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Provider Knowledge of Tickborne Diseases

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PROVIDER KNOWLEDGE OF TICKBORNE DISEASES

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PROVIDER KNOWLEDGE OF TICKBORNE DISEASES

An Abstract of the Project by
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Tickborne diseases have increased in incidence in recent years, and new tickborne diseases are being discovered. These increasing numbers show the importance of well-educated health care providers to adequately diagnose and treat these diseases. The purpose of this DNP scholarly project study was to determine the effectiveness of an educational presentation for primary care providers over tickborne diseases in Kansas, Missouri, Oklahoma, and Arkansas. The educational presentation was given at a local nurse practitioner conference and knowledge was assessed via a pre-test, post-test, and 6-week follow-up email. Few research articles are available over this subject and the articles that have been done are limited in their scope to Lyme disease and mostly endemic areas of Lyme disease. A total of 30 participants were at the conference and all of them participated in the study. On average, participants scored 33.33 percent higher on the post-test than on the pre-test which was a statistically significant difference. Due to the loss of follow-up to the six-week follow-up email, statistical analysis of that data was not possible. These findings from the pre and post-test indicate that education on tickborne diseases for healthcare providers is beneficial. Further studies over tickborne disease knowledge and treatment practices in Kansas, Missouri, Oklahoma, and Arkansas should be completed to gain insight into current practices and should include multiple tick diseases.

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CHAPTER I

Introduction

Description of Clinical Problem

Tick borne diseases are an increasingly interesting group of illnesses due to their complexity and increasing numbers in recent years. The 16 diseases currently listed by the Centers for Disease Control and Prevention, including anaplasmosis, babesiosis, *Borrelia mayoni*, *Borrelia miyamatoi*, Bourbon virus, Colorado tick fever, ehrlichiosis, Heartland virus, Lyme disease, Powassan disease, *Rickettsia parkeri* rickettsiosis, Rocky Mountain Spotted Fever, Southern tick associated rash illness, tickborne relapsing fever, tularemia, and 364D rickettsiosis. The Centers for Disease Control and Prevention has shown increasing numbers of diseases such as Rocky Mountain spotted fever and has also identified several new diseases such as Bourbon virus, Heartland virus, and 364D rickettsiosis (CDC, 2017c). Lyme disease is the most prevalent tickborne disease within the United States with 28,453 confirmed cases in 2015 (CDC, 2016), followed by Rocky Mountain spotted fever with 4,470 cases reported in 2012, 25% of which required hospitalization at some point during the course of their illness (CDC, 2017b). The incidence of these diseases is steadily increasing with a rise in Rocky Mountain spotted fever from 2 cases per million to 11 cases per million from 2000 to 2014 (CDC, 2017b).

Spotted fever rickettsiosis is the tickborne most frequently reported to the Kansas Department of Health and Environment (Kansas Department of Health and Environment, 2018). Spotted fever rickettsiosis includes Rocky Mountain spotted fever as well as other rickettsial bacteria such as *rickettsia parkeri* and 364D rickettsiosis that cause symptoms similar to those of Rocky Mountain spotted fever. In 2016, 130 cases of spotted fever rickettsiosis were reported in Kansas, which accounted for 52% of reported tick diseases in Kansas. Data from the Kansas Department of Health and Environment (2018) indicates that there has been an increase in spotted fever rickettsiosis over the past five years. Of the other tickborne diseases in Kansas, ehrlichiosis is the second most reported at 21% followed by Lyme disease at 15%, tularemia at 10%, and anaplasmosis at 2% (Kansas Department of Health and Environment, 2018).

Missouri has also seen an increase in the amount of some tickborne diseases. The number of cases of ehrlichiosis increased 105.2% from 2008 to 2013 with a total of 398 cases (Missouri Department of Health and Senior Services, 2013). Rocky Mountain Spotted Fever is also common in Missouri and is listed by the CDC as one of the top 5 states for RMSF occurrence (CDC, 2017b).

Oklahoma and Arkansas have similar statistics as Kansas and Missouri. In Oklahoma in 2018, there were 92 cases of ehrlichiosis, 80 cases of Rocky Mountain Spotted Fever, 44 cases of tularemia, 5 cases of anaplasmosis, and no reported cases of Lyme disease (Oklahoma State Department of Health, 2019). Arkansas reported 1065 cases of Spotted Fever Rickettsiosis, 173 cases of ehrlichiosis, 55 cases of tularemia, 8 cases of anaplasmosis, 4 cases of Lyme disease, 2 cases of babesiosis, and 1 case of Heartland virus in 2018 (Arkansas Department of Health, 2017).

The Midwest has also been the target of some newly discovered tickborne diseases that are gathering national attention. Bourbon virus was discovered in Southeast Kansas in 2014 and has had several fatal cases (Savage et al., 2018). There have been very few cases of Bourbon virus, so there is still much to be discovered about the disease process and treatment options, which at this time remain limited to supportive care. Heartland virus is another recently discovered tickborne disease with more than 30 reported cases since 2009 (CDC, 2017a). Tick surveillance data in Southeast Kansas has demonstrated positive identification of ticks infected with both Heartland virus and Bourbon virus (Savage et al., 2018).

With the increasing incidence of tickborne diseases it is imperative that advanced practice nurses and other primary care providers be able to accurately assess, diagnose, and treat tickborne diseases. Initial symptoms of Lyme disease include fever, chills, headache, fatigue, muscle and joint aches, swollen lymph nodes, and an erythema migrans rash. If untreated Lyme disease can progress to late stage symptoms which include arthritis and joint pain, facial paralysis, Lyme carditis, neurologic inflammation, nerve pain and memory difficulties (Centers for Disease Control and Prevention, 2018). Proper diagnosis at an early stage can prevent the progression of Lyme disease to the late stage symptoms, thus preventing further symptoms and discomfort for the patients.

The social and economic burden of tickborne diseases is also a consideration for prompt diagnosis and treatment. For those patients who develop post treatment Lyme disease syndrome, poor quality of life and decreased ability to work impacts the individual in all aspects of life. A study of 3090 individuals with post treatment Lyme disease syndrome reported significant decreases in quality of life with 72.3% of

individuals reported fair or poor overall health as compared with 62% of individuals with congestive heart failure reporting fair or poor overall health. Forty-three percent also reported stopping work, activity limitations, increased use of medical services, and greater out of pocket expense (Johnson, Wilcox, Mankoff, Stricker, 2014).

According to a study conducted by Henry, Crabtree, Roth, Blackman, and Morshed (2012), accurate knowledge of Lyme disease by primary care providers led to correct treatment of the disease according to current protocols. A similar study conducted in Arkansas concluded that it is probable that Lyme disease is being under diagnosed in Arkansas as "demonstrated by the inaccuracy and lesser knowledge involving Lyme disease than what is currently accepted as evidence-based standards" (Hill & Holmes, 2015). Although more studies are needed to ascertain the competency of primary care providers in other geographic areas and over other less known tickborne diseases, it is indicated that primary care provider education is needed to ensure proper treatment of tickborne diseases.

Significance

With the increasing incidence of tickborne diseases throughout the United States, knowledgeable primary care providers are essential to rapid recognition and treatment of the diseases. The severity of Rocky Mountain Spotted Fever demonstrates the absolute necessity of prompt diagnosis and treatment by primary care physicians. The severity, morbidity, and mortality associated with the disease are increased with delay of treatment. There is an overall fatality rate of 5-10% for Rocky Mountain Spotted Fever, but if initiation of treatment is delayed until the 8^{th} or 9^{th} day, the fatality rate raises to 40-50%. Severe neurologic manifestations and gangrene are potential complications from

advanced disease (Biggs et al., 2016). The most common symptoms of individuals presenting with tick borne diseases are fever, myalgia, and rash and are difficult to accurately diagnose as these symptoms can be attributed to other illnesses (Centers for Disease Control and Prevention, 2015). Diagnosis may also be a challenge due to many patients not recalling being bitten by a tick, as some diseases are transmitted through the nymph stage of the tick life cycle, making the tick approximately the size of a poppy seed. Advanced practice nurses and registered nurses are often on the forefront providing care in rural areas which increases the significance of recognizing the signs and symptoms of tickborne diseases. Recognizing and quickly treating these diseases leads to decreased cost, mortality, and morbidity for the patients involved. It is vital that primary care providers throughout the country maintain current knowledge of tickborne diseases and evidence-based treatments to ensure appropriate diagnosis and treatment.

Specific Purpose

The purpose of this DNP scholarly project study is to determine the effectiveness of an educational presentation for primary care providers over tickborne diseases in Kansas, Missouri, Oklahoma, and Arkansas. Specifically, this study will present a group of primary care providers with up to date knowledge of tickborne diseases in these states and determine if this presentation increases knowledge immediately after the presentation with pre and post testing questionnaires. A follow-up email questionnaire will assess long-term retention and change in practice. Presenting this education to providers in Kansas, Oklahoma, Missouri, and Arkansas will increase knowledge of the most common diseases in this area, including knowledge of signs and symptoms of disease, treatment options, as well as tick bite prevention techniques. Increasing the knowledge of these

providers will help ensure prompt diagnosis and treatment, as well as prevention techniques for these diseases. The providers will be able to educate their patients on symptoms to report as well as primary prevention techniques to prevent tick bites.

