse with Diarrhea	3.27	0.98	498
Recurrent airway obstruction (RAO)	3.07	1.17	493
Developmental Orthopedic Disease (DOD)	3.04	1.11	495
Recurrent equine rhabdomyolysis (RER)	2.98	1.08	493
Equine polysaccharide storage myopathy (EPSM/PSSM)	2.98	1.17	496
Equine protozoal myeloencephalitis (EPM)	2.96	1.20	493
Orphan Foal	2.92	1.27	491
Hyperkalemic periodic paralysis (HYPP)	2.78	1.16	494

Findings Associated with Objective Three

Objective 3 sought to describe respondents' equine nutrition training received during veterinary school. Respondents rated their satisfaction on a five-point Likert-type scale (1 = *extremely dissatisfied*, 2 = *somewhat dissatisfied*, 3 = *neither satisfied nor dissatisfied*, 4 = *somewhat satisfied*, and 5 = *extremely satisfied*). Of the 529 respondents, 69 (13%) were extremely dissatisfied, 200 (37.8%) were somewhat dissatisfied, 150 (28.3%) were neither satisfied nor dissatisfied, 94 (17.7%) were somewhat satisfied, and 16 (3%) were extremely satisfied (see Figure 2).

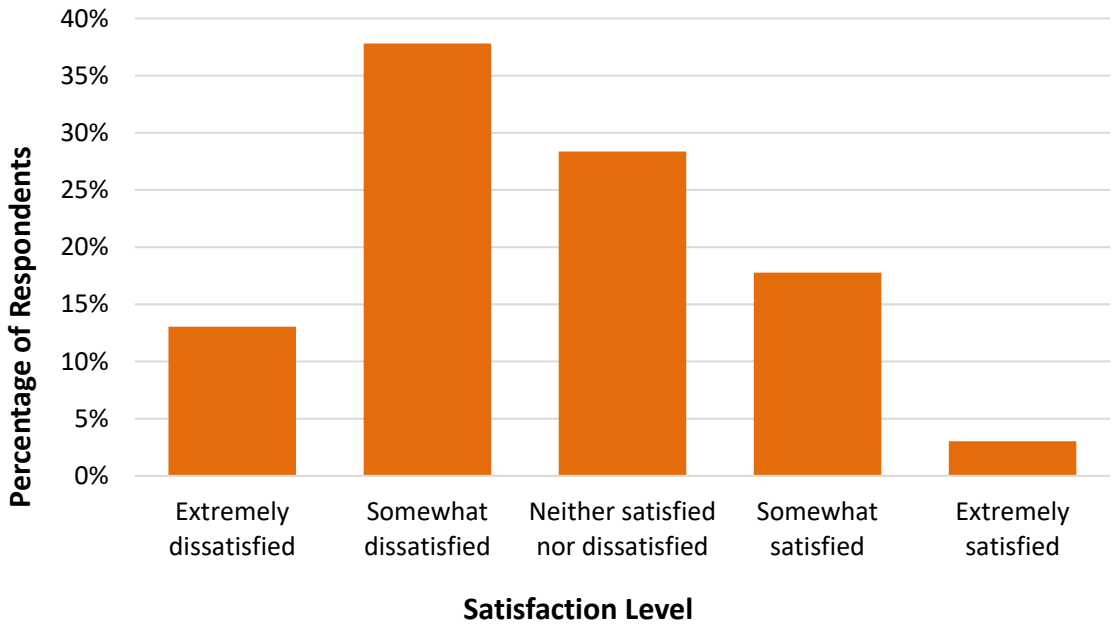

Figure 2. Equine veterinarians' satisfaction level of equine nutrition education received in veterinary school.

In the last 12 months, 131 (25%) respondents attended a continuing education course in equine nutrition while 400 (75%) had not, as illustrated in Figure 3. Regarding the latter, when asked why they did not attend a continuing education course in equine nutrition in the last year, the most popular responses were *chose to spend time on other topics* (40.77%), *no courses were offered at the symposium/conference I attended* (20.83%), and *no courses were offered online* (10.04%), as reported in Table 9.

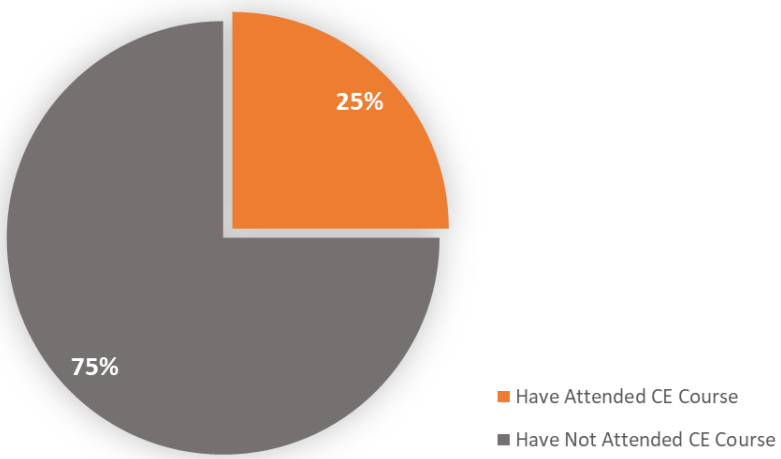

Figure 3. Percent of equine veterinarians who have attended an equine nutrition continuing education course in the last year.

Table 9

Veterinarians' Reasons for Not Attending Continuing Education in Equine Nutrition

Answer	*f*	%
I chose to spend my time on other topics	276	40.77
No courses were offered at the symposium/conference I attended	141	20.83
No courses were offered online	68	10.04
Courses offered were scheduled on inconvenient dates	55	8.12
Coursed offered were in unsuitable locations	41	6.06
Not interested	39	5.76
Courses offered were too expensive	26	3.84
Other	25	3.69
Courses offered were too long in duration	6	0.89

When asked how many equine nutrition continuing education hours had been earned since graduating veterinary school, 483 respondents reported 24.6 (*SD* = 106) hours with a minimum of 0 and a maximum of 2001 (see Table 10).

Table 10

Number of Equine Nutrition Continuing Education Hours Earned Since Graduating Veterinary School

	M	*SD*	*N*
Cumulative Hours	24.6	106	483

Findings Associated with Objective Four

Objective 4 sought to describe respondents' preferences for using equine nutrition in daily veterinary practice. Respondents were asked to reflect on their practice philosophy and indicate the level of importance they place on equine nutrition using a five-point Likert-type scale (1 = *very important*, 2 = *somewhat important*, and 3 = *not important at all*). Of the 522 veterinarians who responded, 364 (70%) considered nutrition to be *very important*, 154 (29%) considered it *somewhat important*, and 4 (1%) considered it *not important at all*, as shown in Figure 4.

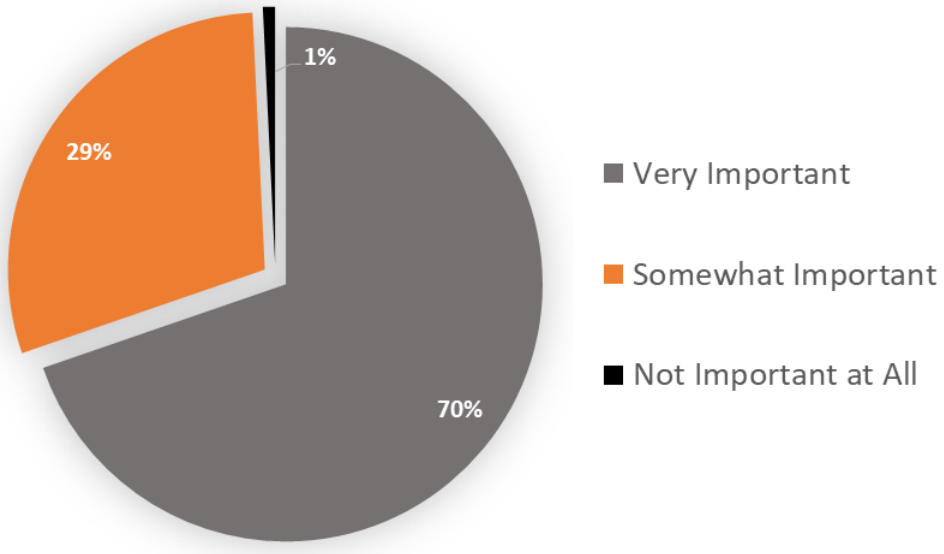

Figure 4. Importance of equine nutrition in the practice philosophy of equine veterinarians.

When asked whether or not they personally provide equine nutrition counseling to clients, 432 (82.8%) responded *yes* and 90 (17.2%) responded *no*. Of the 429 veterinarians who indicated they do provide nutrition counseling, 251 (58.5%) considered it an integral part of routine health exams, 46 (10.7%) provided it only when requested by the client, 115 (26.8%) provided it only when a specific disease or condition was diagnosed, and 17 (3.96%) cited other reasons (see Table 11). Three hundred ninety-five (93%) veterinarians do not charge additional fees for providing nutritional council, while the remaining 29 (7%) do, as shown in Figure 5.

