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Antibiotic Stewardship Among Primary Care Providers In Mississippi

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ANTIBIOTIC STEWARDSHIP AMONG PRIMARY CARE PROVIDERS IN MISSISSIPPI

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Abstract

The World Health Organization states antimicrobial resistance is the ability of a microorganism to stop an antimicrobial from working which results in ineffective treatment and persistent infections. The Center for Disease Control and Prevention (CDC, 2017) reported that in the year 2015, 269.4 million antibiotic prescriptions were written in the outpatient setting, and approximately 30% of antibiotics written are unwarranted. Of those cases, most patients receive an antibiotic related to acute uncomplicated bronchitis, pharyngitis, or rhinosinusitis. The CDC reported that Americans spend nearly $11 billion yearly on antibiotics alone. However, up to 50% of all antibiotics prescribed are not indicated or optimally effective which eventually leads to resistance. Antibiotic resistant infections are associated with loss of productivity, poorer health outcomes, and greater healthcare costs. The CDC launched The Get Smart: Know When Antibiotics Work campaign in 2003 which aimed to direct appropriate antibiotic use (CDC, 2017). Within this campaign, the CDC provides

outpatient regarding condition, epidemiology, diagnosis, and management for providers to follow for appropriate prescription.

The purpose of this study was to determine if primary care providers in Mississippi are following the CDC Adult Treatment Recommendations for antibiotic use in the treatment of acute uncomplicated bronchitis, streptococcal pharyngitis, and acute unspecified pharyngitis (CDC, 2016). The researchers collected data in six rural clinics across Mississippi. This study consisted of a quantitative, retrospective chart review with descriptive statistics. A convenience sampling of 582 charts were obtained for the retrospective review. For data collection, the researchers used a data collection tool which included information related to age, gender, insurance, title of provider, and diagnoses related to the current research and CDC Adult Treatment Recommendations. Prior to conducting the study, consent was obtained from the Institutional Review Board (IRB) at the Mississippi University for Women. After data collection, data were subjected to analyses using descriptive statistics including, but not limited to, frequency, distributions, and percentages. The findings suggested that primary care providers in Mississippi are not consistently following the CDC Adult Treatment Recommendations for acute pharyngitis and uncomplicated bronchitis.

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CHAPTER I

Introduction: Dimensions of the Problem

Background Information and Statement of the Problem

The World Health Organization (2017) stated antimicrobial resistance was the ability of a microorganism to stop an antimicrobial from working against it resulting in ineffective treatment and persistent infections. Antimicrobial resistance occurs naturally through genetic changes; however, the misuse and over-prescribing of antibiotics have accelerated the process. "Antibiotic resistance has been called one of the world's most pressing public health problems" (Lee et al., 2014, p. 1741). Each year more than 100 million visits to an ambulatory care clinic end with the prescription for antibiotics. Of those cases, many nonbacterial illnesses still receive antibiotics, especially non-strep pharyngitis and bronchitis. It is imperative that primary care providers in Mississippi become better stewards of antibiotics to help decrease this growing problem.

The discovery of antibiotics was one of the most important scientific advances in human health, but antibiotic resistance is increasing (Hicks et al., 2015). Antibiotic resistance around the world is driven by antibiotic use. Antibiotics are among the most commonly prescribed drugs used in human medicine. The Centers for Disease Control and Prevention (CDC, 2017) reported that Americans spent over $10 billion on antibiotics, including more than $6 billion among patients who visited their primary care providers. Up to half of all the antibiotics prescribed for people are not needed or are not optimally effective as prescribed. However, antibiotics prescribed for upper respiratory infections account for 75% of all antibiotic prescriptions written by office-based prescribers (Schroeck et al., 2015). Antibiotic resistant infections have been

associated with loss of productivity, poorer health outcomes, and increased healthcare costs. Antibiotic resistance costs the United States billions annually. Antibiotic overuse is not only leading to antibiotic resistance, but it also has led to an increase in allergic reactions and adverse events, such as *Clostridium difficile*. The National Action Plan for Combating Antibiotic-Resistant Bacteria was initiated by the White House in March 2015. The goal of this plan was to reduce inappropriate antibiotic use by 50% by the year 2020 (Fleming-Dutra et al., 2016). In 2003, the CDC launched The Get Smart: Know When Antibiotics Work campaign which was aimed to direct appropriate outpatient antibiotic use. Within this campaign, the CDC provides outpatient adult treatment recommendations regarding condition, epidemiology, diagnosis, and management for providers to follow for appropriate prescription and prevention of resistance.

The Adult Treatment Recommendations addressed many common diagnoses for patients who visit an outpatient setting and receive antibiotics (see Appendix A) (CDC, 2016). Cough is the most common symptoms for which adult patients visit their primary care provider. These visits usually end with a diagnosis of acute bronchitis. Evaluation of these patients should focus on ruling out pneumonia, which is rare among otherwise healthy adults in the absence of abnormal vital signs (heart rate $\geq$ 100 beats/min, or oral temperature $\geq 38^{\circ}$ C) and abnormal lung examination findings (focal consolidation, ego phony, fremitus). Routine treatment of uncomplicated acute bronchitis with antibiotics is not recommended regardless of cough duration. Options for symptomatic therapy include cough suppressants, first-generation antihistamines, decongestants, and beta agonists.

Group A beta-hemolytic streptococcal (GAS) infection is another common reason for outpatient visits. This diagnosis is the only indication for antibiotic therapy for sore throat cases. Less than 10% of adult sore throat cases are caused by GAS. Clinical features alone do not distinguish between GAS and viral pharyngitis; a rapid antigen detection test (RADT) is necessary to establish a GAS pharyngitis diagnosis. Those who meet two or more Centor criteria (e.g., fever, tonsillar exudates, tender cervical lymphadenopathy, and absence of cough) should receive a RADT. Throat cultures are not routinely recommended for adults, and antibiotic treatment is not recommended by the CDC for patients with negative RADT results. Amoxicillin and penicillin V remain first-line therapy due to their reliable antibiotic activity against GAS. For penicillin-allergic patients, cephalexin, cefadroxil, clindamycin, or macrolides are recommended. GAS antibiotic resistance to azithromycin and clindamycin are increasingly common.

Given the information provided, many patients are being over treated which has led to increased resistance of antibiotics. Promoting antibiotic stewardship is essential to combat antibiotic resistance. Therefore, the problem addressed in this study was antibiotic stewardship among primary care providers in Mississippi particularly in the treatment of acute uncomplicated bronchitis and pharyngitis.

Purpose Statement

The purpose of this study was to determine if primary care providers in Mississippi are following the CDC Adult Treatment Recommendations for antibiotic use in the treatment of acute uncomplicated bronchitis and pharyngitis. Antibiotic prescribing guidelines helped to establish standards of care and focus quality improvement efforts. The research questions were guided by the CDC's most recent

recommendations for appropriate antibiotic prescribing for adults seeking care in an outpatient setting. The purpose of this study was to evaluate healthcare providers' adherence to the CDC's guidelines for the diagnosis and treatment of acute uncomplicated bronchitis and pharyngitis.

Significance of the Study

Antimicrobial resistance is one of the greatest threats to human health worldwide. The results of this research may help increase healthcare providers' adherence to the selected CDC Adult Treatment Recommendations by triggering heightened awareness. In addition to patient education, provider education regarding appropriate antibiotic prescribing practices as indicated by the CDC's Adult Treatment Recommendations for acute uncomplicated bronchitis and pharyngitis will aid healthcare providers in decreasing antibiotic overuse ultimately decreasing antibiotic resistant infections.

Nursing. Nurses and advanced practice nurses play a vital role in disease prevention and health promotion of patients. Advanced practice nurses must obtain a detailed history to successfully care for their patients. This health history is important for the advanced practice nurse to initiate proper screening and treatment of patients. For this research study, the advanced practice nurse needs to be familiar with the current recommendations of the CDC to screen and treat acute uncomplicated bronchitis and pharyngitis.

The current research provides information regarding the adherence to the CDC's (2016) recommendations by primary healthcare providers. This aids the advanced practice nurse in becoming familiar with the recommendations and the treatment options. Ideally, this study increases healthcare providers' awareness of the CDC Adult

Treatment Recommendations for acute uncomplicated bronchitis and pharyngitis to improve the overall outcome and the patient's quality of life.

Education. Another component of prescribing antibiotics in the primary care setting is patient education about antibiotic overuse. Nurse practitioners are mentors for their patients. Each clinic visit is an opportunity for practitioners to educate patients regarding appropriate antibiotic prescribing practices as indicated by the CDC. providers need to be reminded that improper use can lead to future resistant infections, adverse events such as *Clostridium difficile*, and ultimately death. Primary care providers who adhere to the CDC's Adult Treatment Recommendations for acute uncomplicated bronchitis and pharyngitis will assist in preventing the development of future complications and deaths regarding antibiotic resistant infections.

Research. The prevalence of antibiotic overuse was an important factor for this study. The goal of the study was to determine if primary healthcare providers are screening and treating acute uncomplicated bronchitis and pharyngitis as recommended by the CDC. The findings from this study are significant to research by establishing grounds for further research on the compliance of screening and treatment of acute uncomplicated bronchitis and pharyngitis by primary healthcare providers. The research findings provide primary healthcare clinics with information needed to improve their practice as it relates to screening and treating acute uncomplicated bronchitis and pharyngitis.

Conceptual Framework

Nola Pender's Health Promotion Model (HPM) was used as the framework for this research. This framework was chosen for this body of work because it assesses multifactorial influences on health-promoting behavior. The theory suggests that family

as well as healthcare providers help to influence patient behaviors in an attempt to accomplish the best possible health outcome for the patient. In this study, the antibiotic-prescribing practices of primary care providers in Mississippi were examined to determine if antibiotics were justifiable to improve immediate health as well as decrease the prevalence of antibiotic resistance in the future.

To better understand the HPM and the application of the model to practice, Pender, Murdaugh, and Parsons (2015) defined many major concepts and definitions. These concepts and definitions have expanded over the years; therefore, they are even more relevant to the promotion of healthy lifestyles. The HPM is a multidimensional model that illustrates a person interacting with interpersonal and physical environments as they pursue optimal health. It is focused on beneficial health behaviors and outcomes with overall wellness being the ultimate goal. Pender believed that health promotion included all activities that enhance or develop a person's well-being. The HPM encompasses 10 categories of determinants of health-promoting behaviors that examine prior related behavior, personal factors, perceived benefits of action, perceived barriers to action, perceived self-efficacy, activity-related affect, interpersonal influences, situational influences, commitment to a plan of action, and competing demands/preferences. Health-promoting behavior or action is the endpoint of the HPM. Prior related behavior has a direct and indirect impact on health-promoting behavior due to habits being formed in the past which consequently impact the future. Personal factors include categories of biological, psychological, and sociocultural influences. Anticipated positive outcomes are considered perceived benefits of action. Perceived barriers to action can include anticipated, imagined, or real blocks that inhibit a given behavior change. Perceived self-efficacy is one's personal judgement of self in ability

to execute a behavior change, and it has a direct effect on benefits of action. Activity-related affect refers to one's positive or negative feelings during the course of a behavior change. Interpersonal influences include families, peers, and healthcare providers. Situational influences also have a direct and indirect effect of behavior change and include factors of the environment in which the change is planned to take place. Competing demands and preferences refer to events in which the individual has little control over, such as work or family care responsibilities. These events occur immediately prior to when the behavior change is planned to take place. Commitment to a plan of action is the strategy that the individual and healthcare provider develop in order to elicit a health-promoting behavior. The abovementioned categories depict the holistic approach that Pender's HPM encompasses, and she theorized that successful health promotion is dependent on all of these variables (Pender, Murdaugh, & Parsons, 2015).

The current research explored health-related behaviors, specific to antibiotic stewardship, using Pender's HPM. These researchers determined whether or not primary care providers are providing health promotion services through their antibiotic prescribing practices. One of Pender's assumptions was that healthcare providers are part of the patient's interpersonal environments that can wield influence across the lifespan. Pender also believed nurses and providers were responsible for creating a healthy environment for patients. Literature and statistics support the fact that antibiotics are over-prescribed during unwarranted situations which proposes a public health crisis of antibiotic resistance that will not only affect the patient but also the community. The current research evaluated whether or not providers are adhering to the CDC's Adult Treatment Recommendations for prescribing antibiotics for acute

bronchitis and pharyngitis. These recommendations were set forth to assist in curbing overuse of antibiotics and promote antibiotic stewardship. Improving antibiotic stewardship will have a direct impact on individual and public health by preventing antibiotic resistant infections and antibiotic complications. These preventions allow for optimal patient and community health and wellness which are the ultimate goals of the HPM. The current researchers assume that, whether or not providers are following the recommendations, healthy behaviors are being promoted. Pender also believed educating patients was an important role of the healthcare provider in relation to the HPM for behavior modification. Healthcare providers should educate patients on indications for appropriate antibiotic use and implications of overuse in order to modify patient's beliefs and behaviors, thereby resulting in a changed perception and expectations during an illness which they previously believed required antibiotic use. This speaks to the situational influence of Pender's HPM. Therefore, the HPM was used to guide the current research focusing on the interpersonal and situational influence of the healthcare provider in exerting positive health behavior changes that will not only influence the individual but will ultimately influence the entire community. The HPM served as a valuable framework to guide this study.

Research Questions

Research for the current study was based on the following questions:

1. How frequently do primary care providers follow the CDC Adult Treatment Recommendations when prescribing antibiotics to adult patients with bronchitis and pharyngitis.

2. How frequently do primary care providers prescribe antibiotics to patients with diagnoses of J20.9 (acute bronchitis) and J02.9 (acute unspecified pharyngitis)?
3. How frequently do primary care providers order and have documentation of a positive rapid strep antigen detection test before prescribing antibiotics for streptococcal pharyngitis J02.0?