Theoretical Framework

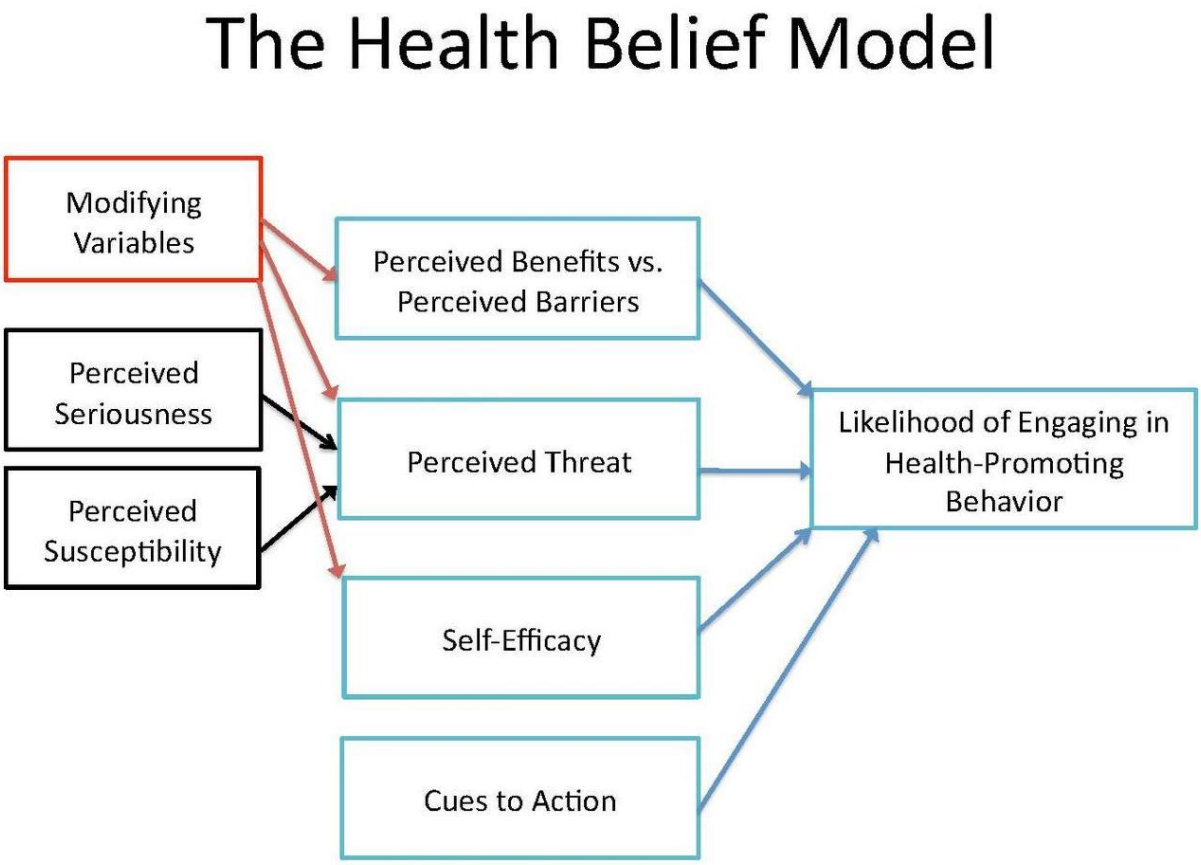
The theoretical framework used for this study is the Health Belief Model by Hochbaum, Rosenstock, and Kegels. The Health Belief Model consists of six core statements related to human health behavior: Perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy (Boston University School of Public Health, 2016). Perceived susceptibility pertains to the individual's belief of their risk of acquiring an illness. Perceived severity is the individual's belief of how the illness would impact them if contracted. This pertains to medical as well as social and cognitive functioning and is largely based on knowledge of the disease. Perceived benefits relate to the believed good that can come from adopting behaviors to decrease the chance of illness of treat the illness once it is contracted.

For action to occur the perceived benefit must outweigh perceived obstacles. Perceived barriers are the beliefs of the disadvantages of health actions. If the health action is described "as being inconvenient, expensive, unpleasant, painful or upsetting" (Rosenstock, 1974, p 331), it is less likely to be acted on by the individual. Cues to action are the triggers that prompt action to occur. With high perceived susceptibility, the triggers might be subtle. On the other hand, if an individual has a very low perceived susceptibility, the triggers might become intense before action is taken (Rosenstock, 1974). Self-efficacy refers to the individuals perceived ability to complete the health task (Boston University School of Public Health, 2016). The purpose of the

Health Belief Model for health education is to use the education to increase the perceived susceptibility and perceived severity of contracting the disease, and to increase self-efficacy of completing health behaviors while decreasing perceived barriers. Using the Health Belief Model with primary care providers will increase general knowledge of tickborne diseases in their area of practice, including primary prevention strategies for patient education, signs and symptoms of diseases, and treatment. Reviewing statistics of disease in this area will increase the perceived susceptibility of patients contracting these diseases. Perceived barriers will be reduced by education of appropriate treatment.

Figure 1:

The Health Belief Model



Research Questions

The incidence of tickborne diseases in Kansas, Missouri, Oklahoma, and Arkansas is rising and there is little research on primary care provider knowledge in this area. Some studies in other geographical areas have shown providers are knowledgeable (Henry, Crabtree, Roth, Blackman, & Morshed, 2012), while other studies indicate that more education is needed to ensure appropriate diagnosis and treatment (Hill & Holmes, 2015). Early recognition and prompt treatment are imperative for improved patient

outcomes. An effective education program for primary care providers in these states could improve primary care providers knowledge of the most common tickborne diseases in this area and improve patient outcomes through prompt recognition and treatment. The research questions for this DNP scholarly project include:

1. Does the implementation of tickborne disease education for primary care providers in Kansas, Missouri, Oklahoma, and Arkansas increase provider knowledge of disease?
2. Does the implementation of tickborne disease education for primary care providers in Kansas, Missouri, Oklahoma, and Arkansas change the provider's current practice?

Definition of Key Terms

The terms to be defined include tick and tickborne disease.

Tick

Ticks come from the order of *Parasitiformes* and have many different species. Ticks are known to be parasites and can transmit disease to both humans and animal species. Ticks can be classified as hard or soft bodied and commonly reside in wooded areas and tall grass habitat (Encyclopedia Britannica, 2018).

Tickborne Diseases

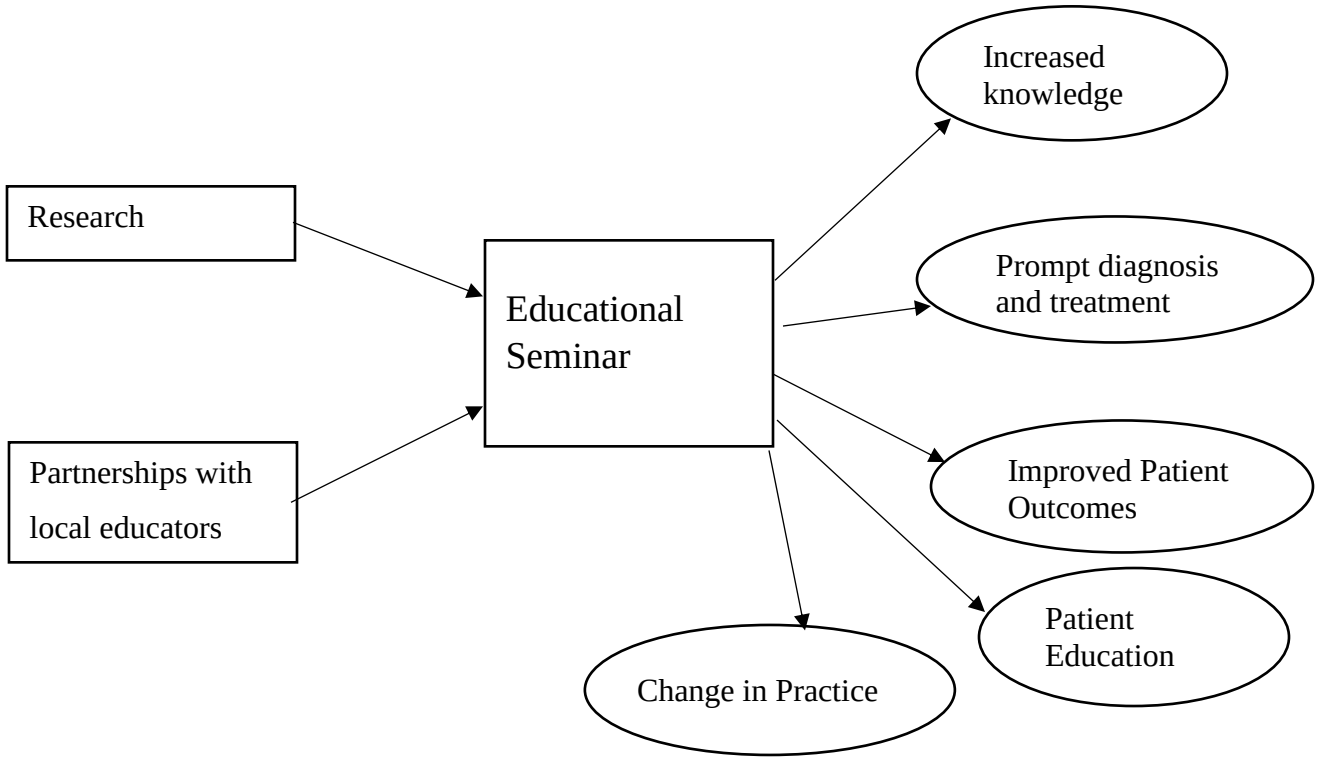
The Centers for Disease Control and Prevention defines tickborne diseases as diseases that are caused from a pathogen transmitted through the bite of an infected tick. There are currently 16 tickborne diseases listed by the Centers for Disease Control and Prevention that cause disease in the United States (Centers for Disease Control and Prevention, 2017c).