Table 11

Reasons Equine Veterinarians Provide Nutrition Counsel to Clients

	f	%
It is an integral part of routine health checks	251	58.50
Provided only when a specific disease/condition is diagnosed	115	26.80
It is provided only when requested by the client	46	10.70
Other	17	3.96

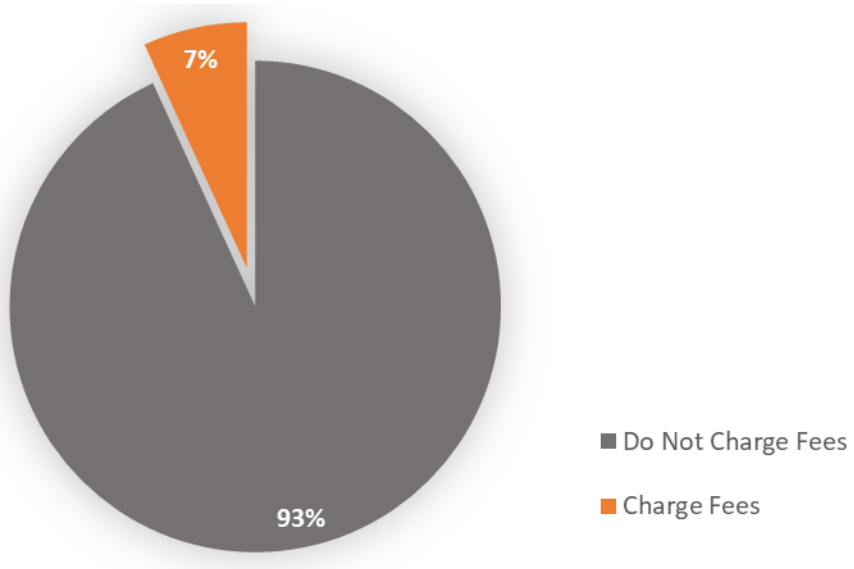

Figure 5. Veterinarians who charge fees for providing nutrition counsel for equine patients

Respondents were asked how likely they are to provide nutrition advice when addressing horses in specific categories using a five-point Likert-type scale (1 = *extremely likely*, 2 = *somewhat likely*, 3 = *neither likely nor unlikely*, 4 = *somewhat likely*, and 5 = *extremely unlikely*). Veterinarians were most likely to offer nutrition advice for senior horses and least likely to offer advice for racehorses (see Table 12).

Table 12

Categories in which Veterinarians are Most Likely to Provide Equine Nutrition Council

Patient Category	*M*	*SD*	*N*
Senior	4.53	0.90	414
Growing	4.14	1.05	406
Companion (non-riding)	4.13	0.92	409
Performance (other than racehorses)	3.88	0.99	420
Broodmares	3.63	1.21	400
Working (ranch, police, draft, etc.)	3.28	1.19	392
Other	3.21	1.31	92
Stallions	2.98	1.18	399
Racehorses	2.58	1.36	389

Note. Categories listed in Other included: ponies, miniatures, underweight, overweight, sick, rescue, therapy, trail horses, and horses with endocrine disorders.

Findings Associated with Objective Five

Objective 5 sought to describe respondents' preferences for acquiring knowledge in equine nutrition. Respondents were asked to identify the categories in which they would like a better understanding of the role nutrition plays. The top four topics in which veterinarians indicated a need for more nutrition education were insulin resistance (IR), equine gastric ulceration syndrome (EGUS), equine metabolic syndrome (EMS), and performance horses (see Table 13). Stallions, broodmares, non-riding companion horses,

and orphan foals are the categories veterinarians were least interested in for improving their knowledge in relation to nutrition (see Table 13).

Table 13

Veterinarians' Self-Perceived Need for Nutrition Education by Topic

Topic	*f*	%	Rank
Insulin Resistance (IR)	237	5.34	1
Equine gastric ulceration syndrome (EGUS)	231	5.20	2
Equine metabolic syndrome (EMS)	231	5.20	2
Performance Horses	230	5.18	4
Equine pituitary pars intermedia dysfunction (PPID)	225	5.07	5
Equine polysaccharide storage myopathy (EPSM/PSSM)	224	5.05	6
Diarrhea	219	4.93	7
Geriatric/Senior Horses	212	4.78	8
Equine protozoal myeloencephalitis (EPM)	208	4.69	9
Recurrent equine rhabdomyolysis (RER)	208	4.69	9
Developmental Orthopedic Disease (DOD)	204	4.60	11
Arthritis/Joint Pain	199	4.48	12
Growing Horses	198	4.46	13
Laminitic Horses	197	4.44	14
Recurrent airway obstruction (RAO)	181	4.08	15
Malnourished Horses	174	3.92	16
Colic	170	3.83	17
Obese Horses	169	3.81	18
Hyperkalemic periodic paralysis (HYPP)	137	3.09	19
Working Horses	137	3.09	19
Orphan Foals	128	2.88	21
Companion/Non-Riding Horses	118	2.66	22
Broodmares	117	2.64	23
Stallions	85	1.91	24

Veterinarians were asked to rate 17 information sources on the level of importance for obtaining nutrition information. The 17 information sources were ranked

from most important to least important. Respondents identified the three most important sources for obtaining equine nutrition information as equine nutritionists with Ph.D., veterinarians, and peer-reviewed journals (see Table 14).

Table 14

Veterinarians' Preferred Sources for Equine Nutrition Information

Information Source	Rank	*M*	*SD*	*N*
Equine nutritionist, Ph.D.	1	4.13	0.88	470
Veterinarian	2	3.97	0.89	474
Peer-reviewed journals	3	3.96	0.82	471
Equine nutritionist, master's degree	4	3.70	0.98	468
Professional equine conferences/symposiums	5	3.68	0.85	473
University instructor/extension agent	6	2.99	0.95	471
Feed companies	7	2.66	1.01	474
Equine nutritionist, no degree	8	2.17	1.05	469
Supplement companies	9	2.08	0.98	470
Equine magazines	10	2.06	0.87	471
Web/internet	11	2.05	0.94	469
Horse owners	12	1.65	0.80	469
Riding instructors/horse trainers	13	1.63	0.78	471
Feed store or animal health store personnel	14	1.63	0.85	470
Farrier	15	1.62	0.76	470
Radio/TV/newspaper	16	1.47	0.73	470
Equine dentist (other than veterinarian)	17	1.43	0.76	470

Veterinarians were presented with a list of seven continuing educational methods and asked to select if they had (*yes*) or had not (*no*) ever participated in training using each method. The two most common methods in which veterinarians have experienced continuing education were by *traveling to a lecture/seminar* (*f* = 464; 97.68%) and *reading peer-reviewed journal articles* (*f* = 447; 94.90%), as reported in Table 15.

Table 15

Veterinarians' previous experience with continuing education

	Yes		No		
Continuing Education Method	*f*	%	*f*	%	*n*
Traveled to a lecture/seminar	464	97.68	11	2.32	475
Reading peer-reviewed journal articles	447	94.90	24	5.10	471
Traveled to a lab/wet lab	377	81.25	87	18.75	464
Interactive distance (online/teleconference)	260	56.52	200	43.48	460
Non-interactive distance (online self-study with exam)	252	55.26	204	44.74	456
An accredited CE course coming to your clinic	123	27.03	332	72.97	455
Participating in nutrition research	73	16.26	376	83.74	449

Veterinarians were asked the likelihood of participating in each of the seven methods to continue their education in equine nutrition. Table 16 represents the seven methods ranked in order of veterinarians' most preferred to least preferred methods for obtaining continuing education in equine nutrition. Veterinarians were most likely to obtain equine nutrition information by reading peer reviewed journal articles, and were least likely to participate in nutrition research (see Table 16).

Table 16

Veterinarians' Preferred Methods For Continuing Education In Equine Nutrition

Continuing Education Method	*M*	*SD*	*N*
Reading peer-reviewed journal articles	3.97	1.06	471
Traveling to a lecture/seminar	3.57	1.26	472
Interactive distance (online/teleconference)	3.39	1.25	471
Non-interactive distance (online self-study with exam)	3.32	1.28	468
Traveling to a lab/wet lab	3.25	1.29	471
An accredited CE course coming to your clinic	2.91	1.48	468
Participating in nutrition research	2.67	1.24	470

When respondents were asked how interested they were in taking equine nutrition continuing education courses within the next year, 128 (26.83%) were *very interested*,

284 (59.54%) were *somewhat interested*, and 65 (13.63%) were *not interested at all* (see Table 17).

Table 17
Veterinarians' Interest Level in Taking Equine Nutrition Continuing Education Courses in the Next Year

	f	%
Somewhat interested	284	59.54
Very interested	128	26.83
Not interested at all	65	13.63

Veterinarians were asked if they would be more likely to take an equine nutrition continuing education course if it were offered online, and 339 (71%) responded, *yes* and 138 (29%) responded, *no* (see Figure 6).