Definition of Terms

Primary care provider

Theoretical: Taber's Medical Dictionary (Venes, 2013) defines *primary care provider* as the healthcare provider to whom a patient first goes to address a problem with his or her health.

Operational: For the purpose of this study, a *primary care provider* is a nurse practitioner (NP), medical doctor (MD), physician assistant (PA), or doctor of osteopathic medicine (DO) that works in one of the six primary care clinic settings in Mississippi whose charts are being reviewed by the current researchers.

Antimicrobial stewardship

Theoretical: MacDougall and Polk (2005) defined *antimicrobial stewardship* as an overarching program to change and direct antimicrobial use at a healthcare institution which may employ any of a number of individual strategies in order to prevent an outbreak of antimicrobial resistant bacteria.

Operational: For the purpose of this study, *antimicrobial stewardship* is defined as appropriate antibiotic prescribing and diagnosis based on CDC's Adult Treatment Recommendations for bronchitis and pharyngitis.

Antibiotics

Theoretical: A drug used to kill or limit the growth of microorganisms and treat infections (Venes, 2013).

Operational: For the purpose of this study, *antibiotics* is defined as the antimicrobial prescribed by a NP, MD, DO, or PA to treat bacterial infections, such as bronchitis and pharyngitis, at one of the six outpatient clinics utilized in this study.

Adult Patient

Theoretical: Any patient who is male/female/transgender and has reached sexual maturity that receives medical care or treatment.

Operational: For the purpose of this study, *adult patient* is defined as a person over the age of 18 years who receives care from a primary care provider at one of the six outpatient clinics utilized for this study.

Bronchitis

Theoretical: *Taber's Medical Dictionary* (Venes, 2013) defines acute bronchitis as the inflammation of mucous membranes of the bronchial airways caused by irritation or a virus that elicits coughing and sputum production; rarely an infectious origin.

Operational: For the purpose of this study, *acute bronchitis* will be defined as the inflammation of the bronchial airways resulting in cough with sputum production with normal vital signs and lung examination along with an ICD-10 code J20.9 as documented in the medical record.

Pharyngitis

Theoretical: *Taber's Medical Dictionary* (2013) defines pharyngitis as the inflammation of the mucous membranes and lymphoid tissues of the pharynx, usually as a result of infection causing throat pain, fever, and malaise.

Operational: For the purpose of this study, *pharyngitis* is defined as a condition that causes the patient to experience a sore throat with or without fever, tonsillar exudate, tender cervical lymphadenopathy, and the absence of a cough with a diagnosis code of J02.9 as documented in the medical record until proven as streptococcal pharyngitis J02.0 per rapid strep antigen.

Definitive Test

Theoretical: *Taber's Medical Dictionary* (Venes, 2013) defines *definitive test* as an indisputable and clear answer without question.

Operational: For the purpose of this study, *definitive test* is defined as a positive rapid strep antigen detection test determining if the diagnosis of pharyngitis warrants the need for antibiotic therapy.

Assumptions

Assumptions in this study included the following:

1. Adherence to CDC's Adult Treatment Recommendations for acute uncomplicated bronchitis and pharyngitis by primary care providers in regard to antibiotic prescribing practices.
2. Data required to perform this research would be available upon the review of the charts, and the data would be organized and comprehensible.
3. The frequency with which the healthcare providers adhere to national recommendations can be measured by reviewing documentation in the medical record.
4. The likelihood of adherence to guidelines is based on perceived benefits to actions and perceived self-efficacy of providers performing those actions.

5. The data would be gathered in a legal and ethical manner.

6. The data collected would be correctly interpreted by the researchers.

CHAPTER II

Review of Literature

The purpose of this study was to determine if primary care providers in Mississippi are adhering to the CDC's Adult Treatment Recommendations in the treatment of acute uncomplicated bronchitis and pharyngitis. It has been documented that the overuse of unwarranted antibiotics leads to adverse drug events as well as antibiotic resistance. Antimicrobial resistance is a pressing public health concern as it leads to increased morbidity, healthcare cost, and mortality. The CDC launched a campaign entitled Get Smart: Know When Antibiotics Work which aims to direct appropriate outpatient antibiotic use.

To expand knowledge of antibiotic use and prescriber's practices, the current research group reviewed numerous research articles. The purpose of this chapter is to present the conceptual framework that was the foundation of the current research as well as related literature focusing on outpatient antibiotic use. The literature review provided evidence that compliance to guideline adherence is subpar and that implementations need to be taken to improve antibiotic stewardship among primary care providers in Mississippi.

Conceptual Framework

The researchers reviewed several articles that utilized Nola Pender's Health Promotion Model as the theoretical basis when determining a framework for the current study. In one study, Nola J. Pender and Albert R. Pender conducted a cross-sectional survey in 1980 entitled "Illness Prevention and Health Promotion Services Provided by Nurse Practitioners: Predicting Potential Consumers." The study held major significance, as estimates suggested that the majority of deaths in the United States are

related to unhealthy behaviors. Pender and Pender stated that significant improvements could be made through illness prevention and health promotion, and nurse practitioners have a major responsibility in supporting and developing programs that encourage health promotion. Therefore, if improvements in health promotion behaviors can be made, lives can be significantly improved. According to Pender and Pender (1980), possible areas of impact include longevity, improved quality of life, and reduced healthcare costs. The purpose of their study was to determine if nurse practitioners (NP) would be utilized for preventative and health promotion services once available in the community. Pender and Pender also sought to determine the psychosocial and behavioral characteristics linked to individuals who intended or did not intend to choose health promotion services provided by NPs. While Pender and Pender's current HPM was not yet complete, this study helped lay the foundation and addressed several areas of the model in relation to health-promoting behaviors. The study applied the HPM characteristics through the examination of individual characteristics and behaviors related to an event. The research centered on behavior-specific cognitions, such as intention and reason for intent, which is one of the key areas of focus in the HPM. Therefore, Pender and Pender (1980) used concepts from the HPM to evaluate health-related behavior in a population examining characteristics of individuals who would participate in health prevention programs (Pender & Pender, 1980).

Hussein, Salam, and Amr (2016) conducted a study using Pender's HPM entitled "A Theory Guided Nursing Intervention for Management of Hypertension Among Adults at a Rural Area." The researchers understood that hypertension (HTN) is a major public health concern and a major modifiable risk factor for conditions, such as heart disease, stroke, and renal disease. Lifestyle modifications and medication

compliance are important to control HTN and prevent long-term complications. Therefore, the researchers sought to apply Pender's HPM to the management of HTN in order to determine the efficacy of disease management with the application of the theory. Hussein et al. (2016) chose the HPM because it encompasses the relationship of the individual's characteristics and experiences, behavior specific cognitions, and behavioral outcomes. The researchers chose to study the application of the HPM in management of HTN because it allows the individual to take initiative to care for his or her own health. Management of HTN requires education about the disease, management of the disease, and lifestyle modifications. The researchers also chose to use the HPM because it encompasses interpersonal relationship of the healthcare provider in relation to disease education, management, and assisting the individual to commit to a plan of action. Hussein et al. (2016) used a quasi-experimental design for their study and randomly selected participants in which they divided into a control and study group. The researchers composed an interviewing questionnaire that was founded on the 10 categories of Pender's HPM that were mentioned earlier. Aside from the questionnaire, physical measurements, such as height, weight, BMI, and blood pressure readings, were also obtained. Data were collected during three visits to the participant's home. During the first visit, the initial questionnaire was distributed and physical measurements were obtained. Also, education about HTN was given, such as: blood pressure readings, risk factors, classifications of HTN, signs and symptoms, and complications. Lifestyle modifications were also explained during the first visit. The second visit included education on the management of HTN and included topics such as weight reduction, nutrition, physical activity, smoking cessation, and pharmacological management. Booklets were left with the participants after the educational session to

help motivate and for the participants to review. The third visit focused on evaluation of the interventions by comparing pre- and post-knowledge and evaluating behavior changes of lifestyle modification. Hussein et al. (2016) found statistically significant results of the posttest in the study group that received interventions based on Pender's HPM. This evidence supports a strong correlation between self-efficacy, perceived benefits, situational influences, affects related to behavior, interpersonal relationships, and commitment to an action plan in regard to applying the HPM in management of HTN. Hussein et al. (2016) recommended increased health education programs to increase awareness of risk factors and HTN in order to prevent development of the disease or disease complications.

A third study that incorporated Pender's HPM focused on the provider's interpersonal relationship with the patient in regard to smoking cessation. Kelley, Sherrod, and Smyth (2009) conducted a study entitled "Coronary Artery Disease and Smoking Cessation Intervention by Primary Care Providers in a Rural Clinic.". Pender's HPM was used as the conceptual framework for the study. The researchers sought to determine if providers were following the American Heart Association (AHA) and American College of Cardiology (ACC) guidelines in regard to providing smoking cessation to patients who smoke with known coronary artery disease (CAD) as evidenced by acute coronary syndrome. The HPM was chosen because it assesses multifactorial influences on health-promoting behaviors. Specifically, for this study, the researchers observed the interpersonal influences of the HPM in regard to providing education and smoking cessation to patients with CAD. Healthcare providers are models and encouragers that directly and indirectly influence the patient to commit to a plan such as smoking cessation. Kelley et al. (2009) realized that interpersonal

influences, such as providers, can exert a positive impact on the patient in order to encourage compliance with a healthy behavior. The researchers found that 68.7% of patients were provided educational information concerning smoking cessation. This supports a positive interpersonal relationship influencing a healthy behavior change in agreeance with the HPM. Kelley et al. (2009) stated that when providers recognize the positive interpersonal relationship with the patient it influences them to educate and assist the patient in committing to a plan. The researchers also stated that a provider's incentive to elicit the positive change may cease if there is little ambition from the patient or poor compliance with the smoking cessation plan. In turn, this could change the provider's perception and incentive to provide smoking cessation to future patients if he or she feels underappreciated in the past (Kelley et al., 2009).

In conclusion, Nola Pender's HPM provided a solid holistic foundation for the current body of research. The holistic nature of the HPM allowed the researchers to evaluate the provider's health promotion practices as part of the interpersonal relationship whenever prescribing antibiotics in the outpatient setting.

Review of Related Literature

The articles reviewed for this research project further validated the importance of the current study concerning antibiotic stewardship. The articles highlighted themes such as regional and demographic variance related to prescribing and strategies to improve compliance with prescribing recommendations. Several articles also spoke to the adherence to the CDC's Adult Treatment Recommendations.

Adherence to guidelines. Schroeck et al. (2015) performed a retrospective chart review in order to identify if antibiotic prescribing practices for upper respiratory infections (URI) in the outpatient veteran population were adhering to the CDC's

recommendations set forth in the Get Smart Campaign which aimed to decrease antibiotic resistance. The CDC provides specific criteria for diagnosing and treating URIs. Antimicrobial resistance poses a significant threat to the future of public health. Schroeck et al. also sought to identify if there was a relationship between certain symptoms and inappropriate prescribing. Furthermore, the researchers also evaluated readmission rates in patients that were included in the study population. The researchers identified that 75% of all outpatient antibiotic prescriptions were prescribed for URIs. "In 2010, 258 million courses of antibiotics were prescribed in the United States. Antibiotic usage is a major driving factor for antibiotic resistance" (Schroeck et al., 2015, p. 3851). In this study, URIs were identified as bronchitis, pharyngitis, sinusitis, and nonspecific upper respiratory infections.

There were no actual research questions or hypotheses stated by Schroeck et al. (2015); however, it can be implied that the researchers aimed to answer several research questions. First, are primary care providers adhering to CDC recommendations for prescribing antibiotics to adult veteran patients with the diagnosis of URIs? Secondly, what are the symptoms associated with inappropriate prescribing and readmission rates?

The study was conducted as a retrospective chart review that included 1,662 patients with the International Classification of Disease, Ninth Revision (ICD-9) code diagnosis of the specific URIs between January 2009 and December 2011. The setting for the study was the Veteran Affairs Western New York Healthcare System emergency rooms and outpatient clinics. The study used a randomized consecutive-qualified sampling process to select the veteran patient population. In order to be included in the population several factors were met and reviewed. The patients had to be treated in the outpatient setting and be at least 18 years old. Also, the CDC's Get Smart Campaign

applied to otherwise healthy adults. Therefore, patients with preexisting conditions, such as HIV, immunosuppressant therapy, chemotherapy, or dialysis, were excluded from the study. Also, Schroeck et al. (2015) reviewed whether or not the correct ICD-9 code corresponded with the patient's presenting symptoms resulting in the correct diagnosis. Charts with incorrect coding were excluded. The method of collecting the data included using the electronic computer system and searching for appropriate ICD-9 codes. First, Schroeck et al. (2015) gathered baseline demographic information as well as additional information, such as comorbid conditions. The data gathered included age, sex, race, serum creatinine, weight, smoking status, diagnosis of URI, symptoms, and whether or not antibiotics were prescribed (Schroeck et al., 2015). Also, the researchers gathered data regarding whether or not the patient was readmitted to the hospital or if the patient developed a *Clostridium difficile* infection after initial treatment. Schroeck et al. (2015) then utilized the CDC's Get Smart Campaign guidelines to assess the appropriateness of antibiotic prescribing in relation to symptoms and diagnosis.