Logic Model

A logic model is a visual representation of the proposed project and shows more clearly the steps to be taken during the process (Community Tool Box, 2018). The following logic model depicts the process of educating primary care providers about common tickborne diseases in Kansas, Missouri, Oklahoma, and Arkansas.

Figure 2

Provider Knowledge of Tickborne Diseases Logic Model



Summary

With the incidence of tickborne diseases on the rise, having primary care providers that are current and knowledgeable of diagnosis and treatment options is essential. There is a lack of research of primary care provider knowledge of tickborne diseases in the states of Kansas, Missouri, Oklahoma, and Arkansas. Improving the knowledge of primary care providers on tickborne diseases in these areas will help ensure prompt diagnosis and improve patient outcomes.

CHAPTER II

Literature Review

Tickborne diseases remain an increasing problem in the United States, with Lyme disease being the most common tickborne illness (CDC, 2016a), followed by Rocky Mountain Spotted Fever (CDC, 2017c). In addition to these most common tickborne illnesses, new tickborne diseases are still being discovered and are on the rise. Bourbon Virus, Heartland Virus and 364D rickettsiosis have all been recently discovered, and these viruses have been found in areas not endemic with Lyme disease (CDC, 2017d). The spread of tickborne diseases and discovery of new tickborne diseases underscores the importance of primary care providers having adequate knowledge to address tickborne diseases promptly and competently in their patients.

In this literature review, a thorough background of provider knowledge of tickborne diseases will be discussed, as well as the significance to nursing and theoretical framework used for this critique. The current literature over provider knowledge of tickborne diseases will be systematically studied and critiqued for similarities, differences, any gaps in current knowledge and a summary of findings.

Background and Problem Statement

There are 16 tickborne diseases of the United States currently listed by the CDC. Lyme disease is the most common tickborne illness in the United States with 28,453

confirmed cases in 2015 (CDC, 2016a), followed by Rocky Mountain Spotted Fever with 4470 cases reported in 2012 (CDC, 2017a). Although both Lyme disease and Rocky Mountain Spotted Fever are both treatable with antibiotics, there can be long term effects, and even fatalities, from severe cases. Other tickborne diseases, such as heartland virus and bourbon virus, are only treated symptomatically and can range from mild symptoms to severe cases causing multiple system organ failure and death (CDC, 2017a).

The severity of Rocky Mountain Spotted Fever demonstrates the absolute necessity of prompt diagnosis and treatment by primary care physicians. The severity, morbidity, and mortality associated with the disease are increased with delay of treatment. There is an overall fatality rate of 5-10% for Rocky Mountain Spotted Fever, but if initiation of treatment is delayed until the 8th or 9th day, the fatality rate raises to 40-50%. Severe neurologic manifestations and gangrene are potential complications from advanced disease (Biggs et al., 2016).

The common symptoms of Lyme disease include headache, myalgias, swollen lymph nodes, fever, fatigue, and an erythema migrans rash. If untreated, the symptoms can progress to arthritis, severe headaches, neck stiffness, facial palsy, memory problems, brain and spinal cord inflammation, and carditis (CDC, 2016b).

Both Rocky Mountain Spotted Fever and Lyme disease prove that untreated tickborne disease can be complicated, life threatening, and produce significant amounts of morbidity associated with the disease. Adequate knowledge by primary care providers for prompt diagnosis and treatment is essential to promote the optimum health for patients.

Significance to Advanced Practice

With the increasing incidence of tickborne diseases throughout the United States, knowledgeable primary care providers are essential to rapid recognition and treatment of the diseases. The most common symptoms of individuals presenting with tick borne diseases are fever, myalgia, and rash, which can make tickborne diseases difficult to accurately diagnose as these symptoms can be attributed to other illnesses (CDC, 2015c). Diagnosis may also be a challenge because many patients do not recall being bitten by a tick, as some diseases are transmitted through the nymph stage, making the tick approximately the size of a poppy seed. According to a study conducted by Henry et al.,(2012), accurate knowledge of Lyme disease by primary care providers led to correct treatment of the disease according to current protocols. A similar study conducted in Arkansas concluded that it is probable that Lyme disease is being under diagnosed in Arkansas as "demonstrated by the inaccuracy and lesser knowledge involving Lyme disease than what is currently accepted as evidence-based standards" (Hill & Holmes, 2015). It is vital that primary care providers throughout the country maintain current knowledge of tickborne diseases and evidence-based treatments to ensure appropriate diagnosis and treatment.

Purpose

The purpose of this literature review is to identify the current literature pertaining to primary care provider knowledge of tickborne diseases and to determine if any factors can be identified that contribute to knowledge deficits. Any gaps in knowledge will also be assessed and recommendations for further study will be made based on that assessment.

Literature Synthesis

A search of the literature was performed in PubMed and CINAHL Plus with Full Text using the MeSH terms of tickborne disease and education. CINAHL Plus with Full Text yielded 55 results and PubMed yielded 131 results. Articles were excluded that did not pertain to primary care providers, or that were focused on prevention techniques. The relevant articles references sections were also searched for additional articles. A total of 8 articles were relevant for this literature review. The articles range in publication date from 1994 to 2017. In the following sections, the knowledge assessment, similarities, gaps in knowledge, and theoretical models will be covered in detail.

Knowledge Assessment

Survey Method. Five of the eight articles used surveys to assess the knowledge of primary care providers. Four of those articles utilized mailed surveys (Hill & Holmes, 2015; Magri et al., 2002; Henry et al., 2012; Eppes, Klein, Caputo, & Rose, 1994), while in the fifth study, the survey was distributed at an academic medical center to faculty and residents (Singh et al., 2016). The survey sample size ranged from 91 participants (Singh et al., 2016) to 5566 mailings with 1673 respondents (Henry et al., 2012). Three of the samples included pediatricians, family practice and internal medicine (Henry et al., 2012; Magri et al., 2002; Hill & Holmes, 2015), one included family practice, pediatricians, internal medicine, and a small number of subspecialists (Eppes, Klein, Caputo, & Rose, 1994), and the final article included internal medicine, family practice, and emergency medicine (Singh et al., 2016).

The results of the surveys indicate that more education of providers is needed. Three of the surveys indicate that physicians have accurate knowledge of the signs and

symptoms of disease and clinical management, but indicate the need for further education in the areas of diagnostic testing and reporting of the disease (Henry et al., 2012; Magri et al., 2002; Singh et al., 2016). Hill & Holmes (2015) study indicates that providers in Arkansas need education provided on Lyme disease diagnosis, transmission, symptoms, and reporting practices. The survey by Eppes, Klein, Caputo, & Rose (1994) also indicate the need for education over diagnostic criteria and management of the disease.

Qualitative Interviews. One article used qualitative interviews based on grounded theory methodology to understand how experience and context contributed to the diagnosis of Lyme disease. Nine physicians were interviewed using a semi-structured format from backgrounds of obstetrics, pediatrics, rheumatology, family practice, internal medicine, and infectious disease. The themes that emerged indicated that repetition in diagnosis and counter experiences with Lyme-like cases aided in memory retention and familiarity of Lyme disease cases. The article made specific recommendations for the design of educational programs to educate physicians on Lyme disease (Bakken, 2002).

Other Methods of Knowledge Assessment. Solano et al., (2013) evaluated the use of a multi-level educational intervention to improve diagnosis and testing rates of Lyme disease and two other lesser-known illnesses. Diagnosis and testing of Lyme disease showed a slight increase during the intervention period but this was not sustained post-intervention **(**Solano et al., 2013).