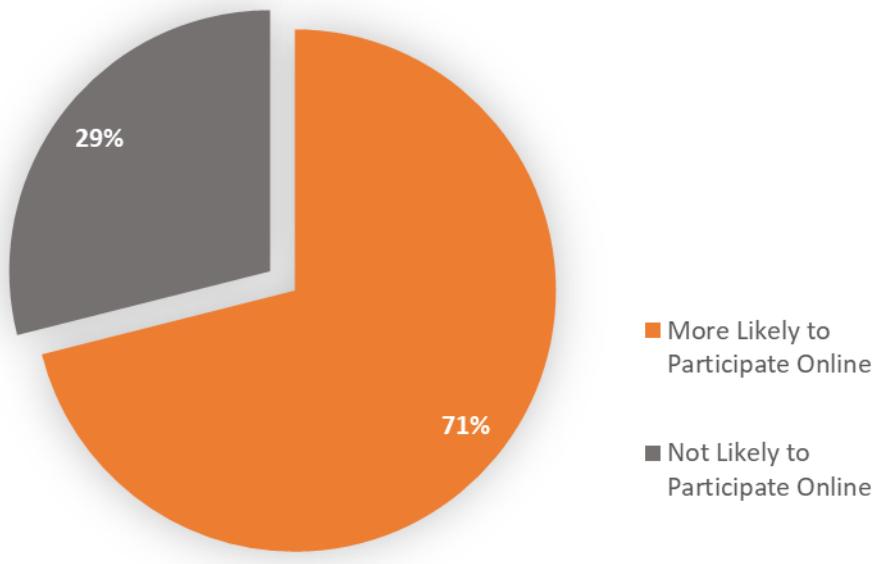

Figure 6. Percent of equine veterinarians who are more likely to participate in equine nutrition continuing education if the course were offered online.

Findings Associated with Objective Six

Objective 6 sought to prioritize nutrition-related conditions in need of curricular enhancement using the Borich (1980) needs assessment model. The Borich (1980) model

allows for two independent constructs to be measured simultaneously by calculating discrepancy scores. The constructs measured were the frequency in which veterinarians encountered clinical categories and their level of confidence in providing nutrition council for each category. Borich's (1980) model is easily "adapted to meet a variety of institutional needs" (p. 41); thus, this study used the term frequency rather than importance to obtain more objective data from respondents. A mean weighted discrepancy score (MWDS) was calculated for each clinical category and then ranked so that those with the items with the largest discrepancies were listed with the highest priority. As shown in Table 18, the clinical categories with the highest priority were arthritis/joint pain, general wellness exams, senior horses, obese horses, and equine gastric ulceration syndrome (EGUS) while the lowest priority was in malnourished horses, orphan foals, and hyperkalemic periodic paralysis (HYPP). Negative discrepancy numbers arose when the mean confidence score was higher than the mean frequency score in a given clinical category.

Table 18
Equine Veterinarians' Prioritized Nutrition Education Needs Using Mean Weighted Discrepancy Scores

Clinical Category	MWDS	Priority
Arthritis/Joint Pain	2.53	1
General Wellness Exam	0.16	2
Senior Horse	-0.03	3
Obese Horse	-0.86	4
Equine gastric ulceration syndrome (EGUS)	-0.97	5
Equine pituitary pars intermedia dysfunction (PPID)	-1.07	6
Recurrent airway obstruction (RAO)	-1.11	6
Insulin Resistance (IR)	-1.14	6
Colic	-1.21	9
Equine metabolic syndrome (EMS)	-1.24	9
Developmental Orthopedic Disease (DOD)	-1.38	11

Equine protozoal myeloencephalitis (EPM)	-1.68	12
Horse with Diarrhea	-1.85	13
Recurrent equine rhabdomyolysis (RER)	-2.35	14
Horse with Laminitis	-2.69	15
Equine polysaccharide storage myopathy (EPSM/PSSM)	-2.77	16
Hyperkalemic periodic paralysis (HYPP)	-3.03	17
Orphan Foal	-3.33	18
Malnourished Horse	-3.66	19

Summary of the Findings

Objective One – Demographics

In all, 531 licensed veterinarians, representing all 50 states, participated in the study. States with the highest representation of veterinary respondents were consistent with those having the highest populations of horses. Regarding sex of the respondents, 51% were female. The mean age of respondents was 51, and the mean number of years in practice was 23. The majority of veterinarians (85%) held positions in private clinical practice, and 75% defined themselves as either *equine exclusive* or *equine predominant practitioners*. Respondents spend 83% of their species-contact time with equine patients, and the majority (75%) was not board certified in any category at the time of this study. On average, respondents cared for 46 horses per week with the most common type being performance horses (44%). The most frequently encountered clinical categories were arthritis/joint pain, senior horses, general wellness exams, colic, and obese horses.

Objective Two – Veterinarians' Self-Perceived Knowledge of Equine Nutrition

Only 21% of veterinarians ranked their level of equine nutrition knowledge as *good* (*n* = 92) or *excellent* (*n* = 19) *after graduation from veterinary school*. The remaining respondents considered their knowledge of equine nutrition to be *average*,

poor, or *unsatisfactory* after graduating with a veterinary degree. Just over one-half of veterinarians have confidence in their *current level of equine nutrition knowledge* with 52% ranking their knowledge as either *good* (*n* = 224) or *excellent* (*n* = 51). Veterinarians are most confident providing nutrition advice for colic, senior horses, general wellness exams, obese horses, and horses with laminitis.

Objective Three – Veterinarians' Experiences with Equine Nutrition Education

The largest portion of respondents (38%) was *somewhat dissatisfied* with the amount of equine nutrition education training they received during veterinary school, and the smallest portion (3%) was *extremely satisfied.* In the last year, only 25% of respondents had attended a continuing education course in equine nutrition. Among the 400 respondents who did not attend a course, 70% simply *chose to spend time on other topics*. The mean number of continuing education (CE) hours veterinarians in this study had earned in equine nutrition since graduating from veterinary school is 25.

Objective Four – Veterinarians' Preferences for using Equine Nutrition in Practice

Seventy percent of veterinarians (*n* = 522) considered nutrition to be *very important* in their practice philosophy; less than 1% considered it *not important at all*. Approximately 83% of veterinarians provide personal nutrition counsel to clients with 59% of them considering it an integral part of routine examinations. Veterinarians who offer nutritional advice do so with approximately 39% of patients, and the vast majority (93%) does not charge additional fees to provide this counsel. Veterinarians were most likely to offer nutritional advice for senior horses and least likely to offer it for racehorses.

Objective Five – Veterinarians' Preferences for Acquiring Continuing Education in Equine Nutrition

Veterinarians felt a need for additional education in the role nutrition plays in insulin resistance (IR), equine gastric ulceration syndrome (EGUS), equine metabolic syndrome (EMS), and performance horses. They least desired additional information for the nutritional management of stallions, broodmares, companion/non-riding horses, and orphan foals.

When asked to rate the most important sources for obtaining equine nutrition information, the three most popular choices were equine nutritionists with a doctor of philosophy degree, veterinarians, and peer-reviewed journals. The least important sources were equine dentists (other than veterinarians), radio/television/newspaper, farriers, and trainers/riding instructors.

The two most common methods of continuing education experienced by respondents were traveling to a lecture/seminar and reading peer-reviewed journal articles. When veterinarians were asked for their preferred method of acquiring continuing education in equine nutrition, the most popular responses were reading peer-reviewed journal articles, traveling to a lecture/seminar, and online learning. Only 14% of veterinarians stated they had no interest in taking a continuing education course in equine nutrition within the next year, and 71% of all veterinarians in this study would be more likely to take a course in equine nutrition if it were offered online.

Objective Six – Prioritization of Nutrition-Related Conditions in Need of Curriculum Enhancement

According to the Borich needs assessment model, the top five clinical categories in which veterinarians had the greatest need for equine nutrition curricular enhancement were arthritis/joint pain, general wellness examinations, senior horses, obese horses, and equine gastric ulceration syndrome (EGUS). Areas least in need were the malnourished horse, orphan foal, and hyperkalemic periodic paralysis (HYPP).

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

Chapter 5 refreshes the reader on the purpose of the study and research objectives. This chapter provides conclusions and implications for each of the six research objectives, and then offers recommendations for practice and future research in equine veterinarians' practices, perceptions, and preferences related to equine nutrition education.

Purpose

The purpose of this study was to assess equine veterinarians' practices, perceptions, and preferences associated with nutrition in horses. This study evaluated the congruence between *what is* and *what should be* as it relates to the educational needs of equine veterinarians on the topic of equine nutrition. Additionally, this study sought to describe veterinarians' preferred methods of acquiring continuing education hours in equine nutrition.

Research Objectives

1. Describe selected personal and professional characteristics of licensed equine veterinarians in the United States.

2. Describe self-perceived equine nutrition knowledge of licensed equine veterinarians.
3. Describe licensed equine veterinarians' equine nutrition training received during and after veterinary school.
4. Describe licensed equine veterinarians' preferences for using equine nutrition in their daily veterinary practice.
5. Describe licensed equine veterinarians' preferences for acquiring continuing educational knowledge in equine nutrition.
6. Prioritize nutrition-related conditions in need of curricular enhancement using the Borich (1980) needs assessment model.

Conclusions and Implications

Conclusions and Implications Associated with Objective 1

The typical equine veterinarian is a male or female who has been in practice in excess of 20 years, which is consistent with a similar study by Roberts and Murray (2013). It could stand to reason that equine veterinarians are drawn to geographic areas such as Texas, California, and Florida where horse numbers are highest (AHC, 2017). Equine veterinarians care for an average of 46 horses per week, and the most common type of patient is a performance horse. This patient profile adds to the body of literature because data from previous, similar research (Roberts & Murray, 2013) was based primarily on horses used for pleasure. Prior research has failed to obtain data exclusively from equine veterinarians (Becvarova et al., 2016; Buffington & LaFlamme, 1996; Roberts & Murray, 2013); therefore, this study provides much needed insight on veterinarians who spend the majority of their species contact time with horses.