Schroeck et al. (2015) used many different forms of statistical analysis to evaluate the data collected. As previously stated, the study aimed to evaluate the appropriateness of antibiotic prescribing for the treatment of URI according to the CDC Get Smart Campaign Guidelines. For evaluating this aspect of the data, Schroeck et al. (2015) used bivariate analysis to compare those appropriately treated with those inappropriately treated. Continuous variables were measured with the independent sample *t* test; however, chi-squared or Fisher's exact test was used for the categorical variable in order to evaluate important differences compared to the baseline characteristics. Schroeck et al. (2015) also sought to determine what variables

influenced prescribing antibiotics for URIs. "Aggregate significant baseline characteristics and symptomatology ($p < 0.05$) from the bivariate analysis were built into a multivariate logistic regression analysis to determine predictors of appropriate treatment" (Schroeck et al., 2015, p. 3849). Backwards elimination was used to reduce factors until a stable model to determine antibiotic use was established.

A total of 1,662 patient charts with ICD 9 diagnosis codes for bronchitis, pharyngitis, sinusitis, and nonspecific upper respiratory infections qualified for the study. Of the entire population studied, 595 (35.8%) of patients were treated appropriately, and 1067 (64.2%) of patients were treated inappropriately according to treatment recommendations. Bronchitis accounted for 400 patient charts of the total population. Of those treated for bronchitis, 80 patients (20.5%) were treated appropriately, and 318 patients (79.5%) were prescribed antibiotics when unwarranted by the CDC recommendations. Hospital admission rates within 30 days of diagnosis were also evaluated. Patients appropriately treated yielded a 1.2% hospital admission rate within the first 30 days of diagnosis, and the rate was 1.6% for those treated inappropriately. The most common antibiotic prescribed for bronchitis according to Schroeck et al. (2015) was macrolides. Pharyngitis accounted for 402 of the total population. Appropriate treatment was given to 158 patients (39.3%), and 203 patients that presented with pharyngitis were prescribed an antibiotic when it was not warranted. Also, 13 patients received the wrong antibiotic. A total of 244 of the 402 patients treated for pharyngitis were treated inappropriately. Of those that received appropriate treatment, there was a 1.9% hospital admission rate after 30 days of treatment was observed, and 0.4% admission rate for those treated inappropriately. Penicillin was the most commonly prescribed antibiotic for pharyngitis. According to Schroeck et al.

(2015), sinusitis was treated appropriately in 175 (43.8%) of cases with penicillin being the most prominent antibiotic prescribed to this group. A total of 400 patients were treated with sinusitis. Of those treated, 117 patients received an unwarranted antibiotic, and 108 received the wrong antibiotic which resulted in a total of 225 patients with inappropriate treatment for sinusitis. For those who received appropriate treatment, there was a 1.7% hospital admission rate within 30 days after diagnosis and a 0.9% rate for those inappropriately treated. Of the 406 patients with nonspecific URIs, 180 patients (30.3%) received appropriate treatment leaving 280 of these patients receiving unwarranted antibiotics. Patients that received appropriate treatment had a 1.7% hospital admission rate while those that received inappropriate treatment had a 2.5% admission rate. The most common antibiotic prescribed to this group was macrolides.

Schroeck et al. (2015) also analyzed factors that accompanied appropriate and inappropriate treatment practices. The age range for inappropriate treatment was 53.7 ± 16.3 years, and the age range for appropriate treatment was 52 ± 17.5 years. According to Schroeck et al. (2015), common factors associated with inappropriate prescribing were patients with the diagnosis of chronic obstructive pulmonary disease (COPD) and patients with a penicillin allergy. The researchers found no significant difference between the baseline characteristics in relation to those treated appropriately versus those treated inappropriately. Schroeck et al. (2015) identified three common symptoms associated with appropriate treatment which included fever, tonsillar exudates, and lymphadenopathy; and cough was the most commonly associated symptom for inappropriate treatment. Schroeck et al. (2015) found no statistically significant difference between hospital admission rates among patients treated appropriately versus those who were treated inappropriately. However, of the 25

patients admitted within 30 days of diagnosis, 76% had received an antibiotic and 24% did not receive an antibiotic prior to admission.

The research by Schroeck et al. (2015) provided evidence that current efforts are not efficient in curbing inappropriate antibiotic use. The researchers concluded that compliance was poor in relation to antibiotic-prescribing practices in accordance with the CDC Get Smart Campaign. Of the total patient population, only 35.8% received treatment in compliance with the campaign guidelines. Inappropriate treatment was administered most commonly to those diagnosed with bronchitis or nonspecific URIs. The implications of this study were very significant for the future of public health and the prevention of antibiotic resistance. The study implied that further education was needed in order to guarantee that the patient population received appropriate antibiotic treatment. Using this study, providers will be able to identify target areas of improvement along with identifying symptoms associated with inappropriate prescribing to better understand the scope of antibiotic use in the outpatient setting. The implications of these findings included a need for education in regard to antibiotic-prescribing guidelines. According to the researchers, "expansion of stewardship programs or performance standards to the outpatient setting is necessary to combat excessive and inappropriate antibiotic use" (Schroeck et al., 2015, p. 3852). Schroeck et al. identified several areas for future research. It can be deduced from the article that future studies should also evaluate the duration of treatment in regard to antibiotic treatment. The researchers stated that duration of the antibiotic regimen could either be too lengthy for the diagnosis or the regimen might be insufficient in length. The researchers also stated that it would be interesting to evaluate the immunocompromised patient in future studies to determine if overtreatment is more prevalent in this

population. This study was limited to only the veteran population. Lastly, Schroeck et al. (2015) identified the need for a larger sample size in future studies in order to accurately evaluate readmission rates.

The work done by Schroeck et al. (2015) utilized many different statistical analyses. This was strength of the study because it gave the researchers an impressive amount of information based on the data. The researchers identified that prior literature studies were unable to utilize patient specific data, such as diagnosis and patient visits which is another positive attribute to this study. The researchers used strong statistical data in order to validate the increased need for antibiotic stewardship programs in clinical practice. Not only did the researchers identify that antibiotics were being overprescribed, they also provided an analysis of inappropriate prescribing. The study also provided several tables to help illustrate the statistical analysis which was helpful when reading the article. An identifiable weakness of this study was that the researchers limited their population to only veterans.

This research provided significant evidence that current efforts are insufficient for decreasing inappropriate antibiotic use. The basis of the current research study was "antibiotic stewardship in primary care providers" was similar to Schroeck et al. (2015).

Fleming-Dutra et al. (2016) used the 2010-2011 National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Care Survey (NHAMCS) to obtain baseline data and estimates in order to determine the rate of outpatient oral antibiotic prescriptions in relation to age and diagnosis. The researchers aimed to determine the appropriateness of antibiotic prescribing according to national guidelines in order to inform the public and prove the need for increased antibiotic stewardship programs. According to the CDC, 2 million people are affected annually

by antibiotic resistant infection, and it also results in 23,000 deaths annually. "Antibiotic use is the primary driver of antibiotic resistance and leads to adverse events ranging from allergic reactions to *Clostridium difficile* infections" (Fleming-Dutra et al., 2016, p. 1865). Over the past several years, national guidelines for prescribing antibiotics have been published for a wide range of diagnoses. This movement began in an effort to reduce over-utilization which was directly related to antibiotic resistance and adverse events. An astonishing 262 million outpatient antibiotics were prescribed in the United States in the year 2011 alone. The CDC's Get Smart: Know When Antibiotics Work Program and the National Action Plan for Combating Antibiotic-Resistant Bacteria are two national campaigns that aim to reduce inappropriate antibiotic prescribing. Reducing inappropriate use of antibiotics by 50% by 2020 is the main goal of the National Action Plan for Combating Antibiotic-Resistant Bacteria. According to Fleming-Dutra et al. (2016), current research regarding antibiotic appropriateness does not address patient's age or diagnosis; however, this study aimed to address both aspects when determining appropriate prescribing.

Fleming-Dutra et al. did not identify a specific hypothesis or research question. The researchers aimed to describe antibiotic prescribing practices during 2010-2011 in the outpatient setting, assessing age and diagnosis in order to determine appropriate versus inappropriate prescribing practices. The researchers sought to inform public health and antibiotic stewardship efforts to determine gaps in current practice.

Fleming-Dutra et al. (2016) utilized the NAMCS and NHAMCS cross-sectional surveys as data sources to estimate baseline antibiotic prescribing rates. The CDC's National Center for Health Science randomly distributes these surveys annually. The NAMCS used a 3-stage probability sample design to collect data related to geographic

regions, physicians, and visits from nonfederally-employed office-based physician clinics. The NHAMCS used a 4-stage probability sample design to collect data related to geographic regions, hospitals, outpatient department clinics, and emergency service areas. The NHAMCS also only addressed nonfederal departments and hospitals. According to Fleming-Dutra et al. (2016), data collected from the surveys included patient demographics, 3 diagnoses classified with the *International Classification of Disease, Ninth Revision* (ICD-9) coding system, and up to 8 medications that were mentioned during the visit. For this study, the researchers used data from 2010-2011. The surveys were approved by the National Center for Health Statistics research ethics review board. Fleming-Dutra et al. (2016) stated that institutional review board approval was not needed because analysis was based on deidentified public data. Hospital admission, admission to an observation unit, and mention of parenteral antibiotic use were criteria for exclusion in determining the national estimates. According to Fleming-Dutra et al. (2016), 184,032 visit surveys were used in order to determine the national estimate. In regard to antibiotics, it was understood that antibiotics are only available by prescription; and, if mentioned, it was assumed a prescription was given for an antibiotic.

After describing the data source, Fleming-Dutra et al. identified the method of establishing the baseline for the study. The researchers were interested in the relationship between age and geographic region in regard to annual rates of antibiotics prescriptions. Fleming-Dutra et al. (2016) calculated the mean annual rates for prescribing per 1,000 population of visits by age and region. The regions identified were the Northeast, South, Midwest, and West. Diagnosis and age group were used to establish the number and percentage of visits resulting in an antibiotic prescription, and

the mean annual rate per 1,000 population was again used. "For diagnosis-based analyses, larger age groups (0-19, 20-64, ≥ 65 years) were used to produce more reliable estimates" (Fleming-Dutra et al., 2016, p. 1866). Visits were then classified into diagnostic categories. A tiered approach was used to classify diagnostic categories and the most likely indication for antibiotic prescription because neither NAMCS nor NHAMCS links diagnoses with medications. Fleming-Dutra et al. (2016) identified three tiers of diagnoses. Diagnoses, such as pneumonia, urinary tract infection, or bacterial infections (such as pertussis), were placed in Tier 1—meaning that an antibiotic is "almost always" indicated. Diagnoses included in Tier 2 include sinusitis, suppurative otitis media, skin infections, pharyngitis, gastrointestinal infections, and acne. Antibiotics "may" be indicated for Tier 2 diagnoses. Tier 3 consisted of diagnoses in which antibiotics were not indicated. Fleming-Dutra et al. (2016) stated that priority was given to a Tier 1 diagnosis if multiple diagnoses were listed.

After baseline estimates of age, geography, diagnoses, and rates of prescription were obtained, Fleming-Dutra et al. then estimated the suitability of prescribing. In order to determine appropriateness for outpatient antibiotic use, an expert panel was obtained. The panel reviewed national guideline recommendations associated with each age and diagnosis in order to determine the level of appropriateness. The panel reviewed guidelines for the diagnoses previously mentioned in each Tier. If guidelines did not exist or could not be used, regional variability was used to determine whether antibiotic administration was warranted. "Estimates were combined using national guidelines and regional variability to calculate overall estimate of appropriate antibiotic prescriptions per 1000 population" (Fleming-Dutra et al., 2016, p. 1866.)

Fleming-Dutra et al. (2016) used several different modes of statistical analysis to measure data. In order to increase the sample size for age and diagnosis, 2 years of surveys were included. The researchers used STATA 12 to analyze the data, and 95% confidence intervals were obtained. The X^2 test for heterogeneity was used to compare prescribing rates. A 2-sided p value $< .05$ was considered significant. The lowest-prescribing region was used as a benchmark for post hoc sensitivity analysis in determining diagnoses targeted for reduction.

Fleming-Dutra et al. (2016) found statistically significant results that identified antibiotic overuse in the outpatient setting. For the purpose of this study, the researchers described each result estimate in relation to 1,000 population. According to Fleming-Dutra et al. (2016), 12.6% of the 184,032 sample visits received an antibiotic prescription which in turn was 506 prescriptions per 1,000 population. Regional variability for antibiotic prescribing ranged from 423 in the West to 553 in the South per 1,000 population. Acute respiratory conditions accounted for the majority of the diagnoses associated with antibiotic prescriptions with the top three being sinusitis, suppurative otitis media, and pharyngitis. According to national guidelines, antibiotics are only to be prescribed to patients with pharyngitis if the patient tests positive for group A *Streptococcus*. According to Fleming-Dutra et al. (2016), recent literature stated that 37% of children who presented with sore throat tested positive, and only 18% of adults tested positive. However, the study found that 56.2% of children and 72.4% of adults that presented with a sore throat and pharyngitis symptoms were prescribed an antibiotic at the time of initial visit. For the purpose of this study, antibiotics were considered inappropriate when prescribed for conditions that did not warrant antibiotics per national guidelines. According to Fleming-Dutra et al. (2016)

these conditions included the following: bronchitis, bronchiolitis, viral upper respiratory infections, asthma, allergy, influenza, viral pneumonia, and nonsuppurative otitis media. The study excluded chronic conditions, such as chronic bronchitis, emphysema, and chronic obstructive pulmonary disease. The researchers identified that it was difficult to address the appropriateness for prescribing in regard to conditions such as sinusitis and suppurative otitis media because these cases "sometimes" warrant antibiotic use. The researchers used the lowest regional rate for prescribing in regard to sinusitis and suppurative otitis media to estimate the need for antibiotic therapy. Fleming-Dutra et al. (2016) stated that for diagnoses such as pneumonia and urinary tract infections, antibiotics were considered appropriate because these conditions "almost always" indicate the need for antibiotics. As previously stated, acute respiratory infections accounted for the majority of the diagnoses. Fleming-Dutra et al. (2016) identified within all ages studied that of the 221 per 1,000 population acute respiratory infection visits that received antibiotics, only 111 were estimated to be appropriate; meaning that there is a 50% potential reduction in prescription rates if national guidelines are followed. Fleming-Dutra et al. (2016) identified that, within all diagnoses and ages per 1,000 population, 506 was the annual prescribing rate when only 353 were estimated as appropriate—meaning that there is a 30% potential reduction of inappropriate prescribing per national guidelines.