The final study was conducted to ascertain if a provider's suspicion of Lyme disease in the emergency setting is accurate or not. Five pediatric emergency rooms conducted the study over a 2-year period and enrolled 3152 children into the study. Physicians scored these patients on a scale of 1 to 10 on how likely the patient was to

have Lyme disease. The study indicated that erythema migrans is accurately diagnosed by pediatric emergency room physicians and should be treated without further testing. The study found that other more ambiguous presentations of Lyme disease should be tested with the standard 2-tier testing to confirm to avoid false positive or negative diagnosis of the disease (Nigrovic et al., 2017).

Similarities in Literature

Geographic Regions. The majority of these articles conducted research in areas known to be endemic with Lyme disease **(**Solano et al., 2013; Eppes, Klein, Caputo, & Rose, 1994; Singh et al., 2016; Magri et al., 2002; Nigrovic et al., 2017). These areas include New Hampshire, Delaware, New Jersey, Maryland, Pennsylvania, West Virginia, and Wisconsin. One article was conducted in both endemic and nonendemic areas (Bakken, 2002), and two were conducted in non-endemic areas (Henry et al., 2012; Hill & Holmes, 2015).

Gaps in Knowledge

Primary Care Providers. All of the articles included in this literature review conducted research of physicians. Family medicine, internal medicine, pediatrics, and emergency medicine physicians were included in the research. According to the American Association of Nurse Practitioners (2018), there are 248,000 licensed nurse practitioners that are practicing in the United States. Of that number, 77.8% deliver primary care (AANP,2018). This indicates an area for further research into the knowledge of tickborne diseases.

Geographic Regions. The areas included in these research articles are mainly the Northeastern United States (Eppes, Klein, Caputo, & Rose, 1994; Magri et al., 2002;

Nigrovic et al., 2017; Singh et al., 2016; Solano et al., 2013) with a few recent studies being conducted in areas not endemic with Lyme disease. The areas studied that are not endemic with Lyme disease include British Columbia (Henry et al., 2012), Arkansas (Hill & Holmes, 2015), and an area not specifically named (Bakken, 2002). No other research pertaining to provider knowledge of tickborne disease could be found in other areas of the United States.

Tick Diseases Included in Education. All of these research articles assessed provider knowledge of Lyme disease for analysis. With Lyme disease being the most common tickborne disease in the United States, this is a logical choice, but leaves gaps in knowledge related to new and expanding diseases (CDC, 2016). The CDC lists 16 tickborne diseases in the United States and no research has been done pertaining to provider knowledge of any of the other 15 diseases.

Theoretical Models. None of the quantitative articles based the analysis on a theoretical model. Although theoretical models are not a necessity for scholarly articles, it does bolster the quality of the articles themselves. Grounded theory was used for the qualitative article to aid the researcher in gathering data that is subject driven versus investigator driven (Bakken, 2002).

Summary

Tickborne diseases continue to be a concern for patients and providers. The studies have indicated some conflicting results, with some stating adequate knowledge of signs and symptoms of disease, and some indicating further education is needed. Providers need to be educated on management, diagnosis, and reporting of Lyme disease. Further studies should be conducted in areas of the country where new tick diseases are

emerging, such as Heartland virus and Bourbon virus, to ensure that providers are adequately knowledgeable in those areas. In addition to expanding areas of study, studies should be done over tickborne diseases other than Lyme disease to assess the knowledge of providers on those diseases. Studies involving nurse practitioners should also be done to ensure all primary care providers have adequate knowledge of tickborne diseases. Ensuring adequate knowledge of all primary care providers is essential to maintain good outcomes for patients with tickborne diseases.

CHAPTER III

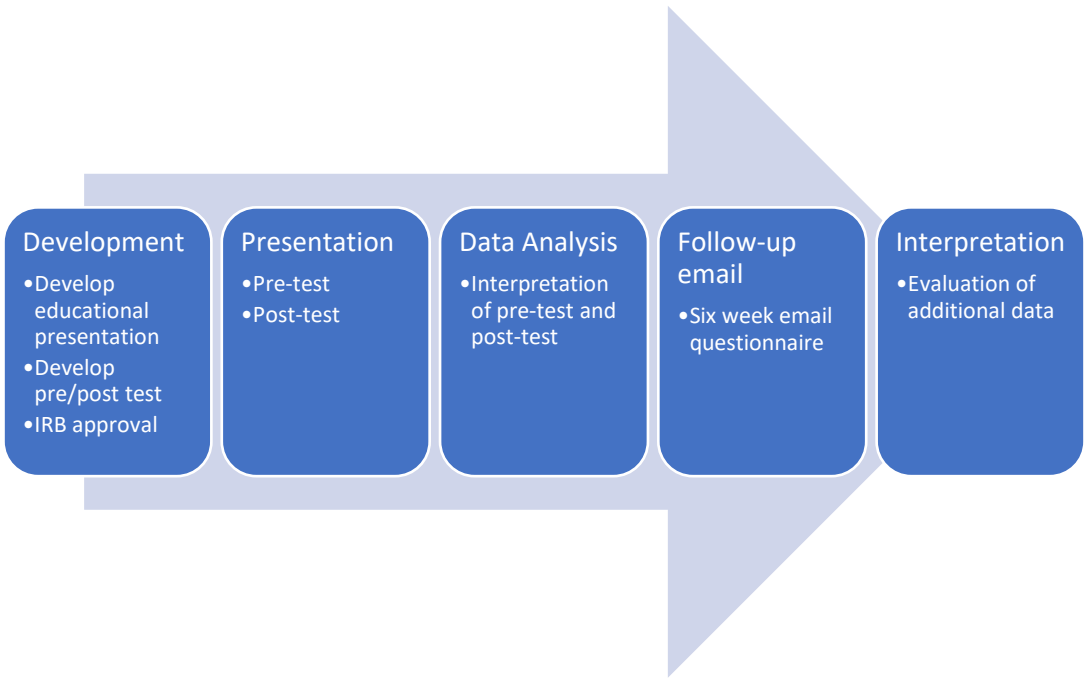
Methodology

Project Design

This chapter will provide an overview of the project design, population, inclusion and exclusion criteria, instruments, project procedure, evaluation, and plan for sustainability. The design for this scholarly project was an educational presentation to nurse practitioners over tickborne diseases in Kansas, Missouri, Oklahoma, and Arkansas. A quasi-experimental design using a pretest and posttest format was utilized to assess the baseline knowledge prior to the presentation and how much knowledge was gained following the presentation. Pretest and posttest study designs "have the strength of temporality to be able to suggest that the outcome is impacted by the intervention" (Thiese, 2014). This study design aided in the ease of recruiting participants and timely data collection. A six-week follow-up questionnaire was emailed to the participants to determine long term retention and if there is any identified change in the providers current practice. The study design is shown in the figure below.

Figure 3:

Study Design



Population

Target Population

The target population of this scholarly project was nurse practitioners and nurse practitioner students who reside or practice in Kansas, Missouri, Oklahoma, and Arkansas and were in attendance of the 4 State APN yearly conference. Both nurse practitioners and students were invited to participate in the pre-test, educational seminar, and post-test portion of the study. Nurse practitioners were required to have a valid nurse practitioner license and email address to participate in the 6-week follow-up email.

Target Population Recruitment

Subjects were recruited at the annual meeting of a local advanced practice nursing group, the 4 State APN. 4 State APN is a group offering membership to nurse practitioners and students in the states of Kansas, Missouri, Oklahoma, and Arkansas. An annual conference is held as well as monthly meetings for their members. The sample for this study was a convenience sample of the advance practice nurses and nurse practitioner students that attended the annual meeting. Pre-tests were passed out prior to the educational presentation over tickborne diseases. The pre-tests and post-tests were filled out on a voluntary basis, and there was no monetary incentive for participation. The six-week follow-up email survey was sent to the participants that voluntarily submitted an email address on the post-test. A chance to win a $20 Wal-Mart gift card was used as an incentive to participate in the 6-week follow-up email.

Inclusion & Exclusion Criteria

Nurse practitioners and nurse practitioner students who were residing or practicing in the states of Kansas, Missouri, Oklahoma, and Arkansas and who attended

the 4 State APN conference were included in this study. Participants were required to be at least 18 years of age to be included in this study. Nurse practitioners were required to have a valid license to be included in the 6-week email follow-up questionnaire.

Nurse practitioners from other states or not in attendance were excluded from this study. Nurse practitioners without a valid license or email address were excluded from the 6-week follow-up email questionnaire. Other healthcare professionals besides nurse practitioners were excluded from this study.