The most common ailment of horses seen by equine veterinarians is *arthritis/joint pain*. This conclusion is supported by equine insurance provider, Petplan® Equine, with a recent report that identified *arthritis* as the number one health problem affecting horses in 2017 (Allianz, 2018). Data from human medicine shows arthritis and joint pain is highly correlated with aging and obesity (Kane, 2018). Since there was a high frequency of obese and senior horses, it stands to reason that there would be a high frequency of patients with arthritis and joint pain.

Conclusions and Implications Associated with Objective 2

Nutrition courses taken during veterinary school do not prepare veterinary students adequately to address nutrition related conditions in horses. Equine veterinarians are not comfortable with their level of equine nutrition knowledge after graduation from veterinary school, which supports previous research by Buffington and LaFlemme (1996) and Roberts and Murray (2013). Should schools offer equine nutrition courses specifically for students who wish to have a specialized equine practice? Is an undergraduate level general livestock nutrition course the only requirement for veterinarians? Perhaps the coursework is available, but the level of comprehension is lacking. Moore, Leamon, Cox, and Servis (2002) stated that, “few faculty members involved in veterinary medical education have had extensive formal training in teaching or in the educational concepts that underlie pedagogical methods” (p. 117). The fact that veterinary students are graduating from programs with such a low confidence level supports the notion from Moore et al. (2002) that veterinary instructors may benefit from a better understanding of educational theories. Perhaps veterinary instructors should be

required to complete courses in educational learning theories prior to becoming part of the faculty.

Roberts and Murray (2013) reported that veterinarians rate their *current* level of knowledge in equine nutrition to be higher than their level of knowledge at *graduation*. This study supports those findings as the average confidence score shifted in a positive direction when comparing equine nutrition knowledge at *graduation* to *current* knowledge of equine nutrition. Thus, human capital of veterinarians increased from the time of graduation to the present time. "Human capital is accumulated in two ways: through experience or education" (Serneels, 2008, p. 1143). Could this positive shift in human capital be a result of gaining on-the-job training and experience, or simply a result of becoming more confident in one's own professional opinion and role as an expert in equine health? It might be a combination of both.

Veterinarians in a similar study (Roberts & Murray, 2013) reported the most confidence in providing nutritional advice for colic, senior horses, laminitis, and obesity. Equine veterinarians in this study show the most confidence offering nutrition advice for colic, senior horses, general wellness examinations, and obesity. Those four categories also were in the top five *most frequently encountered* clinical situations reported in this study. Might it be that the increase in confidence is a result of acquiring more human capital in the form of experience and exposure in practice?

Objective Three – Veterinarians' Experiences with Equine Nutrition Education

Equine veterinarians are dissatisfied with the educational experience they receive in veterinary school regarding equine nutrition, yet, appear to have little desire to fill the knowledge gap through participation in continuing education. In 2002, the American

Veterinary Medical Association Council on Education discontinued the Continuing Education Standard (the 11th essential for veterinary college accreditation), meaning accreditation reviews of veterinary colleges no longer include evaluations of continuing education programs (Moore, 2003). A possible consequence of this discontinuation could be that colleges are failing to invest in professional development of professors and choosing not to enhance course offerings. Research by Becvarova et al. (2016) supports this notion by identifying "limited human resources and an unsatisfactory number of nutrition teaching hours [as] the key barriers to improving graduate skills and performance" (p. 358).

As lifelong learners, practicing veterinarians are expected to pursue continuing education hours to improve knowledge deficiencies and remain current on the latest developments related to their profession. Unfortunately, only one-quarter of veterinarians are participating in continuing education courses related to equine nutrition. These findings support those of other researchers (Buffington & LaFlamme, 1996; Roberts & Murray, 2013). Interestingly, the main reason equine veterinarians do not pursue continued education in nutrition is not due to a lack of available courses, but rather a lack of desire, which has been reported previously in the literature (Roberts & Murray, 2013). Is it possible that continuing education courses in equine nutrition are failing to meet the needs of adult learners? Andragogic theorist Malcom Knowles (1980) advocated that adults have the best learning experience when they have a *need* for knowledge, are *motivated* to learn, are able to use their *experience*, are allowed *self-direction*, and when the learning experiences are *oriented* in a way that allows immediate use of the

knowledge. Perhaps continuing education instructors are failing to utilize principles of adult learning theory.

This study found that on average, veterinarians have devoted only three business days (approximately 25 hours) of their career to improving their knowledge of equine nutrition. From an annual perspective, veterinarians are devoting only 65 minutes per year to continued education in equine nutrition. Could this lack of desire be influenced if veterinarians understood the principles of human capital theory? The main pillars for increasing human capital are learning, education, and training (Becker, 1964; Coff, 2002; Mincer, 1974; Smylie, 1996); therefore attending continuing education courses in equine nutrition is an obvious way to refine a "sector-specific" skill (Smith, 2010, p. 42). Enhancing the equine nutrition skill-set would increase a veterinarian's human capital, which in turn, makes them more valuable (Smith, 2010). Would veterinarians with a refined nutrition skill-set feel more at liberty to charge for nutrition counsel, considering only seven percent do so currently?

Objective Four – Veterinarians' Preferences for using Equine Nutrition in Practice

Nearly all equine veterinarians consider equine nutrition to be an important component of their practice philosophy, which aligns with prior findings (Roberts & Murray, 2013); yet, less than one-half are providing nutrition advice for their clients. Why is there incongruence between the high level of importance equine veterinarians place on nutrition in their practice philosophy compared to the relatively low number of patients who actually receive nutrition counsel? Could it be because the owner is not receptive to hearing and receiving the advice? A review of the literature suggests otherwise (AAHA, 2003; Bushell & Murray, 2016; Hartmann, et al., 2017; Laflamme et

al., 2008; Martinson et al., 2006; Michel et al., 2008; Murray, et al., 2015; Swirsley et al., 2017; USDA, 2015; USDA, 1998). Could it be because the veterinarian is not able to communicate with the direct caretaker of the horse? Or, that veterinarians believe nutrition is important but do not feel confident in their ability to make recommendations for certain conditions? Maybe veterinarians are not comfortable in their own understanding of nutrition's effect within a specific disease process or life stage; or, maybe they understand it, but are not confident in communicating it with the horse owner.

Less than one-tenth of veterinarians in this study report charging an extra fee for providing nutrition advice. Perhaps charging clients for nutrition counsel would encourage veterinarians to increase the amount of communication they have with clients regarding equine nutrition. Veterinarians who invest in continuing education to advance their skill-set in equine nutrition would have the human capital necessary to justify charging extra for nutrition counsel. However, what if money is not the driving factor, but rather it is confidence? This study found veterinarians are most confident offering nutrition advice for senior horses, which supports prior research findings (Roberts & Murray, 2013) and growing horses. Could this be due to marketing efforts made by feed companies that label product as *senior* and *growing* horse feeds, which makes the recommendation a thoughtless process? Is it possible that veterinarians are more confident recommending nutrition products that have a clearly defined purpose printed on the label?

Objective Five – Veterinarians' Preferences for Acquiring Continuing Education in Equine Nutrition

Veterinarians have a very low desire for obtaining additional nutrition education on stallions, broodmares, and foals and a high desire to learn about the role of nutrition in insulin resistance, gastric ulcers, and equine metabolic syndrome. These results are additive to the current body of literature because prior studies like this have not included life stages of stallions, broodmares, and foals which have unique nutritional needs (NRC, 2007). Are veterinarians disinterested in stallion, broodmare, and foal nutrition because higher education and continuing education are currently providing adequate curriculum in theriogenology? This study found that stallions, mares, and growing horses as a summed group accounted for 22% of patients, so maybe veterinarians do not perceive these categories as important because they represent such a small percentage of clients on an individual basis. It is likely that veterinarians have a high desire to learn about nutrition when it is closely related to a disease, disorder, or syndrome.

Veterinarians regard themselves highly as an information source for equine nutrition, preceded only by equine nutritionists with a doctoral degree. This supports prior findings by Roberts and Murray (2013). Veterinarians view themselves as a preferred resource over peer-reviewed journals, equine nutritionists with a master's degree, and professional conferences/symposiums. Veterinarians assigned an extremely low ranking to university instructors/extension agents as a source for equine nutrition information. Why do veterinarians perceive themselves as the preferred resource in equine nutrition above all other sources, aside from a Ph.D. equine nutritionist? Is it because they do not feel comfortable communicating with others outside of their peer group? Is it because the other sources have done a poor job communicating information to veterinarians? Could it be related to adult learning theory in that veterinarians need an

andragogic approach to learning and their past involvement with university professors and extension specialists was pedagogical in nature?

Online learning is a promising avenue for continuing education in equine nutrition. Although veterinarians prefer to participate in continuing education program structures with which they are familiar (e.g., such as traveling to a lecture and reading peer-reviewed journals), they also are open to using online options such as interactive and non-interactive distance learning. This finding supports research by Roberts and Murray (2013) who noted that a high percentage of veterinarians are interested in online opportunities for continuing education in equine nutrition.

Reading peer-reviewed journals is the most popular method for obtaining continuing education in equine nutrition. Is this because veterinarians can selectively learn about topics on their own schedule? Is the low number of acquired continuing education hours in equine nutrition due to the fact that veterinarians are reading peer-reviewed journals rather than attending educational programs? Are peer-reviewed journal articles an adequate substitution for education programs when it comes to lifelong learning? It would be interesting to know which journals equine veterinarians are reading, and if veterinarians have ever been formally trained to critically evaluate a research study.