Fleming-Dutra et al. (2016) discussed the implications and importance of the findings. The researchers concluded that antibiotics were prescribed to 506 out of 1,000 patients, and within that statistic half of antibiotics prescribed for acute respiratory infections were inappropriate. Fleming-Dutra et al. estimated that only 353 of the antibiotics prescribed were actually warranted. This accounted for a total of nearly 34

million inappropriate antibiotic prescriptions. The study also concluded that across all diagnoses, 30% of antibiotic prescriptions were inappropriate. A conservative mixed approach was used to derive the estimates of inappropriate outpatient prescribing. It included estimates of ambulatory visits, which antibiotics were prescribed unnecessarily, and diagnoses that were over used. The researchers pointed out that while it would be informative to confirm the bacterial pathogen, it is impractical to perform routine sinus aspiration and tympanocentesis. Fleming-Dutra et al. (2016) stated that antibiotic overuse is most likely driven by over diagnosing. Antibiotic overuse was also evaluated based on geographic regions. The researchers stated that areas where prescribing was low did not have data that suggested adverse events related to under treatment. Fleming-Dutra et al.'s (2016) sensitivity analysis of geographical regions found that if the national rates were the same as the lowest prescribing region, total prescribing would be 19% lower than the 2010-2011 rate. The researchers referred to a study performed in Sweden concerning antibiotic use. "Sweden dispensed 328 antibiotic courses per 1,000 population in 2014 compared with 877 antibiotic courses dispensed per 1,000 population in the United States in 2011. The Swedish study showed a 50% decrease in antibiotic prescribing for acute otitis media between 2000 and 2005. Educational campaigns and stricter diagnosis criteria were what the Swedish study accounted as the reason to the decrease in prescribing rates. The researchers concluded that in order to meet the White House National Action Plan for Combating Antibiotic Resistant Bacteria Goal of reducing inappropriate use by 50% in 2020, a 15% reduction in overall antibiotic use would be imperative. Results of this study can be used to inform the public as well as healthcare providers of the importance of strict antibiotic stewardship programs. Fleming-Dutra et al. (2016) concluded that effective

interventions to reduce inappropriate prescribing were imperative to combat the vicious cycle that ultimately leads to antibiotic resistance. This potentially poses a public health crisis. The researchers stated the following areas are ways to improve appropriate antibiotic use: provider and patient education, clinical decision support, delayed prescriptions, audit and feedback, academic detailing, and rapid diagnostics. The aforementioned results validated the need for establishing a goal for outpatient antibiotic stewardship.

Fleming-Dutra et al. (2016) identified several strengths and limitations to the study. National representation was a strength of the study as well as the inclusion of diagnosis and therapy. However, there were limitations in regard to the surveys. The surveys did not allow for validation of diagnosis and links to medications. Since they rely on clinician diagnosis alone, some ICD-9 codes lack specificity to differentiate all diagnoses. Also, the surveys only allowed for three diagnoses to be listed. If one of the three were not an antibiotic-appropriate diagnosis, the researchers assumed that none existed. The researchers also stated a weakness of nonresponse bias in relation to the surveys. Another limitation was the possibility of overestimating inappropriate prescribing because the surveys represented visits instead of illness episodes. "Multiple prescriptions for 1 person would be captured separately, and therefore the overall estimate of antibiotic prescribing per population and inappropriate prescribing may be overestimated" (Fleming-Dutra et al., 2016, p. 1871). The surveys also had time delays which limited the researchers with data more current than 2011. The surveys do not include antibiotics prescribed at urgent care clinics, federal facilities, hospital discharges, long-term care, or telemedicine encounters. They also do not include physician assistants or nurse practitioners. As a result, these areas may be

underrepresented which creates another limitation. Finally, the surveys focused on antibiotic medication and could not be differentiated between standard prescriptions from delayed prescribing.

The research performed by Fleming-Dutra et al. was pertinent to the current researchers' area of recent research for several reasons. Fleming-Dutra et al. founded their research on outpatient antibiotic prescribing practices in order to draw awareness for the need of strict antibiotic stewardship programs, paralleling the current study. The researchers also used the same national guidelines in determining appropriate prescribing practices that the current researchers plan to use. Fleming-Dutra et al. did not address if the appropriate antibiotic class was selected whenever antibiotics were prescribed. This study provided pertinent areas in which the current study could be molded, as well as pertinent statistical data that the results of the current study can be compared.

Crocker et al. (2013) performed a retrospective cohort study on clients treated for upper respiratory Infection (URI), sinusitis, and pharyngitis at an outpatient clinic to determine practices of overprescribing antibiotics. The diagnoses of sinus infections, upper respiratory tract infections (URI), and sore throats are the most common reasons patients seek medical care. There are set guidelines for antibiotic prescribing, but these guidelines often go unfollowed. Between January 1, 2008, and January 30, 2012, 1,548 patient visits were reviewed to assess adherence of guidelines. This study showed significant variables for nonadherence of guidelines that included provider for URI and age for pharyngitis. Crocker et al. (2013) did not identify any theoretical framework in this study.

The hypothesis was to determine if primary care providers adhere to guidelines for prescribing antibiotics for sinusitis, pharyngitis, and URI. The diagnoses included URI, pharyngitis, and sinusitis. Variables studied to assess antibiotic adherence guidelines were physician, BMI, gender, age, presence of a learner, day of the month, day of the week, COPD, diabetes, and immunosuppression. Crocker et al. (2013) assumed the primary care providers would adhere to treatment guidelines if a learner was present.

There were 1,548 patient visits identified in the 4-year timeframe of which only 722 patients over the age of 18 years qualified for the study. The population included patient encounters at an internal medicine practice. Patient encounters with ICD 9 codes for diagnoses of sinusitis, pharyngitis, and URI were under investigation. The researchers used the electronic medical record system to search for these diagnoses. There were 826 patient encounters that were excluded from this study. The exclusions included patients who were diagnosed with chronic sinusitis, treated with antibiotics prior to the visit, and those with other diagnoses that justified an antibiotic prescription. The discrete variables included day of the week, gender, month of the year, provider, diagnosis of diabetes, COPD, presence of a learner, and immunosuppression. The continuous variables were BMI and age. A chart review was then performed to determine whether adherence of guidelines was met by the provider. The physician author and the research associate performed the chart review by selecting every10th chart after simultaneously selecting the first 10% of charts.

Following analysis, Crocker et al. (2013) found that 97 of 104 patients did not possess the criteria for antibiotic prescribing according to the guidelines. Furthermore, there were only 14 of 31 patients who did meet the criteria for antibiotic prescribing

according to the inclusions for the study. This study concluded that 42% of patients met the criteria for antibiotic prescribing for acute sinusitis, 24% for pharyngitis, and 79% for URI. The variable that positively affected the provider's decision was the presence of a learner. The variables that negatively affected the provider's decision were immunosuppression and diabetes. However, comorbidities with diabetes, immunosuppression, and COPD did not have a great impact on provider prescribing behavior. This study shows that the younger population was associated with nonadherence of guidelines for pharyngitis treatment. The researchers identified several factors that may have caused such a low rate of guideline adherence to prescribing antibiotics. First, unfamiliarity of the guidelines was mentioned along with the possibility of disagreeing with the guidelines. The next factor suggested that time does not allow the providers to adequately assess whether or not patients would benefit from an antibiotic prescription. This study reported that it may take longer to explain the reasoning behind not prescribing an antibiotic than actually writing a prescription. Another factor involved providers worrying about patient satisfaction results. They wanted to give their patients what they requested including antibiotics even if it was not indicated. The researchers suggested considerations for adherence to guidelines in the future. These included patient education on antibiotic resistance, making adherence to guidelines a quality measure, and education for providers on current guidelines. The researchers also suggested a noon conference or morning report of adherence to antibiotic-prescribing guidelines would be beneficial. This study did not include recommendations for further study, but it did suggest that further study was needed to assess the best measure for assisting providers to adhere to appropriate antibiotic prescribing guidelines.

Several limitations were identified in this study (Crocker et al., 2013). First, the researchers could not define the knowledge and acceptance of guidelines by providers when these patient encounters were reviewed. Second, the guidelines were not listed in this study. Also, this study exclaimed that the guidelines did not state recommendations regarding care of chronic immunosuppressive patients. All of the chronic immunosuppressive patients received antibiotics in the study that showed symptoms of pharyngeal and respiratory infections. Last, this study had limited generalizability since it took place in a single internal medicine clinic and not part of a larger organization. This study did show the amount of adherence to guidelines for prescribing antibiotics to URI, pharyngitis, and acute sinusitis which was at a disappointing 57%. This study was relevant to the current study due to the diagnoses studied are the ones that the current researchers have reviewed. The study performed also used patients over 18 years of age, which was the focused population for the study. Some of the implications for the study that have been reviewed are some that were applied to the current research, such as providing education for patients and providers on habits of inappropriately prescribing antibiotics.

Regional and Demographic Variance

Arizpe, Reveles, and Aitken (2016) performed a retrospective cohort review of Medicare Part D enrollees. Antibiotic resistant infections account for an estimated 23,000 deaths and approximately $20 billion in healthcare costs in the United States each year. An estimated 30% of the antibiotics that cause such resistant organisms are inappropriately prescribed. The appropriate use of antibiotics is important in all age groups; however, the appropriate use of antibiotics is particularly important in the elderly population. Elderly patients are at increased risk for complications due to drug-

to-drug interactions as well as increased sensitivity to adverse antibiotic reactions. Antibiotic prescription rates among outpatient older adults increased by 30% from 2000 to 2010. The researchers identified that a necessary step toward the development of directed antibiotic stewardship efforts is the understanding of the regional variations of antibiotic use in the elderly population which was the significance of Arizpe et al.'s study.

Arizpe et al. sought to determine the prescription patterns for elderly adults in the United States. The researchers sought to identify antibiotic prescriptions by regional variation as well as antibiotic prescriptions costs for Medicare Part D enrollees. Antibiotics were calculated by geographic region and by state. Antibiotic use was also calculated by overall cost and by antibiotic class cost. The review applied data from the 2013 Medicare Provider Utilization and Payment Data: Part D Prescriber Public Use File. Information from 35.7 million patients in the Medicare Part D prescription drug program was utilized in the study. The Prescriber Public Use File contained 99.99% of all claims submitted by independent Prescription Drug Plans and the Medicare Advantage Prescription Drug Plan. The total number of prescriptions dispensed was incorporated as well as the total drug cost. The total number of prescriptions dispensed included refills as well as the original prescription. The total drug cost included the ingredient cost, dispensing fees, sales, tax, and administration fees. The number of total recipients was calculated by using an additional public database —the Medicare Advantage/Part D Contract and Enrollment Data—that contains the total enrollment statistics from both Medicare Advantage and Medicare Advantage Prescription Drugs Plans as well as independent Prescriptions Drug Plans. Quantities were calculated

across both states and regions. *Geographic region*, as defined by the United States Census Bureau, was utilized to descriptively analyze the data.

Arizpe et al. (2016) provided research to identify regional variations and costs of antibiotic prescribing among Medicare Part D beneficiaries. Representing more than $1.5 billion in total antibiotic expenditures, over 54 million outpatient antibiotic claims were filed for Part D enrollees in 2013. By geographical region, the highest antibiotic claims were in the South. With the South being the highest geographic region for antibiotic claims, second was the Midwest followed by the Northeast and the West. Similarly, the highest antibiotic prescription cost average per enrollee was also in the South. Average antibiotic costs following the South at $46.58 were the Northeast, Midwest, and West at $36.42. The highest antibiotic prescription claims were found in Mississippi which was followed closely by Tennessee, Kentucky, and Alabama. The lowest antibiotic prescription claims were found in Hawaii, Minnesota, Oregon, and Vermont. Antibiotic cost average was highest per enrollee in Kentucky at $55.14 which was followed by West Virginia and the District of Columbia. Similarly, to the states that were among the lowest in antibiotic prescription claims, Hawaii had the lowest antibiotic cost average per enrollee at $29.41 followed by Vermont at $29.70. The most commonly prescribed class of antibiotics was consistent among all geographic regions. Fluoroquinolones were most commonly prescribed at 12.2 million claims which accounted for 22% of all claims followed by oral penicillins at 10 million claims accounting for 15%, macrolides at 8.6 million claims accounting for 16%, and oral cephalosporins at 6.8 million claims accounting for 13%. The 10 most frequently prescribed antibiotics (Azithromycin, Ciprofloxacin, Amoxicillin, Cephalexin, Sulfamethoxazole-Trimethoprim, Levofloxacin, Amoxicillin-Clavulante, Doxycycline,

Nitrofurantoin, and Metronidazole) accounted for 82% of antibiotic prescription claims. The most commonly prescribed antibiotic, Azithromycin, resulted in 7.2 million total claims. Doxycycline accounted for 3.2 million total claims resulting in $221 million. The researchers suggested that the use of publicly available data can serve as a new tool for researchers and public health officials to further research trends in antibiotic prescribing practices at a national level.