Protection of Human Subjects

The forms were submitted in the fall of 2019 for IRB approval for this scholarly project. The application was submitted for an exempt review due to no specific subject identifiers being gathered during data collection. Pittsburg State University reviewed the project and application. Approval was granted before continuation of the project. Participation in the study was voluntary and participants were not considered part of a vulnerable group. All data was collected under coded numbers to protect subject confidentiality. The completed paper questionnaires were stored in a locked container to prevent any breach of data. The computerized data and statistical analysis were stored on a password protected device with access only granted to scholarly project committee members. At completion of the project, the paper questionnaires were destroyed, and emailed responses were deleted to eliminate any further risk to participants. Risks for participation were minimal since only demographic data was collected. Benefits of participation included furthering knowledge of tickborne diseases and accurate diagnosis during practice.

Instruments

The pre-test and post-test survey were developed from the literature review and research over tickborne diseases as there was not an appropriate previously validated instrument for this study. The survey was reviewed and revised by two local doctors to ensure accuracy of information and relevance. The pre-test and post-test were comprised of multiple-choice questions that covered knowledge of tickborne disease symptoms, treatment, and prevention. Demographic data included age, years of experience, occupation, and area of practice.

The pre-test consisted of 5 questions relating to demographic data and 22 knowledge-based questions over tickborne diseases. The post-test contained the same 22 questions regarding knowledge of tickborne diseases as well as an area to fill in an email address to receive the follow-up email questionnaire at 6 weeks. The emailed questionnaire also contained the questions related to knowledge of tickborne diseases as well as 2 additional questions pertaining to any change in practice since receiving the education.

The knowledge portion of the multiple-choice test was scored with one point given to each question. The more questions answered correctly will equal a higher score. Statistical analysis was conducted using SPSS to determine if there was a statistically significant gain in knowledge. Further evaluation of scores was compiled upon completion of the six-week follow-up email questionnaire to determine if knowledge has been retained and if there had been any change in current practice.

Procedure

Approval and Timeline of Events

In the fall of 2019, the application to IRB for exempt review was submitted. Following approval from IRB and the Irene Ransom Bradley School of Nursing, the project proceeded to the implementation phase. The local nurse practitioner group was approached via email with the proposal of a presentation at the yearly conference. There was no monetary incentive provided to the group for allowing the presentation. The incentive for allowing the presentation was the knowledge gained by its members. Upon approval the presentation was presented at the conference in March 2020. Data collection began after the delivery of the presentation and data was analyzed over the next several months. Following the data analysis, the fourth and fifth chapters of the scholarly project were written, and the project was completed in the spring of 2021.

Resources Needed

The resources needed for implementation of the scholarly project was a projector and screen, paper tests for before and after testing, an assistant to pass out papers, and a statistics expert to assist with data interpretation.

Description of Participant Involvement

Participation in the event was voluntary for the subjects. The meeting held by the local nurse practitioner organization was not required for nurse practitioners in the area, and for those in attendance, the pre-test and post-test were encouraged but optional. The subjects in attendance were informed of the nature of the presentation and voluntary participation was requested. Pre-test paperwork was distributed prior to the presentation. Demographic data was requested on the forms, but no identifiable data was used.

Following the pre-test, the subjects were presented with an educational presentation over tickborne diseases in southeast Kansas. The presentation was made with a PowerPoint for aided learning of key points and was approximately 30 minutes in length. Following the presentation, the posttest was provided to ascertain the amount of knowledge gained.

Data Collection

Data was collected from the pretests and posttests and was coded into SPSS software for analysis and interpretation. The coding of data was performed under corresponding numbers from the pretests and posttests. The data was stored on a secure computer and was only accessed by members of the scholarly project committee.

Evaluation Plan

The objectives of this scholarly project were to ascertain current knowledge of tickborne diseases and to determine if the implementation of an educational presentation increases knowledge. The collected data was analyzed with SPSS software to show correlations and any gaps in knowledge. Analysis of the pre-test versus post-test scores showed the knowledge before the intervention versus the amount of knowledge gained from the presentation. The six-week follow-up email was also analyzed to determine how much knowledge was retained from the educational presentation and if that knowledge caused any change in practice.

Plan for Sustainability

Continuing education on tickborne diseases is necessary to stay up to date on changing epidemiologic statistics. The onset of new diseases such as Bourbon Virus and Heartland virus demonstrates the need to stay current on tick disease information. Sustainability could be facilitated through partnership with the Kansas Department of

Health and Environment to disseminate information about tickborne diseases to the medical community.

CHAPTER IV

Evaluation of Results

Overall Purpose

The purpose of this study was to determine the current level of knowledge primary care nurse practitioners in Kansas, Missouri, Oklahoma, and Arkansas possess related to local tickborne diseases, and if an educational presentation would increase knowledge and/or change the provider's practice. The level of knowledge was assessed with a pre-test, post-test, and a 6-week email follow-up questionnaire. The research questions addressed by this study include:

3. Does the implementation of tickborne disease education for primary care providers in Kansas, Missouri, Oklahoma, and Arkansas increase provider knowledge of disease?
4. Does the implementation of tickborne disease education for primary care providers in Kansas, Missouri, Oklahoma, and Arkansas change the provider's current practice?

Description of Population

The demographic information was collected on the pre-test portion of the analysis and can be seen in Table 1. Demographic questions included age, gender, occupation,

practice area, and years in practice. The majority of the participants were female (96.7%). The largest age category consisted of one-third of the respondents who were 31-40 years of age (33.3%) followed by the next largest group of 41-50 years of age at thirty percent. All but one participant was a nurse practitioner and slightly less than one half were practicing in primary care (46.7%). Almost two-thirds of the participants had been in practice for 0-10 years (63.3%).

Table 1

Demographics

		Frequency	Percent
Age			
	31-40	10	33.3
	41-50	9	30.0
	51-60	8	26.7
	61-70	1	3.3
	>70	2	6.7
	Total	30	100.0
Gender			
	Male	1	3.3
	Female	29	96.7
	Total	30	100.0
Occupation			
	nurse practitioner	29	96.7
	other	1	3.3
	Total	30	100.0
Practice Area			
	primary care	14	46.7
	urgent care	2	6.7
	emergency room	1	3.3
	specialty	13	43.3
	Total	30	100.0
Years in Practice			
	0-10	19	63.3
	11-20	6	20.0
	21-30	4	13.3
	>30	1	3.3
	Total	30	100.0

Description of Key Variables

Independent Variable

The independent variable in this study was the educational presentation over tickborne diseases. The education was presented at the 4-State APN Conference in March of 2020 and lasted approximately 30 minutes. A pre-test to assess knowledge was administered prior to the power point presentation, and a post-test was administered immediately afterward to assess knowledge gained.

Dependent Variable

The dependent variables in this study were the participants' level of knowledge and change in practice. These variables were assessed using the pre-test, post-test, and 6-week follow-up email questionnaire. The change in provider knowledge was assessed immediately by the post-test and again with the 6-week follow-up email. The change in practice was assessed with the 6-week follow-up email questionnaire.

Analysis of Project Questions

The first research question addressed in the analysis is "Does the implementation of tickborne disease education for primary care providers in Kansas, Missouri, Oklahoma, and Arkansas increase provider knowledge of disease?" This question is addressed by a paired sample t-test and pertains to questions 6-27 on the pre-test (appendix A). The results of the t-test are summarized in table 2. The probability (.000) calculated with the test statistic (t= -15.513) is less than alpha (.05) proving there is a statically significant difference between the pre-test and post-test means. On average, participants scored 33.33 points higher on the post-test than on the pre-test.

Table 2

Paired Samples t-test Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	56.0000	30	8.74938	1.59741
	Post-test	89.3333	30	12.84747	2.34562

	Paired Differences					
	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Pretest – Post-test	-33.33333	11.76885	2.14869	-15.513	29	.000

Of the 30 participants, only 13 gave their e-mail address for follow-up. Six responded to the follow-up email. Since there were a small number of individuals in the email follow-up test, the results of this email test were not statistically significant compared to the pre-test and post-test. Those who responded did show that knowledge was retained from the original pre-test score with an average of 75 percent compared to an original pre-test score of 56 percent. These statistics are displayed in table 3.

Table 3

Pre and Post Test Results

	N			
	Participants	Missing	Mean	Std. Deviation
Pretest	30	0	56.0000	8.74938
Post-test	30	0	89.3333	12.84747
Email test	6	24	75.0000	10.00000

The question “Does the implementation of tickborne disease education for primary care providers in Kansas, Missouri, Oklahoma, and Arkansas change the provider’s current practice?” was addressed by two questions on the 6-week email follow-up questionnaire. Due to the small number of participants no statistical tests were

performed. Of the six that responded, two stated that tickborne diseases had been included in a differential diagnosis since the educational presentation but no tick diseases had been diagnosed. Further details are presented in table 4.