Participation in nutrition research was ranked lowest on the list of preferred methods for obtaining nutrition education. Is it just coincidence that university faculty have a similarly low ranking as a preferred resource for nutrition information? Is there friction between academia and the veterinary industry that should be explored?

Objective Six – Prioritization of Nutrition-Related Conditions in Need of Curriculum Enhancement

The role nutrition plays in arthritis and joint pain is an area deserving of attention in the curricula. This supports findings from prior studies that show high instances of arthritis, joint pain, and use of oral joint supplements (Hoffman, Costa, & Freeman, 2009; Murray et al., 2015; Williams, Parise, & Burk, 2009). Curricular development around senior horses and obesity would be beneficial to veterinarians due to the frequency in which they encounter such patients. This supports prior reports on the increasing population of obese (Stephenson et al., 2011; Thatcher et al., 2012; Wyse et al., 2008) and aging horses (Ireland et al., 2011; USDA, 2015). Could it be that arthritis, age, and obesity are inter-related? Perhaps senior horses and obese horses are more likely to suffer from joint pain and arthritis, as is reported in human medicine (Kane, 2018). Could the increases in life-span and obesity be causing an influx of equine patients for which veterinarians are not appropriately prepared?

Interestingly, *general wellness exam* has the second highest discrepancy score in regard to equine nutrition. Veterinarians are in need of training in how to assess the nutritional status and feeding programs of horses during general wellness evaluation. This is in accordance with the findings of Roberts and Murray (2013) that veterinarians may not be well equipped to advise clients on nutritional programs for their horses. Perhaps veterinarians are not taught a protocol for addressing nutrition during general wellness evaluations. Small animal veterinarians have already adopted *nutritional assessment* as the "5th vital sign" (Becvarova et al., 2016, p. 349), thereby assessing nutrition every time an animal is evaluated. Equine veterinarians should be equipped with the skills to

assess body condition and educate owners on the importance of feeding by weight rather than volume, and ensure proper proportions of the diet come from forage.

Areas least in need of curricular enhancement include the orphan foal, malnourished horse, and hyperkalemic periodic paralysis (HYPP). Is this because current curriculum is providing adequate information in these areas already? Perhaps information on these topics are readily available through peer-reviewed journals and other preferred resources outside of a formal education program? It also could be that veterinarians have minimal contact time with these types of patients.

Recommendations

Recommendations for Practice

Equine nutrition education instructors responsible for curricular development for veterinary students, and veterinary continuing education programs should address the influence of nutrition in arthritis/joint pain. Veterinarians also should be taught how to assess nutritional status during a general wellness examination. These areas were identified by the Borich (1980) model as areas of need for curricular enhancement. Instruction in both areas should be offered at veterinary conferences and symposiums as well as being made available online. Program content should be developed with the help of an unbiased equine nutritionist with a doctoral degree. Such person can be found among university faculty, for example. Veterinarians have self-perceived knowledge deficiencies regarding nutrition's influence in insulin resistance (IR), equine gastric ulcer syndrome (EGUS), equine metabolic syndrome (EMS), and performance horses. These areas should be addressed in post-secondary curriculum for veterinary students interested in pursuing a career as an equine veterinarian. A graduate-level elective course should be

developed and taught by university faculty to improve education around nutrition's role in the aforementioned disease processes. This course could be utilized by both veterinary and graduate-level students enrolled in the university. By offering a hybrid course, which allows both on-campus and online students, those from multiple universities would benefit from improved education in situations they will frequently encounter as an equine veterinarian. The university would benefit through increased tuition revenue from veterinary and graduate-level students who may be attending other universities yet enroll in this course online. Faculty in the animal science department who specialize in equine nutrition and supported by faculty in the veterinary college should spearhead the development of this course.

According to the results of this study, there appears to be an invisible barrier between university faculty and veterinarians that should be explored. Academic professors are arguably one of the most knowledgeable sources of information; yet, veterinarians ranked them sixth on a list of preferred resources, and ranked *collaboration in research trials* as the least preferred method for improving knowledge. These results suggest veterinarians either lack respect for university faculty, or they mistrust them. Therefore, university faculty should first make an effort to attend veterinary conferences and symposiums to increase their visibility and rapport among the veterinary community. They also should offer themselves as guest speakers for events that veterinarians attend regularly to improve credibility. As professional friendships develop and university faculty command a higher level of respect, the door will open for discussions and collaboration for identifying needs and closing the knowledge gap in equine nutrition.

Finally, a strong effort should be made to improve veterinarians' understanding of the role nutrition plays in animal wellness. The goal should be to enhance post-secondary nutrition education for veterinary students and increase the number of nutrition continuing education hours obtained by practicing equine veterinarians each year. Improving the nutrition skill set of equine veterinarians can be accomplished through four specific steps: 1) educate veterinarians on the concept of human capital theory and position *nutrition knowledge* as a skill-set that can improve their value, 2) educate program instructors on adult learning theory and encourage them to take an andragogical approach to designing curriculum, 3) develop programs that are applicable to the needs of equine veterinarians by focusing curricula on situations they frequently encounter and topics in which they have the least amount of confidence (e.g., arthritis/joint pain, senior horses, obesity, colic, equine gastric ulcer syndrome, insulin resistance, equine metabolic syndrome, and performance horses), and 4) offer education programs in an online format. Diffusion of innovations theory (Rogers, 1995) should be considered when taking the aforementioned steps. According to Rogers (1995), innovativeness is the degree to which a veterinarian is relatively early in adopting new ideas compared to other veterinarians. Adopter categories in which a veterinarian is classified (i.e., innovator, early adopter, early majority, late majority, or laggard) will influence the point in time they begin to participate in education programs that sharpen their nutrition skill set. Those with a higher level of innovativeness will begin to participate in programs earlier than those with less innovativeness. Those with very little innovativeness will need to be forced to participate through state or association mandated regulations which would require a

certain number of continuing education hours to be acquired prior to license or membership renewal.

To accomplish the goal of increasing the nutrition skill set of equine veterinarians in the United States, the first step should be for the Council on Education (COE) to require *nutrition* in the curriculum of veterinary colleges. The Council on Education is the United States Department of Education approved accrediting agency for colleges and schools of veterinary medicine. For a college or school of veterinary medicine to become a member of the Association of American Veterinary Medical Colleges (AAVMC), it must earn accreditation from the COE. Currently, there is no mention of nutrition education within *Section 7. Requirements of an Accredited College of Veterinary Medicine* of the COE Policies and Procedure Manual (AVMA, 2017). This recommendation is in congruence with action taken already by the American Animal Hospital Association (AAHA) in 2010 and by the World Small Animal Veterinary Association (WSAVA) in 2011 which adopted *nutritional assessment* as the "fifth vital sign" (Becvarova et al., 2016, p. 349), thereby encouraging nutrition to be assessed every time an animal is evaluated by a veterinarian. Once nutrition is added as a requirement for AAVMC accreditation, the COE will be responsible for holding institutions accountable for offering adequate nutrition courses. The second step to accomplishing these goals is to pass legislation for state agencies to require a minimum number of continuing education hours in the field of nutrition to renew veterinary licenses. Lastly, a third party curriculum development team should be created and deployed to support curricular enhancement. This team should include members who bring experience and knowledge from areas of nutrition, disease processes, veterinary medicine, adult learning

theory, human capital theory, and online education development. Ideally, costs associated with this team would be partially offset by extramural grant funding and the remaining costs would be paid through professional fees or dues from those who use their services.

Recommendations for Future Research

The most frequently encountered clinical condition reported by veterinarians in this study was arthritis and joint pain in equine patients. Future research should investigate the reasons behind this high frequency. Could it be due to longer life-spans, poor diets, increased athletic demand, inadequate footing at training centers and event facilities, or even consequences of pharmaceuticals? Experimental researchers should focus on developing technologies for the veterinarian to use when treating horses with joint pain and arthritis. These technologies could be developed from nutritional, pharmaceutical, or biomechanical perspectives.

Researchers should investigate why students have a low self-perceived confidence level in nutrition after graduating from veterinary school. Investigation should include other areas of equine wellness in which veterinarians are the regarded expert (e.g., equine podiatry and dentistry). Research also should focus on the improvements necessary within the classroom to ensure veterinarians entering the workforce have confidence in the role nutrition plays in overall health. Further research should be conducted to explore the phenomenon of mistrust between university faculty and veterinarians. An effort should be made to identify what has led to the invisible barrier that prevents practicing veterinarians from utilizing university faculty as a resource for nutrition information. Efforts should be made to identify and improve communication channels between university faculty and practicing veterinarians.

Finally, research should be conducted on programs developed as a result of this study's recommendations for practice. Specifically, human capital growth of veterinarians should be assessed by evaluating attitudes, confidence levels, and behaviors before and after participation in a program. Human capital takes time and money to develop, so future research also should explore the most efficient and economical options for improving equine veterinarians' nutrition skill-set.