Arizpe et al. described limitations of the study. First, the data may not have represented the prescription patterns of antibiotics for all elderly patients or Medicare recipients as the data only included those under the Medicare Part D prescription drug plan. Those in the Medicare Part D prescription drug plan accounted for an estimated two-thirds of Medicare recipients. Next, the researchers were unable to determine if antibiotic prescriptions were appropriate. The researchers did note that decreased prescriptions rates did not necessarily indicate appropriate antibiotic prescriptions. Third, the antibiotic prescription rates in this age group may have been underestimated due to the data calculation of only medications covered by supplemental benefits or Medicare Part D. Lastly, annual changes in prescription patterns were not evaluated in this study as only a single year of data was researched for the study.

Aripe et al. (2016) was significant to the current research because it addressed the overuse of antibiotics in the elderly population in the United States. The current research group collected data on adults in ambulatory care settings in the United States which included this category of elderly patients. The researchers further researched the antibiotic prescription patterns of primary care providers to determine antibiotic stewardship according to the CDC's Adult Treatment Recommendations for acute uncomplicated bronchitis and pharyngitis. The current researchers also utilized the

findings of the previous researchers by further investigating the variation of prescription patterns in the South and specifically in outpatient primary care in Mississippi.

Shapiro, Hicks, Pavia, and Hersh (2013) performed an analysis of ambulatory care antibiotic prescriptions in the USA from 2007 to 2009. Promoting the correct usage of antibiotics is a priority for public health, because antibiotic overuse is expensive, promotes antibiotic resistance, and leads to adverse events. During adult ambulatory visits in the USA between 2007 and 2009, an estimated 101 million visits were prescribed antibiotics annually. Sixty-one percent of visits where antibiotics were prescribed were prescribed with broad spectrum antibiotics. The researchers identified the significance of their study as the understanding of antibiotic use and prescription patterns that can guide the appropriate use of antibiotics as well as educational programs to influence such understanding.

Shapiro et al. (2013) researched to determine U.S. ambulatory antibiotic prescription patterns for adults, describe diagnoses of antibiotic prescriptions, and describe the factors of patients and physicians that correlate with the prescriptions of broad-spectrum antibiotics. The researchers sought to identify patterns of the national use of antibiotics for adults in ambulatory care settings. The researchers also sought to determine patient-level and physician-level correlations with the use of broad spectrum antibiotics in ambulatory care settings.

The analysis applied the NAMCS) as well as the NHAMCS to study the patterns of antibiotic prescriptions in adults from ambulatory care settings from 2007 to 2009. The survey included medication prescriptions, diagnoses classified by codes from the ICD-9-CM, physician specialty, and patient demographics. Sampling was composed of 112 U.S. geographical regions to produce estimates that are nationally representative.

Patients ≥ 18 years of age who visited ambulatory care settings were included in the population of the study. The ambulatory care visits were grouped into categories to provide an analysis of antibiotic prescriptions via diagnosis utilizing ICD-9-CM codes. Respiratory conditions were further divided into Acute Respiratory Tract Infections (ARTIs) when antibiotics are rarely directed. The Multum Lexicon Drug Database was used to classify antibiotics and contains all U.S. medication prescriptions. The researchers estimated the antibiotic prescription frequency total for all visits and then examined the antibiotic prescriptions by characteristics of clinical practice, physician, and patient. The examination consisted of overall antibiotics and broad-spectrum antibiotics. Clinical practice characteristics consisted of geographical region. Physician characteristics consisted of specialty. A secondary analysis was performed on antibiotic use for respiratory conditions where antibiotics were not usually directed, and antibiotic prescription rates by geographical region were studied. The researchers used the findings from the analysis to recognize the characteristics of patients, providers, and practices linked to the selection of broad-spectrum antibiotics when antibiotics were prescribed.

Shapiro et al.(2013) provided research to identify the condition where antibiotics were the most frequently used. Respiratory conditions including the conditions where antibiotics are not directed were the most frequently used. Broad-spectrum antibiotics were chosen > 60% of the time when there was a prescription for antibiotics. The study revealed an average of 985 million U.S. ambulatory care visits yearly for adults where older patients were prescribed broad-spectrum antibiotics at a higher percentage. Respiratory conditions were the most common category (41%) of antibiotics prescribed during 97 million visits yearly when the diagnosis was classified. Antibiotics were

prescribed for 51% of visits for ARTIs in which antibiotics are rarely directed. Antibiotic use for respiratory conditions showed significant variation between regions where 38% of the visits occurred in the West, and 60% of the visits occurred in the South. The researchers suggested that this large variation between regions necessitates further investigation. Association with receiving broad-spectrum antibiotics was correlated by the researchers to ARTIs and other respiratory conditions as well as old age. Broad-spectrum antibiotic overuse for respiratory conditions provides no benefit but can cause adverse events and promote resistance. The researchers suggested that the findings of broad-spectrum antibiotic use may increase the concern for antibiotic resistance and severe infection vulnerability, especially in those of older age. The researchers also suggested antibiotic stewardship programs to implement the reduction of unnecessary antibiotics and advance the selection method when antibiotic use is indicated.

Shapiro et al. (2013) described limitations of the study. The first limitation identified was the small timeframe of 3 years and the possibility of change in prescription patterns. Second, the use of ICD-9CM codes had the possibility of misclassification as well as the availability of new ICD-10-CM codes. Next, the researchers explained that they were unable to classify the relevance of selection between broad-spectrum antibiotics and narrow-spectrum antibiotics. Lastly, the surveys were unable to confirm if the prescriptions for antibiotics written by primary care providers were filled by the patients. The researchers validated previous research through confirmatory studies, and this was a strength of the study.

The study of Shapiro et al. (2013) was significant to the current research because it recognized the overuse of antibiotics in respiratory conditions in ambulatory care the

in U.S. The current research group collected data in a similar process by using ICD-10-CM codes to further research the antibiotic prescriptions patterns of primary care providers. This current research aims to reduce the unnecessary use of antibiotics and advance the selection method when antibiotic use is indicated as recommended by the previous researchers. The current researchers also responded to the recommendation of the previous researchers by further investigating the variation of prescription patterns in the South and specifically in outpatient primary care in Mississippi.

Hicks et al. (2015) used regression modeling to examine the association between socioeconomic factors, population health factors and antibiotic prescribing rates. The proportions of infections caused by antibiotic resistant bacteria continue to emerge. The CDC estimates 2 million antibiotic resistant related illnesses and 23,000 mortalities will occur each year due to overuse of antibiotic therapy. While resistant bacteria develop, the development of new and stronger antibiotics lags behind. The authors cited previous studies that found 58% of antibiotic prescriptions in ambulatory care are for respiratory illnesses that are predominantly viral in etiology. Antibiotic use is the single most important factor leading to resistance, and promoting appropriate prescription could combat resistance. This study examined factors contributing to prescribing rates. Hicks et al. (2015) identified one hypothesis which stated that variation in health status and access to healthcare may partially explain the geographic variation of antibiotic prescribing rates.

The study used oral antibiotic prescriptions dispensed in the U.S. in the year 2011. The information was retrieved from the Intercontinental Marketing Services (IMS) Health Xponent which captured 100% of all patient prescriptions in the U.S. . Data obtained represented outpatient antibiotic prescription, payer source, and

pharmacies. Prescriptions were grouped by drug category, provider specialty, patient demographics, and the county where the prescriber was located. Drug classes were identified through IMS classification including tetracyclines, cephalosporins, lincosamides, macrolides, penicillins, quinolones, trimethoprim-sulfamethoxazole, and Beta-lactams. Provider population was based on the American Medical Association's self-designated practice; making 17 specialty groups. Family practice, pediatrics, internal medicine, dentistry, nurse practitioner, physician assistant, emergency medicine, dermatology, medical subspecialty, surgery, obstetrics and gynecology, urology, otolaryngology, infectious diseases, pediatric subspecialty, and other made up the provider population that was studied.

The researchers obtained patient demographics from the U.S. Census bridging files by age group, sex, and race per county. The researchers used the total number of prescriptions, corresponding to the county of the provider and county level census to calculate per capita (per 1,000). Patients > 20 years of age were defined as adults, and patients < 20 years of age were defined as children. Hicks et al. (2015) conducted regression modeling to examine the relationship between socioeconomics and health factors as dependent variables and antibiotic prescribing as the dependent variable. County level independent variables included obesity, < 2 years of age, or status as African American. The study stated that the researchers performed numerous multivariable modeling for each independent and dependent variable as potential confounders. To determine unadjusted odds ratio between the exposure and antibiotic prescribing, the researchers performed univariate regression analysis.

Following analysis, the researchers determined that their hypothesis was statistically supported. In the year 2011, healthcare providers prescribed a total of 262.5

million courses of outpatient antibiotics. The prescribing rate was 842 prescriptions per 1,000 persons with penicillins as the most common antibiotic category prescribed. Among adults, 789 antibiotics were prescribed per 1,000 persons. In the adult population, macrolides were most commonly prescribed. The researchers cited that macrolides were often prescribed for conditions not warranting antibiotic therapy. Those > 65 years of age were prescribed antibiotics at the highest rate with 1,048 prescriptions per 1,000 persons. It is noted that prescribing rates were markedly higher for females than males with females 990 to 1,000 per persons and males 596 to 1,000 per persons. Hicks et al. (2015) found that family practitioners prescribed the highest amount of antibiotics followed closely by pediatricians. Lastly, the group looked at geographic region influencing prescription rates. The researchers found that overall rates were consistently higher in the South region with Kentucky as the highest overall prescribing state.

The group hypothesized that health of the population and access to healthcare may explain the geographic variations in antibiotic prescription. They found that counties with higher proportions of obese persons were more likely to have higher prescription rates. The researchers also noted that female sex and healthcare-seeking behavior influenced the encounters with primary care providers. The researchers suggested thoroughly examining social determinants and provider characteristics influencing prescribing for future research.

Although Hicks et al. (2015) represented strong statistical data, several weaknesses were identified throughout the study. The IMS Health Xponent was unable to obtain patient diagnosis. There were no benchmarks for the amount of antibiotics that should have been prescribed per case. Data also did not contain information about

dosing or frequency. The team noted that prescribing data may not actually represent total consumption of antibiotics because they only captured prescriptions filled by pharmacies. Finally, one must also consider patient adherence to drug therapy as well.

This study by Hicks et al. (2015) was very relevant to the current study for several reasons. The basis of the study was identifying overuse of antibiotics in ambulatory care, which was the basis for which current researchers collected data. This study identified the South region as the region with the highest prescribing rates and family practitioners with the highest prescribing rates. This was appropriate to the current study as it has been taking place in rural Mississippi clinics following family practitioners.

Barlem, Saucedo, Cabral, and Kazis (2015) performed a retrospective analysis of ARTI visits between 2006 and 2010 to determine predictors of unnecessary antibiotic prescribing for ARTIs. Data were collected using the NAMCS and the NHAMCS. According to this study, 40% of prescribed antibiotics were unnecessary for the diagnosis of Acute Respiratory Tract Infection. Prescribing unnecessary antibiotics promotes antibiotic-resistant bacteria and increases healthcare costs. Patients are also at an increased risk for adverse drug reactions and Clostridium Difficile infection.

The hypothesis of Barlem et al.'s (2015) study was to discover if patient factors, physician specialty, care setting, and practice demographics were factors in overprescribing antibiotics for ARTIs. The patient factors included age, use of tobacco, insurance carriers, race, sex, and underlying lung disease. The physician specialty factor looked at general practice physicians, pediatricians in primary care, and medical and surgical subspecialists. The care setting included community-based practice, hospital, and emergency departments. The practice demographics included the

geographic area, urban-rural status, poverty or median household income, and those individuals with a bachelor's degree.

There were 5, 653 visits analyzed in the community practice setting, 4, 901 visits analyzed in the hospital practice setting, and 10, 067 visits analyzed in the emergency department practice setting. The NAMCS and the NHAMCS are surveys that are conducted annually at the CDC by the National Center for Health Statistics (NCHS). The NAMCS conducted the survey within a one-week period for general practice providers. The NHAMCS conducted the survey within a 4-week period for hospitals, emergency departments, and clinics within those hospitals. The basis of the survey was the utilization of the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes. A diagnosis of an ARTI according to the ICD-9-CM codes and documentation of an antibiotic prescribed for that diagnosis were categorized as unnecessary or inappropriate. The visits were appropriate if there was no documentation of an antibiotic prescription for this diagnosis. Exclusions from the survey consisted of visits with more than one diagnosis code of an ARTI. The variables of interest included patient factors, physician specialty, care setting, and practice demographics mentioned above. The overall sample was calculated as weighted percentages. The researchers also evaluated the relationship between the outcome and each independent variable. The outcome here would be inappropriate versus appropriate prescribed antibiotics. Barlem et al. (2015) then evaluated the association between the care setting and the outcome.

The population with the visit criteria was fairly young, urban, and Caucasian. Results showed that the emergency departments had more visits with ARTIs than the hospital and community practices. However, there was not as many prescribed

antibiotics for ARTIs in the emergency departments as in the hospital or community practices. The researchers suggested the emergency department providers may not be as worried about patient satisfaction results as primary care providers who have an established relationship with their patients. Another cause of less antibiotic overprescribing may be due to the emergency departments having equipment, such as chest x-rays and laboratories, that can readily provide the appropriate tests. In rural settings, community practice settings were less likely to overprescribe than hospitals. This study showed that patients 18-45 years of age were more likely to receive unnecessary antibiotics than patients younger or older than this age group. Patients 65 years or older were also less likely prescribed inappropriate antibiotics. Barlem et al. (2015) showed that patients with a higher education level lead to less inappropriate antibiotic prescriptions. It has been shown that furthering education leads to good health outcomes. The socioeconomic factor and a diagnosis of chronic pulmonary disease were not significant. However, the low socioeconomic class has fewer opportunities to further their education which leaves them with low health literacy. Visits for privately insured patients were less likely to receive inappropriate antibiotic prescriptions than those who paid out-of-pocket. The researchers suggested that this may be due to the fact that uninsured patients feel like it would be less expensive to pay for antibiotics than over-the-counter medications for symptomatic relief. Tobacco users were more likely to obtain unnecessary prescriptions for antibiotics than those who were not tobacco users. Medical and surgical subspecialists were less likely to overprescribe than general primary providers. The researchers concluded that patient education on the appropriate use with antibiotics for ARTIs should be a healthcare priority. Barlem et al. (2015) suggested further investigation on determining if payment

sources and payment for over-the-counter medications were factors in overprescribing unnecessary antibiotics.