Table 4

Change in Practice

Tick Diseases Included in Differential Diagnosis	Frequency	Percent
yes	2	6.7
no	4	13.3
Total	6	20.0
Missing	24	80.0
Total	30	100.0
Tick Diseases Diagnosed Since Presentation	Frequency	Percent
no	6	20.0
Missing	24	80.0
Total	30	100.0

Summary

These statistics indicated that overall knowledge of tickborne diseases was improved with the educational presentation demonstrated by statistically significant improvement in scores from pre-test to post-test. With the many participants that were lost to follow-up, the threshold for statistical significance was not met, but knowledge retention was demonstrated from pre-test to follow-up scores.

CHAPTER V

Discussion

Relationship of Outcomes to Research

The main purpose of this study was to ascertain the knowledge level of tickborne diseases by providers in local areas, and to assess if an educational presentation will increase knowledge and/or change practice. The data was collected by a pre-test, post-test, and 6-week follow-up email. The data collected from these surveys was analyzed to answer the research questions.

The first research question was "Does the implementation of tickborne disease education for primary care providers in Kansas, Missouri, Oklahoma, and Arkansas increase provider knowledge of disease?" Previous research pertaining to provider knowledge of tickborne diseases is limited but indicates that more provider knowledge is needed for patients to receive appropriate care (Hill & Holmes, 2015; Magri et al., 2002; Henry et al., 2012; Eppes, Klein, Caputo, & Rose, 1994). Research by Solano et al. (2013) concluded that an educational intervention increased the diagnosis and testing of Lyme disease during the intervention period but was not sustained post intervention.

The results of this study indicated similar findings. Initial results for the pre-test intervention showed a mean score of 56. Knowledge was showed to be gained by a post-test mean score of 89.3 which is 33.33 points gain above the pre-test. The change from

pre-test to post-test scores was statistically significant. Although the six-week follow up survey was not statistically significant due to the low number of participants, those participants that did fill out the six-week follow up study scored an average of 19 points higher than the pre-test scores, showing that knowledge of tickborne illnesses was retained by those participants.

The second research question was "Does the implementation of tickborne disease education for primary care providers in Kansas, Missouri, Oklahoma, and Arkansas change the provider's current practice?" The study by Solano et al. (2013) indicated that an educational intervention in their study changed practice during the intervention period but was not sustained post-intervention. The data collected during this current study were not statistically significant due to the small number of respondents to the 6-week follow-up. Of the 6 that responded, 2 stated that tickborne diseases had been included in a differential diagnosis since the educational presentation but no tick diseases had been diagnosed. These responses do not indicate a change in practice. This could be due to the timing of the presentation and follow-up. The presentation was given in March with follow-up sent in mid-April. According to the CDC (2020), tick disease infections peak during the summer months (April through September) when ticks become most active. Since the follow-up occurred at the very beginning of peak time for tick diseases, the lack of diagnosis could be contributed to the seasonality of the disease.

Observations

This study is unique since there are few studies over tickborne diseases in general and none that were performed in Kansas, Missouri, or Oklahoma, with only one study performed in Arkansas. This study specifically gives insight into the knowledge of

tickborne diseases in Kansas, Missouri, Oklahoma, and Arkansas as well as showing that an educational presentation improves provider knowledge about the diseases. It is encouraging to see the retention of knowledge on the 6-week follow-up even though it was lower than the immediate post-test. The low number of 6-week follow-up participants was disappointing since the data gleaned was not statistically significant. Since the data collection at the 6-week follow-up was suboptimal, the evaluation of change in practice could not be adequately assessed.

Evaluation of Theoretical Framework

The theoretical framework used for this study is the Health Belief Model. The Health Belief Model consists of six core statements related to human health behavior: Perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy (Boston University School of Public Health, 2019). These concepts were implemented throughout the educational program to increase the likelihood of knowledge retention and practice change by the providers. During the educational presentation the signs and symptoms, mortality and morbidity rates, and treatments of the tick diseases were described to reinforce to the participants the susceptibility and severity of the diseases as well as benefits of prompt treatment. Increasing the provider knowledge of the diseases will decrease perceived barriers and increase self-efficacy of the providers. Due to the small number of 6-week follow-up respondents, the long-term effects of this implementation on practice change were unable to be evaluated. Overall, the providers did show a gain in knowledge due to educational presentation guided by the Health Belief Model.

Evaluation of Logic Model

The logic model for this study was a simple design, showing the research and partnerships used in making an educational presentation over tick diseases and the expected outcomes. The outcome of increased provider knowledge was readily apparent from the data collected. Statistics indicated an increase from pre-test scores for both the immediate post-test and 6-week follow-up scores. Unfortunately, the other four outcomes are unable to be adequately assessed with the data collected. Increased knowledge, improved patient outcomes, patient education, and change in provider practice need statistically significant longer-term data to be sufficiently measured. This was partially hindered due to the loss to follow-up that occurred from the post-test to the 6-week follow-up. With only 6 respondents, the data could not reach statistical significance. Evaluation of these outcomes was also hindered due to the time of year of the intervention. Had the intervention been performed during the summer when tick diseases are peaking in prevalence, there would be a greater likelihood for the providers to implement these changes immediately into practice.

Limitations

This study had several limitations. The sample size of 30 did reach statistical significance but it only represents a small number of nurse practitioners throughout Kansas, Missouri, Oklahoma, and Arkansas. The sample for this study was a convenience sample from a local conference and therefore is not fully able to be generalized throughout the four states. The small number of respondents to the 6-week follow-up greatly limited the data that could be obtained and did not reach statistical significance. The short follow-up time of 6 weeks also limited how well a change in practice could be

determined. The survey used for the pre-test, post-test, and 6-week follow-up may also have been a limiting factor. This survey was created specifically for this study and was not a validated tool.

Implications for Future Research

This project could be carried out with more participants in a randomized fashion to increase the generalizability of the findings. Changing the project to include a longer time frame would also gain insight into the retention of knowledge that was gained during the presentation as well as a more accurate statistical data regarding change in practice behaviors. More accurate data relating to change in practice could be obtained through retrospective chart reviews instead of a self-report survey.

Further studies over tickborne disease knowledge and treatment practices in Kansas, Missouri, Oklahoma, and Arkansas should be completed to gain further insight into current practices and should include multiple tick diseases. The majority of the current studies have focused on Lyme diseases and only in areas where Lyme disease is considered endemic. The addition of more tick diseases and more areas of the United States will increase the depth of knowledge related to this topic.

Implications for Practice/Health Policy/Education

There are several implications for practice derived from this study. This study showed a statistically significant gain in knowledge from the educational presentation. The Centers for Disease Control and Prevention has shown increasing numbers of diseases such as Rocky Mountain spotted fever and has also identified several new diseases such as Bourbon virus and Heartland virus all of which are common tick diseases in this practice area (CDC, 2017). With the increasing number of tick diseases

being reported throughout Kansas, Missouri, Oklahoma, and Arkansas, being well educated about these diseases will lead to more prompt diagnosis and accurate treatment. Patient outcomes will be improved with faster and more accurate treatment.

Local healthcare organizations should incorporate short educational opportunities for providers to refresh their knowledge of tickborne diseases prior to tick season. Offering the education for providers on a regular basis would encourage knowledge retention. Including tick diseases in nurse practitioner school curriculum would provider a base knowledge prior to starting practice.

Conclusion

This study was undertaken to evaluate if an educational presentation could increase provider knowledge of tickborne diseases in Kansas, Missouri, Oklahoma, and Arkansas and/or change practice. This study demonstrated that the educational presentation did increase knowledge immediately after the presentation. Longer term follow-up was not statistically significant due to lack of follow-up responses and therefore change in practice was unable to be determined. The information gained from this study will be beneficial to guide future research and educational opportunities. With the increasing number of tickborne diseases being seen throughout the United States, having well educated health care providers to promptly diagnose and treat these diseases will insure better patient outcomes.

References

Arkansas Department of Health. (2017). *Data from animals & insects*. https://www.healthy.arkansas.gov/programs-services/topics/data-from-animals-and-insects

Bakken, L.L. (2002). Role of experience and context in learning to diagnose Lyme disease. *The Journal of Continuing Education in the Health Professions,* 22(3), 131-141. doi: 10.1002/chp.1340220302

Biggs, H. M., Barton Behravesh, C., Bradley, K. K., Dahlgren, F. S., Drexler, N. A., Dumler, J. S., Folk, S., Kato, C., Lash, R., Levin, M., Massung, R., Nadelman, R., Nicholson, W., Paddock, C., Pritt, B., Traeger, M. S. (2016). Diagnosis and management of tickborne rickettsial diseases: Rocky Mountain spotted fever and other spotted fever group rickettsioses, ehrlichioses, and anaplasmosis -- United States. *MMWR Recommendations & Reports, 65*(2), 1-44.

Boston University School of Public Health. (2019). *Health belief model.* https://sphweb.bumc.bu.edu/otlt/mph-modules/sb/behavioralchangetheories/behavioralchangetheories2.html#:~:text=The%20HBM%20suggests%20that%20a,person%20will%20adopt%20the%20behavior.