Discussion

The substantive area for this research was inspired after personal conversations with doctoral level equine nutritionists revealed an emerging theme that veterinarians have a knowledge gap regarding equine nutrition. The literature shows that horse owners rank veterinarians as the most valuable resource for health and nutrition information. Additionally, the literature shows that veterinarians rank themselves among the most important resources for health and nutrition information. However, equine veterinarians are overwhelmingly dissatisfied with the educational experience they receive during veterinary school. In fact, less than one-quarter of veterinarians are confident in their equine nutrition knowledge at the time of graduation. Veterinarians are expected to be lifelong learners, and are required to complete continuing education courses to maintain an active state license. Therefore, veterinarians would assumingly pursue nutrition as a topic of continuing education, however, that is not the case. In fact, veterinarians have a strong lack of desire to improve their nutrition knowledge, with the average equine veterinarian devoting only 65 minutes per year to closing the knowledge gap.

Two potential reasons exist for this lack of engagement. The first is that veterinarians do not understand the principles of human capital theory, which suggest that

by improving a skill-set such as nutrition knowledge, they become more valuable and in turn generate larger profits. The second is that instructors of nutrition education programs are not well-versed in adult learning theory, thereby the coursework which they create is unappealing to the practicing veterinarian which results in fewer courses taken.

If veterinarians are viewed by themselves, and by horse owners, as a superior resource for nutrition information, proper curriculum and standards must be put in place to provide the knowledge needed to assume such a role. The Council on Education should add *nutrition* to the curriculum requirements for those who wish to become and remain an accredited member of the Association of American Veterinary Medical Colleges. In addition, state legislation should be passed mandating state veterinary licensing agencies to require a minimum number of continuing education hours in nutrition prior to license renewals. Finally, to support the aforementioned regulations, a third party curriculum development team should be deployed to support development of improved nutrition education programs. This team should include members who bring experience and knowledge from areas of nutrition, disease processes, veterinary medicine, adult learning theory, human capital theory, and online education development.

In closing, an invisible barrier appears to exist between university faculty and practicing veterinarians. Veterinarians appear to have a disconnect with university faculty, which is disheartening. University faculty with interest in equine nutrition should make a concerted effort to break through this invisible barrier by developing professional relationships and positioning themselves as a valuable resource for practicing equine veterinarians.

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APPENDIX A

Institutional Review Board Approval

Oklahoma State University Institutional Review Board

Date:	03/27/2018
Application Number:	AG-18-18
Proposal Title:	Survey of Learning Needs of 21st Century Equine Veterinarians
Principal Investigator:	Jyme Nichols
Co-Investigator(s):	
Faculty Adviser:	Shane Robinson
Project Coordinator:	
Research Assistant(s):	
Processed as:	Exempt

Status Recommended by Reviewer(s): Approved

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any recruitment, consent and assent documents bearing the IRB approval stamp are available for download from IRBManager. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be approved by the IRB. Protocol modifications requiring approval may include changes to the title, PI, adviser, other research personnel, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any unanticipated and/or adverse events to the IRB Office promptly.
4. Notify the IRB office when your research project is complete or when you are no longer affiliated with Oklahoma State University.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact the IRB Office at 223 Scott Hall (phone: 405-744-3377, irb@okstate.edu).

Sincerely,

Hugh Crethar, Chair Institutional Review Board

AGRICULTURAL SCIENCES & NATURAL RESOURCES

PARTICIPANT INFORMATION FORM

Survey of Learning Needs of 21st Century Equine Veterinarians

Background Information

You are invited to be in a research study of equine veterinarians in the United States. You were selected as a possible participant because of your membership with the American Association of Equine Practitioners. We ask that you read this form and ask any questions you may have before agreeing to be in the study. Your participation is entirely voluntary.

This study is being conducted by: Jyme L. Nichols, MS, department of Agricultural Education, Communications and Leadership, Oklahoma State University, under the direction of J. Shane Robinson, PhD, Agricultural Education, Communications and Leadership, Oklahoma State University.

Procedures

If you agree to be in this study, you will be asked to proceed with the online survey.
Participation in the study involves the following time commitment: 10 minutes

Risks and Benefits of being in the Study

There are no known risks associated with this project, which are greater than those ordinarily encountered in daily life. There are no direct benefits to you. More broadly, this study may help the researchers learn more about equine veterinarians of the 21st century and may help learning institutions adapt.

Compensation

You will receive no payment for participating in this study.

Confidentiality

The information your give in the study will be anonymous. This means that your name will not be collected or linked to the data in any way. The researchers will not be able to remove your data from the dataset once your participation is complete.

Voluntary Nature of the Study

Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time. The alternative is to not participate. You can skip any questions that make you uncomfortable and can stop the survey at any time.

Contacts and Questions

The Institutional Review Board (IRB) for the protection of human research participants at Oklahoma State University has reviewed and approved this study. If you have questions about the research study itself, please contact the Principal Investigator at 580-768-9071, jyme.nichols10@okstate.edu. If you have questions about your rights as a research volunteer or would simply like to speak with someone other than the research team about concerns regarding this study, please contact the IRB at (405) 744-3377 or irb@okstate.edu. All reports or correspondence will be kept confidential.

You will be given a copy of this information to keep for your records.

Statement of Consent

I have read the above information. I have had the opportunity to ask questions and have my questions answered. I consent to participate in the study.

If you agree to participate in this research, please select "I Agree" below, and proceed in completing the survey.

APPENDIX B

English (US)

Consent

PARTICIPANT INFORMATION FORM

Survey of Learning Needs of 21st Century Equine Veterinarians

Background Information You are invited to be in a research study of equine veterinarians in the United States. You were selected as a possible participant because of your membership with the American Association of Equine Practitioners. We ask that you read this form and ask any questions you may have before agreeing to be in the study. *Your participation is entirely voluntary.*

This study is being conducted by: Jyme L. Nichols, MS, department of Agricultural Education, Communications and Leadership, Oklahoma State University, under the direction of J. Shane Robinson, PhD, Agricultural Education, Communications and Leadership, Oklahoma State University.

Procedures
If you agree to be in this study, you will be asked to proceed with an online survey. Participation in the study involves the following time commitment: 10 minutes

Risks and Benefits of being in the Study
There are no known risks associated with this project, which are greater than those ordinarily encountered in daily life. There are no direct benefits to you. This study may help researchers learn more about equine veterinarians of the 21st century and may help learning institutions adapt.

Compensation
You will receive no payment for participating in this study.

Confidentiality
The information your give in the study will be anonymous. This means that your name will not be collected or linked to the data in any way. The researchers will not be able to remove your data from the dataset once your participation is complete.

Voluntary Nature of the Study
Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time. The alternative is to not participate. You can skip any questions that make you uncomfortable and can stop the survey at any time.

Contacts and Questions
The Institutional Review Board (IRB) for the protection of human research participants at Oklahoma State University has reviewed and approved this study. If you have questions about the research study itself, please contact the Principal Investigator at 580-768-9071, jyme.nichols10@okstate.edu. If you have questions about your rights as a research volunteer or would simply like to speak with someone other than the research team about concerns regarding this study, please contact the IRB at (405) 744-3377 or irb@okstate.edu. All reports or correspondence will be kept confidential.

You will be given a copy of this information to keep for your records.

Statement of Consent
I have read the above information. I have had the opportunity to ask questions and have my questions answered. I consent to participate in the study.

If you agree to participate in this research, please select "I Agree" below, and proceed by completing the survey.

- ○ I Agree
- ○ I do not agree to participate in this survey.

Personal & Professional Characteristics

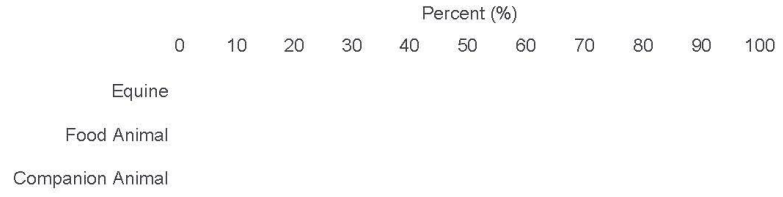
Define your veterinary position:

- ○ Private Clinical Practice
- ○ Government Employment
- ○ Academic Employment
- ○ Corporate Employment
- ○ I am not a veterinarian
- ○ Other, please specify

Select your veterinary category:

- ○ Equine Exclusive
- ○ Equine Predominant
- ○ Equine & Food Animal
- ○ Equine & Companion Animal
- ○ Equine, Food Animal & Companion Animal
- ○ Food Animal
- ○ Companion Animal

What percent of patient contact time is spent with each specie?



Select all areas in which you hold board certification:

- [ ] I do not hold board certification
- [ ] Anesthesia
- [ ] Animal Welfare
- [ ] Behavior
- [ ] Dentistry
- [ ] Dermatology
- [ ] Emergency and Critical Care
- [ ] Internal Medicine
- [ ] Laboratory Animal Medicine
- [ ] Microbiology
- [ ] Nutrition
- [ ] Ophthalmology
- [ ] Pathology
- [ ] Pharmacology
- [ ] Preventive Medicine
- [ ] Radiology
- [ ] Sports Medicine and Rehabilitation
- [ ] Surgery
- [ ] Theriogenology/Reproduction
- [ ] Toxicology
- [ ] Other, please specify:

Age

Sex

- ○ Male
- ○ Female
- ○ Prefer not to answer

How many years have you been in veterinary practice?