The strengths of this study included a variety of settings, populations, and information on the comparison of overprescribing between practices. Also, the researchers included information regarding the providers that are more aware of when to appropriately prescribe antibiotics. Limitations were listed in this study including sampling bias. Another limitation stated that ARTI was not the primary diagnosis for all visits. Last, Barlem et al. (2015) were unable to determine if the antibiotic prescribed was for another infection or for the ARTI.

Quality improvement studies. Gonzales et al. (2013) performed a cluster randomized study for the purpose of determining the effects of implementing a clinical algorithm in two ways to reduce the number of acute bronchitis cases that were treated with antibiotics. Antibiotic overuse was a concern due to the growing trend of antibiotic-resistance. According to Gonzales et al. (2013), 58% of all antibiotics prescribed in 2006 were for acute respiratory tract infections. Eighty percent of all office visits for acute bronchitis were treated with antibiotics (Gonzales et al., 2013). Most cases of upper respiratory infections, such as bronchitis, do not render antibiotic treatment since they are viral in origin. Healthcare providers are particularly careful in treating acute bronchitis cases since acute cough is the main clinical symptom, and life-threatening pneumonia could potentially be misidentified as acute bronchitis. A study was conducted in an emergency department setting in which an algorithm was used to help identify the need for antibiotics in cases with a diagnosis of acute cough. The goal of this study was to extend the algorithm into outpatient settings to reduce the number of antibiotics used for the treatment of bronchitis.

Gonzales et al. (2013) determined which plan of algorithm integration yielded the best results. The researchers compared the use of traditional paper forms (PDS-printed decision support) of the algorithms as well as electronic integration (CDS-computer assisted decision support) in which the algorithm populated in the EHR based on the patient diagnosis. A control group was also used in this study.

The study was a quantitative retrospective chart review conducted in rural central and northeast Pennsylvania. Gonzales et al. (2013) divided 33 clinics into randomized groups of three arms: PPDS (printed decisional support), CDS (computer-assisted decision support), and control. The population consisted of adolescents and adults $\geq$13 years of age whose diagnosis was acute bronchitis. Gonzales et al. implemented the system during peak clinic volumes of bronchitis which included the months of October 1- March 31. The clinicians consisted of all disciplines including physicians, physician assistants, nurse practitioners, and registered nurses. Informed consents were obtained from all participants, and the clinical control site was not enlightened on the study's purpose. The researchers assigned a clinical champion who educated the PDS and CDS arms with information by the CDC regarding acute bronchitis and antibiotic use. At the PDS intervention sites, a brochure was given to any patient who presented with a cough. A poster was also placed in all examination rooms with the algorithm at the PDS locations. At the CDS sites, if the nurse entered "cough" as a complaint, the EHR prompted the nurse to give the patient the educational brochure to read before receiving treatment for the cough. The CDS sites also had specific templates in place that populated as providers entered patient information into the computer to help the provider determine the patient's status according to the acute cough algorithm. Charts were chosen randomly based on ICD9 codes for bronchitis.

Following analysis, Gonzales et al. (2013) determined there was a decrease in antibiotic prescriptions at the CDS and PDS sites. According to Gonzales et al. (2013), the control site had a statistically significant (p =.003 for control versus PDS sites and p =.01 for control versus CDS sites) increase of antibiotic prescriptions. Statistically there was no significant difference in the PDS and CDS sites (p = .67). Antibiotic-prescribing rates were decreased by 20% at both intervention sites. Return visit rates increased slightly at all sites. The findings illustrated the PDS and CDS implementations were equally effective in reducing antibiotic use in patients diagnosed with acute bronchitis. PDS and CDS strategies can improve antibiotic overuse when combined with other methods of traditional education measures among physicians and patients.

Gonzales et al. (2013) identified several weaknesses of their study. First, CDS implementation was not significantly utilized by the physicians at the CDS sites. This finding could have skewed the results. The EHR system had been in place a long time before the study took place which may have led to clinicians skipping over the CDS templates. The study sites were limited to rural areas and were small to medium-sized practices. The patient sample may not have been a true representation of the population. Due to being aware of the problem of overprescribing antibiotics for acute bronchitis, the physicians may have changed their diagnosis codes to reflect ones in which antibiotics were appropriate. The study was limited in time and could better represent clinicians if the research had continued for a longer period of time. Lastly, the researchers were not sure what actually caused the decrease in antibiotic prescribing due to the multiple factors, such as the PDS, CDS, clinical champions, patient education, and awareness of the on-going study. Regardless of the sample size, time, and

implementation measures, the rates of antibiotic prescribing were decreased by implementing measures in which clinicians have a guide to follow when prescribing antibiotics for acute bronchitis.

This study by Gonzales et al. (2013) was very relevant to the current study for several reasons. The basis of the study was overprescribing of antibiotics in regard to acute bronchitis which was the same topic for which the researchers collected data. The study used standardized guidelines to determine if the antibiotics were needed, and the current study also used a set of recommendations set forth by the CDC to determine the need for treatment with antibiotics. The current study's goal was the same as the previous study to reduce overuse of antibiotics to help reduce antibiotic resistance. As evidenced by the previous study, the goal can be accomplished by implementing guidelines.

This study was relevant to the current research. The basis of the study is on unnecessary antibiotic prescribing for ARTIs. The study performed used patients of all ages, but there is some information that can be utilized regarding the adult population which was the focus for the current researchers. The previous researchers suggested patient education regarding treatment decisions for ARTIs. The current researchers did not provide interventions such as education, but the current study analyzed overprescribing antibiotics in patients with a diagnosis of uncomplicated bronchitis and pharyngitis.

Vinnard et al. (2013) performed a quasi-experimental pre-post study with concurrent control groups that identified interventions that would help reduce antibiotic prescribing for upper respiratory infections. Antimicrobial overuse results in adverse drug reactions and unnecessary drug costs and contributes to the development of

antimicrobial resistant drug infections. Although the prescribing rates have decreased, providers are still prescribing antibiotics over 50% of the time for acute bronchitis which does not need to be treated with an antibiotic. There have been many efforts to help reduce the unnecessary prescribing of antibiotics, but few studies have shown improvement. The PRECEDE model has been used in many studies which uses a multidimensional approach, but using this kind of intervention is costly (Vinnard et al., 2013).

The researchers' goal was to determine what types of interventions would yield the best results in reducing unnecessary antibiotic prescribing practices. The researchers repeated a previous cross-sectional study to evaluate the effectiveness of intensive academic detailing of providers, and the researchers also studied the effectiveness of provider involvement in educational mailings (Vinnard, et al., 2013).

The researchers first repeated a previous pre- and post-study using academic detailing as an intervention. In this study, there were an intensive intervention group, a mild intervention group, and a control group. The intervention group consisted of 14 providers from the Clinical Practices of the University of Pennsylvania (CPUP). The 14 providers were chosen based on the providers with the highest number of visits for upper respiratory diagnoses. The inclusion diagnoses consisted of acute bronchitis, bronchitis not specified, cough, acute pharyngitis, and upper respiratory infection not otherwise specified. The seven providers that had the highest prevalence of antibiotic prescribing for acute bronchitis were put into the intensive intervention group. The next seven providers with the subsequent prevalence of antibiotic prescribing for bronchitis were put into the mild intervention group. The control group consisted of 14 Clinical Care Associates (CCA) providers whose numbers of acute bronchitis visits matched

those of the CPUP providers. The providers at CPUP were also faculty members at the University of Pennsylvania. The providers at CCA were non-faculty members but had affiliations with the university. Fifteen patients were identified for each provider in the control group. Overall, each patient was included only one time regardless of multiple visits to the same provider. Patients were excluded from the study for the following reasons: (a) previous diagnosis of chronic bronchitis or emphysema, (b) diagnosis of the same problem 60 days prior to selected visit, (c) diagnosis of acute or chronic sinusitis or pneumonia 60 days prior to selected visit, or (d) if the same patient was selected in the intervention and control group, the patient was replaced. The seven intensive intervention group providers met with a pharmacist and an opinion leader in antibiotic use to review literature and provide specific data regarding prescribing practices. The intensive intervention group was also given two sets of provider-oriented educational materials: (a) "prescription pad" developed by the CDC which allowed the provider to list symptomatic treatment regimens and (b) information sheets explaining the need to refrain from antibiotic use in acute bronchitis. The seven mild intervention group providers were only given the two educational materials via mail. Data were gathered and results were determined (Vinnard et al., 2013).

The researchers' second study was an educational mailing intervention study that consisted of 20 providers from CPUP who had the highest number of visits for the diagnoses included in the previous study. Twenty providers from CCA were also included in the study. The CCA providers were determined in regard to the providers who had the highest number of visits for the diagnoses referenced above. The researchers selected 15 patients or less if 15 were not available from each provider based on the diagnoses that were included in the study. The same participant exclusions

applied. The pre- and post-study participants were chosen around the intervals in which the educational materials were mailed. Educational brochures were mailed to all patients of the selected CPUP providers who had an upper respiratory infection diagnosis in the past 2 years. A second brochure was sent 9 months later to the patients of the CPUP providers who had an upper respiratory infection diagnosis in the last year. In addition to the mailings, the providers received two sets of patient- oriented printed educational material (Vinnard et al., 2013). Data were extracted from the electronic medical records in the intervention group and paper medical records from the control group. The researchers further determined what type of antibiotic was prescribed, such as broad spectrum or narrow spectrum (Vinnard et al., 2013).

Vinnard et al. (2013) determined there was a significant reduction in antibiotic prescribing rates in the intensive intervention group before and after the intervention. There were no significant changes in the control group or mild intervention group. In the patient mailing intervention study, there was a small reduction in antibiotic use in the intervention group but not significant, and there was a slight increase in antibiotic-prescribing in the control group. No change was identified in the type of antibiotics used. The researchers determined academic detailing along with a one-time mailing of patient-oriented educational materials that helped to reduce antibiotic prescribing for upper respiratory infections (Vinnard et al., 2013). The researchers' study also determined that just one academic detailing session alone can decrease antibiotics prescribed for acute bronchitis and upper respiratory infections. Vinnard et al. (2013) noted there was a much lower baseline of antibiotic-prescribing in their intervention group than in the control group which could have magnified their findings. Biases could have occurred based on the provider's outside influences, such as media

campaigns, to reduce antibiotic use. Both groups of providers used in the studies were from the same area and associated with the same university which could have had an effect on their practice methods.

Vinnard et al.'s (2013) study was beneficial to the current research study. The researchers were seeking to identify if the providers were using the CDC Adult Treatment Recommendations when prescribing antibiotics for upper respiratory disorders. This helped to identify if providers in Mississippi were aware of the CDC's recommendations for antibiotic prescribing. The previous study was trying to determine which types of interventions led to decreased antibiotic-prescribing practices; this finding was beneficial to the current researchers in determining what interventions could be implicated to increase provider adherence to the CDC Adult Treatment Recommendations. The goal of both projects was to help decrease unnecessary antibiotic prescribing.

Rattinger et al. (2012) performed a retrospective observational study for the purpose of assessing the effects of a clinical decision support system (CDSS) on congruence of antibiotic prescribing with acute respiratory tract infection treatment guidelines. Antimicrobial resistance leads increased morbidity, costs of infections, and mortality. Without new drug development to battle super infections, the public will be threatened with evolving antimicrobial resistance for years to come. Antibiotic exposure is the leading cause of bacterial resistance. To minimize unnecessary use of antibiotics, efforts to slow such rates have been targeted at acute respiratory infections. Conditions in which antibiotics are routinely over-prescribed include acute bronchitis, acute sinusitis, acute pharyngitis, and nonspecific upper respiratory tract infection (URI).

Rattinger et al. (2012) identified one hypothesis. The hypothesis stated that integrating electronic tools within the natural flow of care could counteract a persistence of unwarranted drug use. From January 2002 to December 2006, the group performed the retrospective observational study. The CDSS intervention began in January 2003 in Maryland at the Veterans Affairs Health Care System. The Veterans Affairs Salt Lake City Health Care System served as the control site. The CDSS targeted azithromycin and gatifloxacin prescription rates related to outpatients with uncomplicated ARI's at the intervention site. Other outpatient antibiotics remained unrestricted. The CDSS was part of a larger quality improvement initiative that targeted 26 medications and was used by 1,379 providers during the study period. The CDSS deployed drug-specific recommendations as clickable choices during order entry, mined the electronic medical record for specific patient information, and based on the provider choice, issued a notice documenting the rationale for drug use. The provider could accept or modify documentation prior to committing it to the electronic medical record.