Centers for Disease Control and Prevention. (2017a). *Bourbon virus*. https://www.cdc.gov/ncezid/dvbd/bourbon/index.html

Centers for Disease Control and Prevention. (2017b). *Heartland virus-statistics and maps*. https://www.cdc.gov/heartland-virus/statistics/index.html

Centers for Disease Control and Prevention. (2018). *Lyme disease*. https://www.cdc.gov/lyme/index.html

Centers for Disease Control and Prevention. (2016). *Lyme disease data tables*. https://www.cdc.gov/lyme/stats/tables.html

Centers for Disease Control and Prevention. (2020). *Preventing tick bites.* https://www.cdc.gov/ ticks/avoid/on_people.html#:~:text=Tick%20exposure%20can%20occur%20year,months%20(April%2DSeptember).

Center for Disease Control and Prevention. (2017b). *Rocky mountain spotted fever-statistics and epidemiology*. https://www.cdc.gov/rmsf/stats/index.html

Centers for Disease Control and Prevention. (2017c). *Tickborne diseases of the united states*. https://www.cdc.gov/ticks/diseases/index.html

Centers for Disease Control and Prevention. (2015). *Symptoms of tickborne illnesses*. https://www.cdc.gov/ticks/symptoms.html

Community Tool Box. (2018). *Section 1: developing a logic model or theory of change.* https://ctb.ku.edu/en/table-of-contents/overview/models-for-community- health-and-development/logic-model-development/main

Conant, J., Powers, J., Sharp, G., Mead, P., & Nelson, C. (2018). Lyme disease testing in a high-incidence state: Clinician knowledge and patterns. *American Journal of Clinical Pathology, 149*(3), 234-240. doi: 10.1093/ ajcp/aqx153

Encyclopedia Britannica. (2018). *Ticks*. Retrieved from https://www.britannica.com/animal/tick

Eppes, S., Klein, J., Caputo, G., Rose, C. (1994). Physician beliefs, attitudes, and approaches toward lyme disease in an endemic area. *Clinical Pediatrics, 33*(3), 130-134. doi: 10.1177/000992289403300301

Healthcare.gov. (2018). *Primary care provider.* https://www.healthcare.gov/glossary/primary-care-provider/

Henry, B., Crabtree, A., Roth, D., Blackman, D., & Morshed, M. (2012). Lyme disease: Knowledge, beliefs, and practices of physicians in a low-endemic area. *Canadian Family Physician,* 58. e289-e295.

Hill, D., & Holmes, T. (2015). Provider knowledge, attitudes, and practices regarding Lyme disease in Arkansas. *Journal of Community Health, 40*(2), 339-346. doi:10.1007/s10900-014-9940-9

Johnson, L., Wilcox, S., Mankoff, J., & Stricker, R. B. (2014). Severity of chronic Lyme disease compared to other chronic conditions: a quality of life survey. *PeerJ,* 2, e322. doi:10.7717/peerj.322

Kansas Department of Health and Environment. (2018). *Epi updates.* http://www .kdheks.gov/epi/download/newsletter/EpiUpdates_March_2018.pdf

Magri, J., Johnson, M., Herring, T., Greenblatt, J. (2002). Lyme disease knowledge, beliefs, and practices of New Hampshire primary care physicians. *The Journal of the American Board of Family Practice, 15*(4), 277-284.

Missouri Department of Health and Senior Services. (2013). *2013 annual report*. https://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/annual13/Annual13.pdf

Nigrovic, L., Bennett, J., Balamuth, F., Levas, M., Chenard, R., Maulden, A., Garro, A., (2017). Accuracy of clinician suspicion of Lyme disease in the emergency department. *Pediatrics, 140*(6), e20171975. doi: 10.1542/peds.2017-1975

Oklahoma State Department of Health. (2019). *Number of reported cases of communicable diseases, Oklahoma, 1990 – 2018*. https://www.ok.gov/health2/documents/History%20Table%201990-2018.pdf

Savage, H., Godsey, M., Panella, N., Burkhalter, K., Manford, J., Trevino-Garrison, I., Straily, A., Wilson, S., Bowen, J., Raghavan, R. (2018). Surveillance for tick-borne viruses near the location of a fatal human case of bourbon virus (family orthomyxoviridae: Genus thogotovirus) in eastern Kansas, 2015. *Journal of Medical Entomology, 55*(3), 701-705. https://doi.org/10.1093/jme/tjx251

Singh, S., Parker, D., Mark-Carew, M., White, R., & Fisher, M. (2016). Lyme disease in West Virginia: An assessment of distribution and clinicians' knowledge of disease and surveillance. *West Virginia Medical Journal, 112*(4), 48-54.

Solano, P., McDuffie, M., Fagan, H., & Gifford, K. (2013). Evaluation of educational interventions for three lesser-known illnesses. *Delaware Medical Journal, 85*(6), 179-185. Retrieved from https://pittstate.illiad.oclc.org/illiad/illiad.dll?Action=10&Form=75&Value=129147

Thiese M. S. (2014). Observational and interventional study design types; an overview. *Biochemia medica*, 24(2), 199–210. doi:10.11613/BM.2014.022

APPENDIX

Appendix A

Pre-Test

This is a short survey to assess the knowledge of tick diseases and use of preventive measures. This survey is conducted by Kristi Harbit, DNP student at Pittsburg State University. Please contact me at kharbit@gus.pittstate.edu with any questions or concerns.

1. What is your age?
    a. 21-30
    b. 31-40
    c. 41-50
    d. 51-60
    e. 61-70
    f. >70

2. What is your gender?
    a. Male
    b. Female

3. What is your occupation?
    a. Nurse practitioner
    b. Nurse practitioner student
    c. Other

4. What area do you practice in?
    a. Primary Care
    b. Urgent Care
    c. Emergency Room
    d. Specialty
    e. Student

5. How many years have you been in practice?
    a. 0-10
    b. 11-20
    c. 21-30
    d. >30

6. When testing for Lyme disease, a positive ELISA test indicates:
    a. The patient has active Lyme disease
    b. Further testing with Western blot is needed
    c. The patient had a previous Lyme infection, but not active infection
    d. None of these are correct

7. Someone with Rocky Mountain Spotted Fever will always have a rash.
    a. True
    b. False

8. Ehrlichiosis primarily effects what type of cells?
    a. Erythrocytes
    b. Osteocytes
    c. Monocytes
    d. Neurons

9. Second or third degree heart blocks can be a sign of:
    a. Anaplasmosis
    b. Tularemia
    c. Rocky Mountain Spotted Fever
    d. Lyme disease

10. Anaplasmosis can be transmitted by:
    a. Blacklegged ticks (*ixodes scapularis)*
    b. Blood transfusions
    c. Both A and B
    d. None of the above
11. Tularemia can be spread from person to person.
    a. True
    b. False

12. Lyme disease is caused by which bacteria?
    a. *Francisella*
    b. *Borrelia burgdorferi*
    c. *Rickettsia rickettsii*
    d. *Babesia microti*

13. Heartland virus and Bourbon virus are presumably spread by:
    a. Blacklegged tick (*ixodes scapularis)*
    b. American dog tick (*dermacentor variabilis)*
    c. Groundhog tick (*ixodes cookie)*
    d. Lonestar tick (*Amblyomma americanum)*

14. Rocky Mountain Spotted Fever causes:
    a. Vasculitis
    b. Abdominal pain
    c. Erythema migrans
    d. Localized ulcer with lymphadenopathy

15. Ehrlichiosis is spread by what type of tick?
    a. Blacklegged tick (*ixodes scapularis)*
    b. American dog tick (*dermacentor variabilis)*
    c. Groundhog tick (*ixodes cookie)*
    d. Lonestar tick (*Amblyomma americanum)*

16. The fatality rate for anaplasmosis is:
    a. <1%
    b. 1-5%
    c. 6-10%
    d. >10%

17. Symptoms of disseminated Lyme disease include:
    a. Erythema migrans
    b. Secondary annular rashes
    c. Ulcer at site of inoculation
    d. Cough

18. Tularemia can be transmitted by:
    a. Bite of infected tick
    b. Deer fly
    c. Inhalation of aerosolized bacteria
    d. Ingestion of contaminated food or water
    e. All of the above

19. What is the most common tickborne disease in the United States?
    a. Rocky Mountain Spotted Fever
    b. Tularemia
    c. Lyme disease
    d. Ehrlichiosis

20. How long does a tick have to be attached for transmission of Rocky Mountain Spotted Fever to occur?
    a. 6-10 hours
    b. 10-24 hours
    c. 24-36 hours
    d. >36 hours

21. First line treatment for ehrlichiosis for all ages is:
    a. Clindamycin
    b. Augmentin
    c. Rifampin
    d. Doxycycline

22. How long must a tick be attached to transmit Lyme disease?
    a. <5 hours
    b. 6-10 hours
    c. 12-24 hours
    d. 36-48 hours

23. Glandular tularemia presents with:
    a. Nonproductive cough
    b. Pharyngitis
    c. Photophobia
    d. Localized lymphadenopathy

24. Confirmatory testing needs to be done if the patient has an erythema migrans rash.
    a. True
    b. False

25. Treatment of tularemia is:
    a. Ceftriaxone
    b. Bactrim
    c. Streptomycin
    d. Meropenem

26. What is the proper way to remove a tick?
    a. Use a match to burn the tick and make it detach
    b. Use tweezers to grasp the tick and pull it off
    c. Coat it with nail polish to make it detach
    d. Smash it with your fingers and pull it off

27. Which tick diseases are reportable to the state?
    a. Lyme disease
    b. Rocky Mountain Spotted Fever
    c. Anaplasmosis
    d. All of the above
    e. Both A and B

Appendix B

Post-Test

This is a short survey to assess the knowledge of tick diseases and use of preventive measures. This survey is conducted by Kristi Harbit, DNP student at Pittsburg State University. Please contact me at kharbit@gus.pittstate.edu with any questions or concerns.