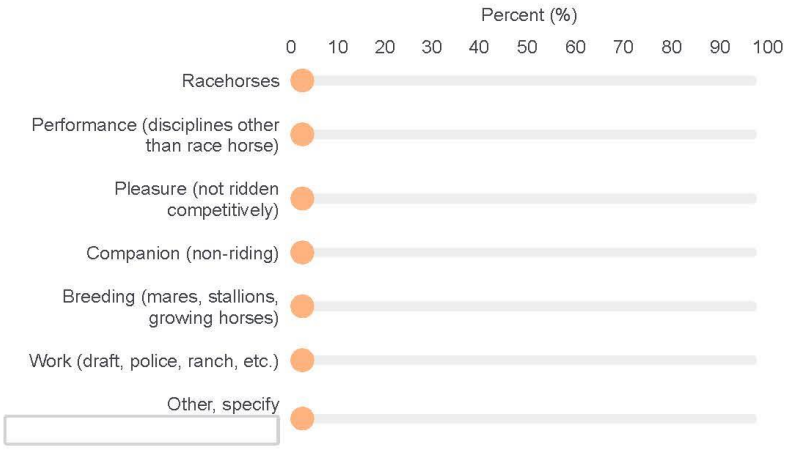
On average, how many equine patients do you see per week?

Select all states in which you practice:

- [ ] Alabama
- [ ] Alaska
- [ ] Arizona
- [ ] Arkansas
- [ ] California
- [ ] Colorado
- [ ] Connecticut
- [ ] Delaware
- [ ] Florida
- [ ] Georgia
- [ ] Hawaii
- [ ] Idaho
- [ ] Illinois
- [ ] Indiana
- [ ] Iowa
- [ ] Kansas
- [ ] Kentucky
- [ ] Louisiana
- [ ] Maine
- [ ] Maryland
- [ ] Massachusetts
- [ ] Michigan
- [ ] Minnesota
- [ ] Mississippi
- [ ] Missouri
- [ ] Montana
- [ ] Nebraska
- [ ] Nevada
- [ ] New Hampshire
- [ ] New Jersey
- [ ] New Mexico
- [ ] New York
- [ ] North Carolina
- [ ] North Dakota
- [ ] Ohio

- [ ] Oklahoma
- [ ] Oregon
- [ ] Pennsylvania
- [ ] Rhode Island
- [ ] South Carolina
- [ ] South Dakota
- [ ] Tennessee
- [ ] Texas
- [ ] Utah
- [ ] Vermont
- [ ] Virginia
- [ ] Washington
- [ ] West Virginia
- [ ] Wisconsin
- [ ] Wyoming
- [ ] I do not practice in the United States

What percent of your equine patients fall into each category:



How often do you encounter the following condition/situation?

	1 Never	2 Yearly Basis	3 Monthly Basis	4 Weekly Basis	5 Daily Basis
General Wellness Exam	○	○	○	○	○
Colic	○	○	○	○	○
Senior Horse	○	○	○	○	○
Malnourished Horse	○	○	○	○	○
Orphan Foal	○	○	○	○	○
Horse with Diarrhea	○	○	○	○	○

	1 Never	2 Yearly Basis	3 Monthly Basis	4 Weekly Basis	5 Daily Basis
Obese Horse	O	O	O	O	O
Horse with Laminitis	O	O	O	O	O
Arthritis/Joint Pain	O	O	O	O	O
Insulin Resistance (IR)	O	O	O	O	O
Equine pituitary pars intermedia dysfunction (PPID)	O	O	O	O	O
Equine metabolic syndrome (EMS)	O	O	O	O	O
Equine polysaccharide storage myopathy (EPSM/PSSM)	O	O	O	O	O
Recurrent equine rhabdomyolysis (RER)	O	O	O	O	O
Equine gastric ulceration syndrome (EGUS)	O	O	O	O	O
Developmental Orthopedic Disease (DOD)	O	O	O	O	O
Recurrent airway obstruction (RAO)	O	O	O	O	O
Hyperkalemic periodic paralysis (HYPP)	O	O	O	O	O
Equine protozoal myeloencephalitis (EPM)	O	O	O	O	O

Your Knowledge

Please rate the following:

	1 Unsatisfactory	2 Poor	3 Average	4 Good	5 Excellent
My initial level of knowledge in equine nutrition after graduating with a veterinary degree	O	O	O	O	O
My current level of knowledge in equine nutrition	O	O	O	O	O

Please rate the following:

	1 Extremely dissatisfied	2 Somewhat dissatisfied	3 Neither satisfied nor dissatisfied	4 Somewhat satisfied	5 Extreme satisfiec
How satisfied are you with the amount of equine nutrition training you received during veterinary school?	O	O	O	O	O

Have you attended an equine nutrition continuing education course in the last year?

- ○ Yes
- ○ No

Select all reasons for not attending an equine nutrition continuing education course in the last year:

- ☐ Not interested
- ☐ I chose to spend my time on other topics
- ☐ No courses were offered online
- ☐ No courses were offered at the symposium/conference I attended
- ☐ Coursed offered were in unsuitable locations
- ☐ Courses offered were scheduled on inconvenient dates
- ☐ Courses offered were too long in duration
- ☐ Courses offered were too expensive
- ☐ Other, please explain

Approximately how many equine nutrition continuing education hours have you earned since graduating veterinary school?

Your Practices and Perceptions

Reflecting on your practice philosophy, how important is equine nutrition?

- ○ Very important
- ○ Somewhat important
- ○ Not important at all

Do you personally provide equine nutrition counseling to your clients?

- ○ Yes
- ○ No

When providing nutritional counseling, this service is:

- ○ An integral part of routine health checks
- ○ Provided only when requested by the client
- ○ Provided only when a specific disease/condition is diagnosed
- ○ Other, please specify:

What percent of the time do you offer equine nutrition advice to your clients?

	0	10	20	30	40	50	60	70	80	90	100
Percent (%)											

How likely are you to provide nutrition advice when addressing the following types of horse?

	5 Extremely likely	4 Somewhat likely	3 Neither likely nor unlikely	2 Somewhat unlikely	1 Extremely unlikely
Racehorses	O	O	O	O	O
Performance (other than racehorses)	O	O	O	O	O
Companion (non-riding)	O	O	O	O	O
Growing	O	O	O	O	O
Senior	O	O	O	O	O
Stallions	O	O	O	O	O
Broodmares	O	O	O	O	O
Working (ranch, police, draft, etc.)	O	O	O	O	O
Other	O	O	O	O	O

Do you charge an additional fee for providing nutritional counseling?

- O Yes
- O No

Identifying Areas of Need

How confident are you at providing nutritional advice for each of the following conditions/situations?

	1 Not confident at all	2 Slightly confident	3 Moderately confident	4 Very confident	5 Extremely confident
General Wellness Exam	O	O	O	O	O
Colic	O	O	O	O	O
Senior Horse	O	O	O	O	O
Malnourished Horse	O	O	O	O	O
Orphan Foal	O	O	O	O	O
Horse with Diarrhea	O	O	O	O	O
Obese Horse	O	O	O	O	O
Horse with Laminitis	O	O	O	O	O
Arthritis/Joint Pain	O	O	O	O	O

	1 Not confident at all	2 Slightly confident	3 Moderately confident	4 Very confident	5 Extremely confident
Insulin Resistance (IR)	O	O	O	O	O
Equine pituitary pars intermedia dysfunction (PPID)	O	O	O	O	O
Equine metabolic syndrome (EMS)	O	O	O	O	O
Equine polysaccharide storage myopathy (EPSM/PSSM)	O	O	O	O	O
Recurrent equine rhabdomyolysis (RER)	O	O	O	O	O
Equine gastric ulceration syndrome (EGUS)	O	O	O	O	O
Developmental Orthopedic Disease (DOD)	O	O	O	O	O
Recurrent airway obstruction (RAO)	O	O	O	O	O
Hyperkalemic periodic paralysis (HYPP)	O	O	O	O	O
Equine protozoal myeloencephalitis (EPM)	O	O	O	O	O

I would like a better understanding of the role nutrition plays in the following conditions (select all that apply):

- ☐ Geriatric/Senior Horses
- ☐ Performance Horses
- ☐ Companion/Non-Riding Horses
- ☐ Working Horses
- ☐ Stallions
- ☐ Broodmares
- ☐ Growing Horses
- ☐ Orphan Foals
- ☐ Colic
- ☐ Diarrhea
- ☐ Malnourished Horses
- ☐ Obese Horses
- ☐ Laminitic Horses
- ☐ Arthritis/Joint Pain
- ☐ Insulin Resistance (IR)
- ☐ Equine pituitary pars intermedia dysfunction (PPID)
- ☐ Equine metabolic syndrome (EMS)
- ☐ Equine polysaccharide storage myopathy (EPSM/PSSM)
- ☐ Recurrent equine rhabdomyolysis (RER)

- [ ] Equine gastric ulceration syndrome (EGUS)
- [ ] Developmental Orthopedic Disease (DOD)
- [ ] Recurrent airway obstruction (RAO)
- [ ] Hyperkalemic periodic paralysis (HYPP)
- [ ] Equine protozoal myeloencephalitis (EPM)

Preferred Resources

What level of importance do you personally place on each source for obtaining information on equine nutrition:

	1 Not at all important	2 Slightly important	3 Moderately important	4 Very important	5 Extremely important
Veterinarian	O	O	O	O	O
Equine nutritionist, PhD	O	O	O	O	O
Equine nutritionist, master's degree	O	O	O	O	O
Equine nutritionist, no degree	O	O	O	O	O
University instructor/extension agent	O	O	O	O	O
Professional equine conferences/symposiums	O	O	O	O	O
Peer-reviewed journals	O	O	O	O	O
Feed companies	O	O	O	O	O
Supplement companies	O	O	O	O	O
Feed store or animal health store personnel	O	O	O	O	O
Riding instructors/horse trainers	O	O	O	O	O
Horse owners	O	O	O	O	O
Farrier	O	O	O	O	O
Equine dentist (other than veterinarian)	O	O	O	O	O
Equine magazines	O	O	O	O	O
Radio/TV/newspaper	O	O	O	O	O
Web/internet	O	O	O	O	O

Have you participated in the following methods regarding continuing education?