The gatifloxacin and azithromycin CDSS comprised treatment plans for community-acquired pneumonia, acute bronchitis, acute sinusitis, non-specific upper respiratory infection, and exacerbations of chronic obstructive pulmonary disease (COPD). For acute bronchitis, acute sinusitis, and nonspecific URI paths, the system's software confirmed the clinical condition matched the guideline's definition. It then sought to identify clinical circumstances where antibiotics could be warranted. Such circumstances included acute bronchitis patients with temperature above 100.4 °F, respiratory rate > 22 breaths per minute, pulse > 100, or clinical signs of lung consolidation. For those with acute sinusitis with symptoms lasting longer than 7 days and were febrile, antibiotics were prescribed. Under such circumstances, antibiotic

prescription was warranted. For cases of sinusitis, bronchitis, and nonspecific URI where guidelines suggested antibiotics could be safely withheld, the software did not issue the need for a prescription. Alternatively, providers were advised on maintaining patient satisfaction with withholding antibiotics. Providers who wished to prescribe an antibiotic regardless of the indication were able to override the CDSS to prescribe what they felt needed for treatment. Providers were able to document their choices as justification.

A case-detection algorithm was applied to the EMR to gather the population. Outpatient visits during the study were flagged if providers assigned an ARI-related diagnostic code, prescribed a cough suppressant, and documented at least two ARI symptoms. There were 7,000 cases manually reviewed, and. 3,169 cases were excluded as they did not meet the predefined criteria as follows: (a) not outpatient, (b) not an ARI, (c) not an in-person, initial visit for a given ARI episode; (d) prior of ARI during the study; (e) stated diagnosis of COPD; and (f) acute pharyngitis as the only ARI diagnosis. The study included a total of 3,831 patients with an initial visit for acute respiratory infection. These patients were mostly older males. The most common diagnosis was acute bronchitis closely followed by pharyngitis and sinusitis. More than one ARI diagnosis was found in 56.9% of cases. While the majority of ARI visits did not include documentation to support the use of antibiotics, 624 encounters warranted antibiotics. For the drugs targeted by the CDSS, unwarranted prescriptions decreased from 22% to 3.3% of visits from pre- to post-CDSS. The proportion remained unaffected for other antibiotics at the intervention site. Although the use of antibiotics congruent with guidelines increased during pre- to post-intervention periods at the

intervention site, use was unchanged at the control site. At the intervention site, correspondence increased in the first post-intervention year and then remained stable.

Rattinger et al. (2012) reported the indicated use of the two antibiotics targets by the CDSS remained undiminished, but their unnecessary use for acute respiratory infections was abridged for a 4-year period. The researchers identified several strengths and weaknesses of their study. One strength included the length of the study, sample size, and treatment criteria. Another strength was that providers were able to override the CDSS recommendations—a safety feature included in the design. Several factors limited the results of the study. The study did not employ a randomized allocation process. The intervention was only implanted at one site where healthcare providers were familiar with a CDSS system. Due to multiple practitioners involved, there was no formal control for potential predictors of prescribing practices. The researchers described a disadvantage to this intervention as the CDSS only targeted two agents. Rattinger et al. (2012) further recommended integration of prescription-based interventions to optimize the overall management of ARI.

Rattinger et al. (2012) was relevant to the current study for several reasons. The hypothesis of the study was to see if integrating electronic tools within the natural flow of care could counteract a persistent form of unwarranted drug use. The CDSS provided a set of recommended guidelines for antibiotic-prescribing for ARI. The researchers observed to see if providers were following the recommendations provided. Rattinger et al. (2012) found that with the CDSS system, providers were more conscientious about antibiotic prescribing as they were prompted when diagnosing a patient with an ARI. For the current study, researchers observed with retrospective

chart reviews to see if providers are following CDC recommendations for managing acute pharyngitis, acute uncomplicated bronchitis, and acute rhinosinusitis.

Hingorani, Mahmood, and Alweis (2015) performed a quality improvement study in an effort to reduce rates of inappropriate antibiotic use for upper respiratory infections, sinusitis, and pharyngitis. For this study, the researchers collectively called this group of diagnoses acute respiratory infections (ARI). The researchers identified that worldwide antibiotic resistance is driven by inappropriate usage of antibiotics as well as patient nonadherence to appropriate antibiotic regimen. Hingorani et al. (2015) stated that over a 3-year period, 101 million ambulatory care visits resulted in the patient receiving an antibiotic. Of those 101 million visits, 41% were for respiratory infections. Past literature stated that antibiotics pose little benefit for ARIs; however, over-prescribing can be detrimental for the patient. Adverse events, such as medication interactions, side effects, and *Clostridium difficile* colitis, are potential complications when a patient receives an antibiotic. In 1995, the CDC launched a national campaign called Get Smart: Know When Antibiotics Work. This campaign has been used to enlighten the pubic and prescribers on the overuse and detrimental effects of inappropriate antibiotic prescribing. The campaign also identified recommendations for prescribers to follow for appropriate prescribing in order to reduce overuse. Hingorani et al. (2015) stated that 25 million people visit primary care providers each year for ARIs, and 73% are prescribed antibiotics despite national treatment guidelines. From 2000-2010 there was no change in adult-prescribing practices, and there was actually an increase in the prescribing of broad spectrum antibiotics during that timeframe. Therefore, the researchers aimed to increase adherence to the CDC's national treatment

guidelines for ARI's in an outpatient internal medicine clinic by implementing educational interventions and a clinical decision support (CDS) tool.

Hingorani et al. (2015) did not clearly state an hypothesis or research question. However, a possible research question could be the following: Will educational interventions and clinical data reminders improve primary care providers' adherence to the CDC's antibiotic prescribing guidelines for ARI's?

Hingorani et al. (2015) performed a quality improvement study that was founded on previously published work of a Plan-Do-Study-Act (PDSA). The first PDSA study focused on passive education materials, and the study yielded only small improvement in adherence. Through this quality improvement study, the researchers aimed to reduce unwarranted antibiotic prescribing for ARIs. The researchers performed a needs assessment based on the first PDSA results in order to formulate the direction for their current study. Hingorani et al. (2015) stated that a PDSA is a tool that is commonly used for continuous quality improvement that focuses on a problem, requires changes to improve the problem, and implementation of the changes. Following implementation, measurement and analysis were performed to determine if the interventions were successful and to determine the next step in interventions. This cycle allowed for small changes in the work environment that has proven successful outcomes in quality improvement. The researchers identified the largest area of need for improvement was a CDS tool built into the electronic medical record. This CDS tool calculated characteristics that were entered in the chart to determine if a diagnosis warranted an antibiotic prescription. The researchers also included active educational interventions for this quality improvement study. These interventions included the following:

provider report cards, academic detailing, and inclusion into the residency quality improvement curriculum (Hingorani et al., 2015).

The study took place at an outpatient internal medicine clinic that was affiliated with a university community hospital's internal medicine residency program. The interventions took place between October 2013 and March 2014. The population for this study was all practice providers in the university-affiliated internal medicine clinic which included 22 residents, one nurse practitioner, and five attending physicians. After the researchers analyzed the first PDSA results, seven interventions were identified for the second PDSA. Those seven interventions composed the current research study. In October 2013, the researchers conducted educational sessions for residents and staff geared toward appropriate antibiotic use for ARIs based on the CDC guidelines. In November 2013, the researchers dispersed summaries of the guidelines to the conference rooms, exam rooms, and patient and staff restrooms. In December 2013, the CDS tool was integrated into the electronic medical record. The providers received via email monthly reminders to use the CDS tool and reinforced the importance to adhere to the guidelines. Also, reminders to use the CDS tool for appropriate diagnosis was placed at each work station. Monthly meetings were also held to reinforce the use of the tool and guideline adherence. The final intervention took place in March 2014 when report cards were sent to providers that detailed their adherence from October 2013 to February 2014. After completion of interventions, two of the researchers performed chart reviews to evaluate rates of appropriate prescribing, usage rate of CDS tool, and 72-hour patient callback. The second researcher assessed inter-rater variability by reviewing the first 10% of charts and then every 10^{th} chart

thereafter. The two researchers found 100% consensus between their reviews (Hingorani et al., 2015).

Data were grouped into categories for analysis which included year, individual diagnosis, aggregate diagnosis, and rate of guideline adherence. The Chi-square test of association was used for data analysis using the SPSS statistical software. A total of 273 patients were seen between October 2013 and July 2014 that had a diagnosis of URI, sinusitis, or pharyngitis. Of these patients, 240 met the inclusion criteria for this study. Patients were excluded if they exhibited the following: diagnosis of HIV, immunocompromised, active malignancy, or more than one visit during the study time. Patients were also excluded if they were already on an antibiotic for another condition prior to the clinic visit. URIs accounted for 157 (65.42%) of the visits. Pharyngitis accounted for 28 (11.66%) of the visits, and sinusitis accounted for 55 (22.92%) of the visits. The researchers concluded that the interventions improved adherence to guidelines. Prior to interventions, the total adherence rate for ARIs was 78.68%. The adherence rate for total adherence for ARIs after interventions was 91.25%. Individual category adherence rates were as follows: 90.90% for sinusitis, 64.28% for pharyngitis, and 96.18% for URI. As previously stated, the CDS tool was implemented in December 2013; after implementation, the rate of usage was 39.7%. Hingorani et al. (2015) stated that of the patients seen, only 11 (0.05%) were callbacks within 72 hours which is unchanged from previous studies. The researchers stated that this finding did not support the belief that antibiotic stewardship would increase post-visit workload. The researchers concluded that simple low-cost interventions led to significant improvement in regard to antibiotic stewardship for ARIs, and identified that provider and patient education is a vital part in the progress (Hingorani et al., 2015).

Hingorani et al. (2015) did not identify many strengths or limitations in their study. One limitation mentioned by the researchers was the limited population since the study was only conducted in one clinic. A larger population would be beneficial when replicating this study in the future. The researchers based their study on reviewing the previous study in order to develop strong interventions. The variety of interventions and modes of intervention were beneficial strengths in ensuring adherence to the guidelines. Another strength of the study was targeting young physician residents before they are "set in their ways." The researchers stated that further study is needed for optimization and to prevent elimination in the areas of provider education and CDS-based interventions since these areas show promising adherence to prescribing guidelines.

Hingorani et al.'s (2015) study was relevant to the current research in several ways. It identified the increased need for antibiotic stewardship and also focused on the provider. The current research was not intervention based like this study. However, the current research identified whether or not primary care providers were adhering to the CDC's treatment recommendations for acute bronchitis and streptococcal pharyngitis. Future researchers could take the results of the current research and develop a quality improvement study to show low adherence to recommendations resulting in unwarranted prescribing.

CHAPTER III

Methodology

The Centers for Disease Control and Prevention (CDC) (2017) published recommendations to assist primary care providers in the diagnosis and management for acute uncomplicated bronchitis and streptococcal pharyngitis. It has been revealed that primary care providers' prescribing accounts for a large percentage of inappropriate antibiotic prescriptions. Mississippi ranks as one of the states with the highest outpatient antibiotic prescribing rates. The prescribing rates were not a problem until recently when an abundance of infections have become resistant to antibiotics. All healthcare providers prescribe inappropriately in many ways. Inappropriate prescribing practices included using the wrong antibiotic, the wrong duration, at the wrong time, or the wrong route of administration. The wrong time included visits in which antibiotics were prescribed for viral illnesses without a watchful waiting period. The wrong antibiotic or duration included situations in which a broad spectrum was prescribed and not indicated and for the incorrect duration. Mississippi's prescribing rates are continually increasing. The purpose of this study was to determine if primary care providers in Mississippi are following CDC Adult Treatment Recommendations for antibiotic use in the treatment of acute uncomplicated bronchitis and streptococcal pharyngitis.

Design of the Study

The researchers employed a quantitative, descriptive design utilizing retrospective chart reviews to determine outpatient primary care providers' adherence to national recommendations regarding treatment of acute uncomplicated bronchitis, pharyngitis, and streptococcal pharyngitis. The researchers investigated whether or not

antibiotics were being appropriately prescribed in adults over the age of 18 years for a diagnosis of acute uncomplicated bronchitis, streptococcal pharyngitis, and pharyngitis. Data were collected by accessing charts with a diagnosis of acute uncomplicated bronchitis (ICD10 J20.9), streptococcal pharyngitis (ICD10 J02.0), or pharyngitis, unspecified (ICD 10 J02.9) in six primary care clinics in Mississippi.

Population and Sample

This study took place in six Mississippi primary care clinics. The target population for the study was patients ages 18 years or older with a confirmed diagnosis of acute uncomplicated bronchitis, pharyngitis, or streptococcal pharyngitis. The accessible population for this study consisted of the entire patient population of the chosen clinics with the required age and diagnosis. A convenience sample was used. Roughly 600 charts were selected that met the above requirements. That number will include approximately 100 charts from each clinic.

Protection of Subjects

Data for this study were gathered through retrospective chart reviews, thus no human subjects were used. All data gathered from charts were kept confidential and protected by the researchers. The data collection worksheet did not contain any identifiable information pertaining to the clinics or patients. At the end of the study all paper and data were shredded. Because the research design was a retrospective chart review, subjects were not at risk nor did they benefit from the study. Approval was obtained from the Mississippi University for Women Institutional Review Board prior to data collection (see Appendix A). The researchers obtained informed consent for the chart reviews from the office manager or review board of each clinic where the study took place (see Appendix B).

Methods of Data Collection

The researchers reviewed 100 charts at each of the six clinics and gathered data to determine if primary care providers were following the CDC recommendations for the diagnosis and management of acute uncomplicated bronchitis, streptococcal pharyngitis, and pharyngitis. Data were collected during normal business hours at the participating clinics and was collected under staff supervision. Charts were pulled if they met the inclusion criteria for the study which included ICD10 codes of J02.0, J02.9, and J20.9. The researchers returned the charts at the end of each data collection day. Data were recorded on a data collection worksheet (see Appendix C). The worksheet consisted of a series of inquiries the researchers were investigating derived from the research questions.