1. When testing for Lyme disease, a positive ELISA test indicates:
    b. The patient has active Lyme disease
    c. Further testing with Western blot is needed
    d. The patient had a previous Lyme infection, but not active infection
    e. None of these are correct

2. Someone with Rocky Mountain Spotted Fever will always have a rash.
    b. True
    c. False

3. Ehrlichiosis primarily effects what type of cells?
    b. Erythrocytes
    c. Osteocytes
    d. Monocytes
    e. Neurons

4. Second or third degree heart blocks can be a sign of:
    b. Anaplasmosis
    c. Tularemia
    d. Rocky Mountain Spotted Fever
    e. Lyme disease

5. Anaplasmosis can be transmitted by:
    b. Blacklegged ticks (*ixodes scapularis)*
    c. Blood transfusions
    d. Both A and B
    e. None of the above
6. Tularemia can be spread from person to person.
    b. True
    c. False

7. Lyme disease is caused by which bacteria?
    b. *Francisella*
    c. *Borrelia burgdorferi*
    d. *Rickettsia rickettsii*
    e. *Babesia microti*

8. Heartland virus and Bourbon virus are presumably spread by:
    b. Blacklegged tick (*ixodes scapularis)*
    c. American dog tick (*dermacentor variabilis)*
    d. Groundhog tick (*ixodes cookie)*
    e. Lonestar tick (*Amblyomma americanum)*

9. Rocky Mountain Spotted Fever causes:
    b. Vasculitis
    c. Abdominal pain
    d. Erythema migrans
    e. Localized ulcer with lymphadenopathy

10. Ehrlichiosis is spread by what type of tick?
    b. Blacklegged tick (*ixodes scapularis)*
    c. American dog tick (*dermacentor variabilis)*
    d. Groundhog tick (*ixodes cookie)*
    e. Lonestar tick (*Amblyomma americanum)*

11. The fatality rate for anaplasmosis is:
    b. <1%
    c. 1-5%
    d. 6-10%
    e. >10%

12. Symptoms of disseminated Lyme disease include:
    b. Erythema migrans
    c. Secondary annular rashes
    d. Ulcer at site of inoculation
    e. Cough

13. Tularemia can be transmitted by:
    b. Bite of infected tick
    c. Deer fly
    d. Inhalation of aerosolized bacteria
    e. Ingestion of contaminated food or water
    f. All of the above

14. What is the most common tickborne disease in the United States?
    b. Rocky Mountain Spotted Fever
    c. Tularemia
    d. Lyme disease
    e. Ehrlichiosis

15. How long does a tick have to be attached for transmission of Rocky Mountain Spotted Fever to occur?
    b. 6-10 hours
    c. 10-24 hours
    d. 24-36 hours
    e. >36 hours

16. First line treatment for ehrlichiosis for all ages is:
    b. Clindamycin
    c. Augmentin
    d. Rifampin
    e. Doxycycline

17. How long must a tick be attached to transmit Lyme disease?
    b. <5 hours
    c. 6-10 hours
    d. 12-24 hours
    e. 36-48 hours

18. Glandular tularemia presents with:
    b. Nonproductive cough
    c. Pharyngitis
    d. Photophobia
    e. Localized lymphadenopathy

19. Confirmatory testing needs to be done if the patient has an erythema migrans rash.
    b. True
    c. False

20. Treatment of tularemia is:
    b. Ceftriaxone
    c. Bactrim
    d. Streptomycin
    e. Meropenem

21. What is the proper way to remove a tick?
    b. Use a match to burn the tick and make it detach
    c. Use tweezers to grasp the tick and pull it off
    d. Coat it with nail polish to make it detach
    e. Smash it with your fingers and pull it off

22. Which tick diseases are reportable to the state?
    b. Lyme disease
    c. Rocky Mountain Spotted Fever
    d. Anaplasmosis
    e. All of the above
    f. Both A and B

There will be a 6 week follow-up email questionnaire. Please leave your email below if you wish to participate. Those that participate will be entered into a drawing to receive a $20 gift card to Wal-Mart.

e-mail_____

Appendix C

Six Week Follow-up Email

1. When testing for Lyme disease, a positive ELISA test indicates:
    c. The patient has active Lyme disease
    d. Further testing with Western blot is needed
    e. The patient had a previous Lyme infection, but not active infection
    f. None of these are correct

2. Someone with Rocky Mountain Spotted Fever will always have a rash.
    c. True
    d. False

3. Ehrlichiosis primarily effects what type of cells?
    c. Erythrocytes
    d. Osteocytes
    e. Monocytes
    f. Neurons

4. Second or third degree heart blocks can be a sign of:
    c. Anaplasmosis
    d. Tularemia
    e. Rocky Mountain Spotted Fever
    f. Lyme disease

5. Anaplasmosis can be transmitted by:
    c. Blacklegged ticks (*ixodes scapularis)*
    d. Blood transfusions
    e. Both A and B
    f. None of the above
6. Tularemia can be spread from person to person.
    c. True
    d. False

7. Lyme disease is caused by which bacteria?
    c. *Francisella*
    d. *Borrelia burgdorferi*
    e. *Rickettsia rickettsii*
    f. *Babesia microti*

8. Heartland virus and Bourbon virus are presumably spread by:
    c. Blacklegged tick (*ixodes scapularis)*
    d. American dog tick (*dermacentor variabilis)*
    e. Groundhog tick (*ixodes cookie)*
    f. Lonestar tick (*Amblyomma americanum)*

9. Rocky Mountain Spotted Fever causes:
    c. Vasculitis
    d. Abdominal pain
    e. Erythema migrans
    f. Localized ulcer with lymphadenopathy

10. Ehrlichiosis is spread by what type of tick?
    c. Blacklegged tick (*ixodes scapularis)*
    d. American dog tick (*dermacentor variabilis)*
    e. Groundhog tick (*ixodes cookie)*
    f. Lonestar tick (*Amblyomma americanum)*

11. The fatality rate for anaplasmosis is:
    c. <1%
    d. 1-5%
    e. 6-10%
    f. >10%

12. Symptoms of disseminated Lyme disease include:
    c. Erythema migrans
    d. Secondary annular rashes
    e. Ulcer at site of inoculation
    f. Cough

13. Tularemia can be transmitted by:
    c. Bite of infected tick
    d. Deer fly
    e. Inhalation of aerosolized bacteria
    f. Ingestion of contaminated food or water
    g. All of the above

14. What is the most common tickborne disease in the United States?
    c. Rocky Mountain Spotted Fever
    d. Tularemia
    e. Lyme disease
    f. Ehrlichiosis

15. How long does a tick have to be attached for transmission of Rocky Mountain Spotted Fever to occur?
    c. 6-10 hours
    d. 10-24 hours
    e. 24-36 hours
    f. >36 hours

16. First line treatment for ehrlichiosis for all ages is:
    c. Clindamycin
    d. Augmentin
    e. Rifampin
    f. Doxycycline

17. How long must a tick be attached to transmit Lyme disease?
    c. <5 hours
    d. 6-10 hours
    e. 12-24 hours
    f. 36-48 hours

18. Glandular tularemia presents with:
    c. Nonproductive cough
    d. Pharyngitis
    e. Photophobia
    f. Localized lymphadenopathy

19. Confirmatory testing needs to be done if the patient has an erythema migrans rash.
    c. True
    d. False

20. Treatment of tularemia is:
    c. Ceftriaxone
    d. Bactrim
    e. Streptomycin
    f. Meropenem

21. What is the proper way to remove a tick?
    c. Use a match to burn the tick and make it detach
    d. Use tweezers to grasp the tick and pull it off
    e. Coat it with nail polish to make it detach
    f. Smash it with your fingers and pull it off

22. Have tickborne diseases been included in your differential diagnosis since the educational presentation?
    a. Yes
    b. No
    c. Not applicable

23. Have you diagnosed any tickborne diseases since the presentation?
    a. Yes
    b. No
    c. Not applicable