	Yes	No
Traveled to a lecture/seminar	O	O
Traveled to a lab/wet lab	O	O
Interactive distance (online/teleconference)	O	O

	Yes	No
Non-interactive distance (online self-study with exam)	O	O
Reading peer-reviewed journal articles	O	O
Participating in nutrition research	O	O
An accredited CE course coming to your clinic	O	O

What is the likelihood you would participate in the following methods regarding equine nutrition continuing education?

	1 Extremely unlikely	2 Somewhat unlikely	3 Neither likely nor unlikely	4 Somewhat likely	5 Extremely likely
Traveling to a lecture/seminar	O	O	O	O	O
Traveling to a lab/wet lab	O	O	O	O	O
Interactive distance (online/teleconference)	O	O	O	O	O
Non-interactive distance (online self-study with exam)	O	O	O	O	O
Reading peer-reviewed journal articles	O	O	O	O	O
Participating in nutrition research	O	O	O	O	O
An accredited CE course coming to your clinic	O	O	O	O	O

How interested are you in taking equine nutrition continuing education courses within the next year?

- O Very interested
- O Somewhat interested
- O Not interested at all

Would you be more likely to take an equine nutrition continuing education course if it were offered online?

- O Yes
- O No

Debriefing

We know your time is valuable, and we sincerely appreciate your effort in completing this survey!

Contacts and Questions

The Institutional Review Board (IRB) for the protection of human research participants at Oklahoma State University has reviewed and approved this study. If you have questions about the research study itself, please contact the Principal Investigator at 580-768-9071, jyme.nichols10@okstate.edu. If you have questions about your rights as a research volunteer or would simply like to speak with someone other than the research team about concerns regarding this study, please contact the IRB at (405) 744-3377 or irb@okstate.edu. All reports or correspondence will be kept confidential.

Appendix C

AAEP News Bulletin: Spur of the Moment View this email in your browser

April 9, 2018
Issue 487

AAEP NEWS

#MeToo & Veterinary Practice: Harassment prevention recommendations for employers
From anti-harassment policies to training for employees, an employment attorney shares guidelines for creating a harassment-free work place. Learn more.

Climb the ladder with AAEP's online career center
Apply for open positions, post your résumé anonymously and sign up for Job Alerts notifying you of new postings with the Career Center. Resources to assist with writing an effective résumé and cover letter and negotiating a salary are also available. For more information, contact Megan Gray.

Equine Veterinary Journal articles of interest

Epidemiology of fractures: The role of kick injuries in equine fractures
Donati, B., Fürst, A.E., Hässig, M., Jackson, M.A.
This retrospective study by Brice Donati and colleagues in Zurich aimed to determine the main causes and factors affecting recovery of fractures in a mixed population of equids.

A longitudinal study of fractures in 1488 Thoroughbred racehorses receiving intrasynovial medication: 2006–2011

Smith, L.C.R., Wylie, C.E., Palmer, L., Ramzan, P.H.L.
This retrospective study by Lewis Smith and colleagues in the UK aimed to investigate the association between the use of intrasynovial anti-inflammatory medication and the incidence of fractures in racehorses.

UPCOMING DEADLINES

First-year grads and students: Submit a case study by May 1 to win $500 and complimentary registration to #AAEP18
Submission instructions can be requested from Carey Ross. For more information click here.

Nominate an exemplary colleague or group for an AAEP award by June 1
You can access the Award Nomination Form, along with full descriptions of each, on our website. Contact Sue Stivers with any questions.

INDUSTRY NEWS

Equine Injury Database shows 20% drop in risk of fatal injury across all racing surfaces since 2009
The rate of fatal injury for Thoroughbreds competing in flat races at North American racetracks in 2017 was 1.61 per 1,000 starts, up from 1.54 per 1,000 starts in 2016. When the EID began collecting data in 2009, the rate of fatal injury was 2.0 per 1,000 starts. Read more here.

Ten Minute Survey on Equine Veterinary Learning Needs
Researchers at Oklahoma State University need your help! Results of this 10 minute survey will help universities and CE programs adapt to the needs of 21st century equine veterinarians. Please click here to begin.

STUDENT NEWS

Application for Merck Animal Health & Oakwood scholarships now open
Current second- and third-year veterinary students are invited to apply. A total of ten (10) will be awarded these scholarships worth $5,000! Both scholarships can be applied for using one application. For more information on the scholarship, eligibility requirements and how to apply, click here. Please email Darcy Brumback with questions.

Register for the student track of the Summer Focus Conference & Labs
Take part in a full day of student-only activities before attending sessions of the Integrative Imaging for Lameness Diagnosis & Treatment and Field Skills for Road Warriors meetings. This session will include skills-based dry labs as well as professional development and networking opportunities. Contact Darcy Brumback with registration questions.

Clinical Techniques for Veterinary Students
June 24 - 26
Raleigh, North Carolina

CONTINUING EDUCATION

Wet labs offered during Summer Focus Conference
Hands-on clinical skill development is now offered during this summer CE event. Limited spots are available and early registration is encouraged to ensure participation.

Track 1: Integrative Imaging for Lameness Diagnosis & Treatment
Track 2: Field Skills for Road Warriors
June 25 - 27
Raleigh, North Carolina

Sponsors: Platinum Level - Boehringer Ingelheim, Dechra and Universal Imaging; Silver Level - Eclipse Loupes and Products, Hallmarq, Owl Manor

Appendix D

Your Expertise is Needed!

Help improve future CE opportunities for yourself and your colleagues.

As a respected equine veterinarian, researchers at Oklahoma State University are asking for a short amount of your time and expertise in a research project.

The goal of this research is to identify learning needs of the 21st century equine veterinarian.

Results of this study will be used by continuing education programs to adapt education topics and delivery methods to fit the needs of modern equine practitioners.

To participate in this **10 minute survey** please click the button below:

Take Survey

This survey was included in the April 9th edition of

AAEP Spur of the Moment.

If you took the survey included in that e-newsletter please disregard this email.

For more information please feel free to contact the primary investigator:

Jyme L. Nichols, MS
PhD Candidate - Oklahoma State University
Email: jyme.nichols10@okstate.edu
Phone: 580-768-9071

The Institutional Review Board (IRB) for the protection of human research participants at Oklahoma State University has reviewed and approved this study.

Appendix E

Equine Veterinarians Needed!

Help improve future CE opportunities for yourself and your colleagues.

Complete a 10 minute research survey:

Begin Survey

This survey was included in the April 9th edition of

AAEP Spur of the Moment.

American Association of Equine Practitioners

If you previously completed the survey please disregard this email.

Researchers at Oklahoma State University are asking for a short amount of your time and expertise for a research project.

The goal of this research is to identify learning needs of the 21st century equine veterinarian.

Results of this study will be used by continuing education programs to adapt education topics and delivery methods to fit the needs of modern equine practitioners.

For more information please feel free to contact the primary investigator:

Jyme L. Nichols, MS
PhD Candidate - Oklahoma State University
Email: jyme.nichols10@okstate.edu
Phone: 580-768-9071

The Institutional Review Board (IRB) for the protection of human research participants at Oklahoma State University has reviewed and approved this study.

Appendix F

Equine Veterinarians

LAST CHANCE!

Help improve future CE opportunities for yourself and your colleagues.

Complete a 10 minute research survey:

Begin Survey

This survey was included in the April 9th edition of

AAEP Spur of the Moment.

If you previously completed the survey please disregard this email.

Researchers at Oklahoma State University are asking for a short amount of your time and expertise for a research project.

The goal of this research is to identify learning needs of the 21st century equine veterinarian.

Results of this study will be used by continuing education programs to adapt education topics and delivery methods to fit the needs of modern equine practitioners.

For more information please feel free to contact the primary investigator:

Jyme L. Nichols, MS

PhD Candidate - Oklahoma State University

Email: jyme.nichols10@okstate.edu

Phone: 580-768-9071

The Institutional Review Board (IRB) for the protection of human research participants at Oklahoma State University has reviewed and approved this study.

VITA

Jyme Lynn Nichols

Candidate for the Degree of

Doctor of Philosophy

Thesis: IDENTIFYING EQUINE VETERINARIANS' CONTINUING EDUCATIONAL NEEDS IN EQUINE NUTRITION

Major Field: AGRICULTURAL EDUCATION

Biographical:

Education:

Completed the requirements for the Doctor of Philosophy in Agricultural Education at Oklahoma State University, Stillwater, Oklahoma, USA in December 2018.

Completed the requirements for the Master of Science in Animal and Range Sciences at Montana State University, Bozeman, Montana, USA in May 2010.

Completed the requirements for the Bachelor of Science in Animal Science at Montanan State University, Bozeman, Montana, USA in May 2008.

Experience:

- Graduate research and teaching assistant at Montana State University, Bozeman, Montana, USA

Professional Memberships:

- Equine Science Society
- American Registry of Professional Animal Scientists