Methods of Data Analysis

The researchers designed a data collection worksheet for the chart reviews. The data collection worksheet included the following information: age, sex, race, provider type, diagnosis, antibiotic prescribed, and payer source. Data were subjected to analysis using descriptive statistics including, but not limited to, frequency distributions and percentages. Data were then analyzed for provider adherence to the CDC's Adult Treatment Recommendations for the treatment of streptococcal pharyngitis, pharyngitis, and acute bronchitis.

CHAPTER IV

Results

Antibiotic resistance is one of the public's most pressing health concerns due to loss of productivity, poor health outcomes, and greater healthcare costs. Antibiotic resistance costs the United States millions annually. In 2003, the CDC launched the Get Smart: Know When Antibiotics Work Campaign with the intent of directing appropriate outpatient antibiotic use. In 2015 the White House initiated the National Action Plan for Combating Antibiotic-Resistant Bacteria by reducing inappropriate use by 50% by the year 2020 (Fleming-Dutra et al., 2016). The purpose of this study was to determine if primary care providers in Mississippi were adhering to the CDC's (2016) Adult Treatment Recommendations when prescribing antibiotics for acute uncomplicated bronchitis and pharyngitis. According to the CDC's (2016) Adult Treatment Recommendations, patients diagnosed with acute uncomplicated bronchitis and acute unspecified pharyngitis should not receive an antibiotic.

The primary goal of this study was to determine how frequently primary care providers in Mississippi followed the CDC's Adult Treatment Recommendations, as well as how frequently these providers appropriately prescribed antibiotics to patients diagnosed with these conditions. The CDC Adult Treatment Recommendations also stated that viral pharyngitis cannot be distinguished from Streptococcal pharyngitis solely on clinical features and, therefore, suggested that a Rapid Antigen Detection Test (RADT) should be performed on patients who present with two or more Centor criteria. Therefore, a secondary focus of research was aimed at determining whether or not the providers ordered and had documentation of a positive RADT before prescribing antibiotics for Streptococcal pharyngitis.

Nonexperimental, quantitative, descriptive, retrospective review of charts in six primary care clinics in Mississippi was conducted to evaluate how frequently primary care providers followed the CDC Adult Treatment Recommendations when prescribing antibiotics for acute uncomplicated bronchitis, acute unspecified pharyngitis, and Streptococcal pharyngitis. A convenience sampling of 582 charts was conducted by performing a retrospective chart review at the six primary care clinics. The data collection worksheet was utilized by each researcher to collect data. This chapter discusses the study's sample as well as answers to the research questions in statistical terms with summaries in tables and figures.

Profile of Study Participants

Data for the research study were collected by method of convenience sampling. Each student researcher performed retrospective chart reviews and collected approximately 100 patient charts from six different primary care clinics in Mississippi. The sample included patients aged 18 years or older with a confirmed diagnosis of acute uncomplicated bronchitis, acute unspecified pharyngitis, or streptococcal pharyngitis. Patients under the age of 18 years were excluded from the study. The sample was used to determine how frequently primary care providers adhered to the CDC Adult Treatment Recommendations for prescribing antibiotics.

If patients were treated prior to the release of the current recommendations, those charts were excluded from the study. Therefore, the sample population included patients aged 18 years and older treated after the year of 2003. At each clinical site, a random, convenience sampling of approximately 100 medical records was selected for the purpose of the chart review for this study. All six clinics utilized electronic medical records. The medical records were chosen by searching the ICD-10 criteria. The chart

selections included patients with the following ICD-10 codes: J20.9 acute uncomplicated bronchitis, J02.9 acute unspecified pharyngitis, and J02.0 Streptococcal pharyngitis. A total of 582 patient records were reviewed. Patient demographic information obtained from the charts included age, gender, race, and insurance type. Finally, provider type was retrieved from the charts.

Age. The research sample consisted of individuals ranging in age from 18 to 97 years, with an average age of 48.69 years (*SD* = 18.09). Figure 1 is a histogram that represents the age distribution among the sample population.

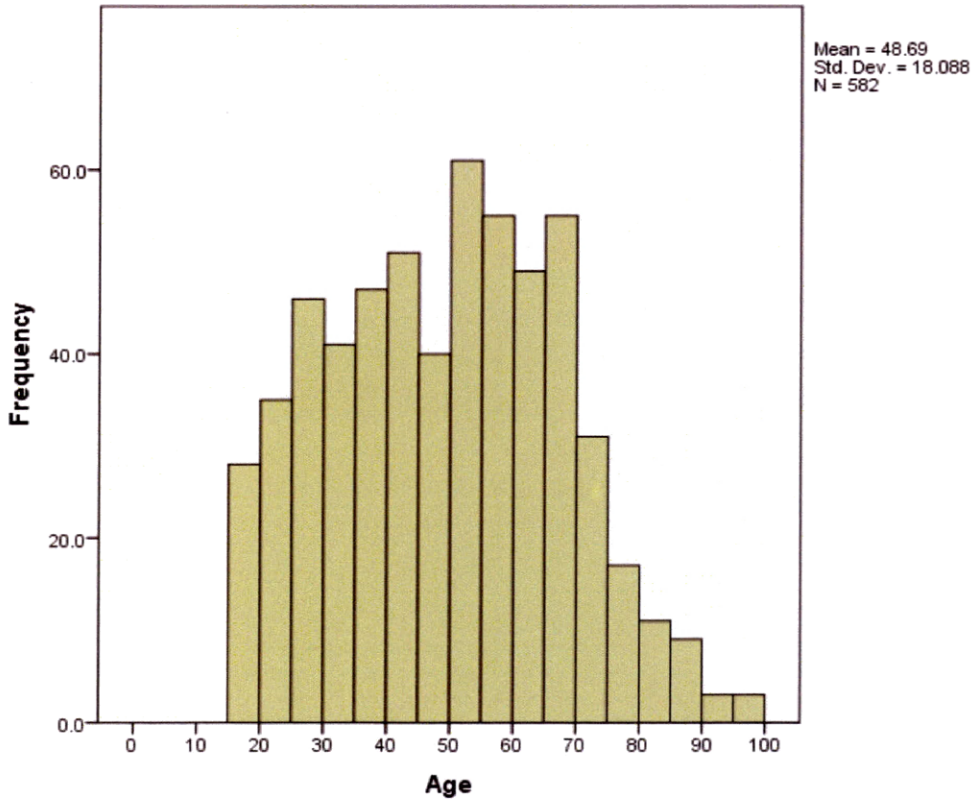

Figure 1. Age distribution among the sample population

Gender. The sample population was comprised of more females than males. Of the records reviewed, 66.5% (*n* = 387) were female patients, and 33.5% (*n* = 195) were male patients.

Race. Ethnicity of the patients was 60.5% (n = 352) White, 38.7% (n = 225) Black or African American, 0.5% (n = 3) Hispanic or Latino, and 0.3% (n = 2) American Indian or Alaskan Native.

Insurance type. Patients used a variety of payment methods, including Commercial Insurance (45.2%, n = 263), Medicare (25.3%, n = 147), Medicaid (18.7%, n = 109), Private Pay (5.5%, n = 32), and none (5.3%, n = 31).

Provider type. The researchers determined the type of prescribing provider while collecting their data. Of the sample population, 75.4% (n = 439) were nurse practitioners, 24.1% (n = 140) were medical doctors, and 0.5% (n = 3) were DO.

Statistical Results

A random convenience sampling of 582 medical records was reviewed to complete this retrospective chart review. In total, 210 of the medical records had a diagnosis of J02.9 (Acute Pharyngitis, Unspecified), 164 had a diagnosis of J02.0 (Streptococcal Pharyngitis), and 208 had a diagnosis of J20.9 (Acute Uncomplicated Bronchitis). Patients aged 18 years and older with the diagnosis of acute uncomplicated bronchitis, acute unspecified pharyngitis, and Streptococcal pharyngitis met the inclusion criteria. The researchers entered all statistical information from the data collection worksheets into a Microsoft Excel spreadsheet and formulated to determine n = number for each category. Subsequent analyses were performed using IBM SPSS statistical software, version 24. Inferential statistics were tested using $\alpha = 0.05$. The researchers investigated the following research questions:

1. How frequently do primary care providers follow the CDC Adult Treatment Recommendations when prescribing antibiotics to adult patients with bronchitis and pharyngitis?

2. How frequently do primary care providers prescribe antibiotics to patients with diagnoses of J20.9 (acute bronchitis) and J02.9 (acute unspecified pharyngitis)?
3. How frequently do primary care providers order and have documentation of a positive rapid strep antigen detection test before prescribing antibiotics for streptococcal pharyngitis J02.0?

Research question 1. How frequently do primary care providers follow the CDC Adult Treatment Recommendations when prescribing antibiotics to adult patients with bronchitis and pharyngitis? The researchers determined how frequently primary care providers followed the CDC Adult Treatment Recommendations for antibiotic prescribing. For a diagnosis of pharyngitis, the CDC recommends that patients who meet two or more Centor criteria (e.g., fever, tonsillar exudates, tender cervical lymphadenopathy, absence of cough) should receive a RADT since clinical features alone do not distinguish between viral and Streptococcal pharyngitis. Of the patients diagnosed with Pharyngitis, 62.0% (n = 127) received a RADT test.

Of those that were diagnosed with acute unspecified pharyngitis and received a RADT test, 49.6% (n = 63) presented zero Centor criteria, 29.9% (n = 38) presented one Centor criteria, 19.7% (n = 25) presented two Centor criteria, and 0.8% (n = 1) presented three Centor criteria. Of those diagnosed with Pharyngitis and did not receive a RADT test, 43.6% (n = 34) presented zero Centor criteria, 39.7% (n = 31) presented one Centor criteria, 12.8% (n = 10) presented two Centor criteria, and 3.8% (n = 3) presented three Centor criteria.

Put another way, RADT was given to 64.9% (n = 64.9) of patients who had zero Centor criteria, 55.1% (n = 38) of patients who had one Centor criteria, 71.4% (n = 25) of patients who had two Centor criteria, and 25.0% (n = 1) of patients who had three Centor criteria.

The CDC is against the use of antibiotic treatment with negative RADT results. In the records reviewed, antibiotic treatment was used for 91.7% (n = 11) of patients with a positive RADT result, 62.1% (n = 72) patients with a negative RADT result, and 11.9% (n = 54) of patients with no RADT test conducted. According to the CDC Adult Treatment Recommendations, amoxicillin and penicillin V remain as the first-line therapy against Group A Streptococcal pharyngitis. For patients allergic to penicillin, cephalexin, cefadroxil, clindamycin, or macrolides are recommended. However, azithromycin and clindamycin show increasing antibiotic resistance to Group A Streptococcal infection and are, therefore, not recommended as first-line treatment options. Table 1 summarizes the types of antibiotics prescribed for pharyngitis in relation to the RADT test results.

After performing a random conveninence sampling of patients diagnosed with acute uncomplicated bronchitis, the researchers determined the frequency of antibiotic prescribing. For the 208 patients diagnosed with acute uncomplicated bronchitis, 85.2% (n = 179) were prescribed an antibiotic. However, the CDC Adult Treatment Recommendations state that treatment with antibiotics is not recommended, regardless of the cough duration. The types of antibiotics prescribed are shown in Table 2.

Table 1

Frequency of Antibiotic Types Prescribed for Pharyngitis Diagnosis by RADT Use

	Pharyngitis diagnosis		
Antibiotic	% Positive RADT	% Negative RADT	% No RADT
Amoxicillin	45.5	5.6	3.7
Amoxil		23.6	25.9
Augmentin		12.5	1.9
Cefdinir		-	1.9
Cleocin	-	1.5	1.9
Doxycycline	9.1	-	3.7
Keflex	-	1.4	-
Levaquin	9.1	1.4	3.7
Zithromax	36.4	25.0	14.8
Z-Pack	-	29.2	42.6

Table 2

Frequency of Antibiotic Types Prescribed Based on Diagnosis in Percentages

Antibiotic	%		
	Acute uncomplicated bronchitis	Streptococcal pharyngitis	Acute unspecified pharyngitis
Amoxicillin	6.2	6.0	5.4
Amoxil	-	35.5	15.1
Augmentin	5.8	6.6	4.9
Biaxin	2.4	-	-
Bicillin	-	10.8	-
Cefadroxil	-	0.6	-
Cefdinir	2.4	3.6	0.5
Ceftin	-	1.2	-
Celestone	-	0.6	-
Cleocin	1.0	-	1.0
Cipro	0.5	-	-
Doxycycline	5.7	-	1.5
Keflex	1.4	0.6	0.5
Levaquin	17.6	0.6	2.0
Lincocin	-	6.6	-
Omnicef	0.5	0.6	-
Pen VK	-	0.6	-
Rocephin	1.0	-	-
Zithromax	23.3	8.4	14.6
Z-Pack	15.2	6.6	21.5
No antiobiotics prescribed	14.8	3.6	33.2

Research question 2. How frequently do primary care providers prescribe antibiotics to patients with diagnoses of J20.9 (acute bronchitis) and JO2.9 (acute unspecified pharyngitis)? The researchers determined how frequently primary care providers were prescribing antibiotics to patients with the diagnosis of acute uncomplicated bronchitis and acute unspecified pharyngitis. After performing a random convenience sampling of 582 medical records, the researchers extracted 208 charts with the diagnosis of acute uncomplicated bronchitis (J20.9) and 210 charts with the diagnosis of acute unspecified pharyngitis (J02.9). For patients diagnosed with J02.9 (acute unspecified pharyngitis), 66.8% (n = 137) were prescribed antibiotics. For patients diagnosed with J20.9 (acute uncomplicated bronchitis), 85.2% (n = 179) were prescribed antibiotics. The types of antibiotics prescribed were shown earlier in Tables 1 and 2.

Research question 3. How frequently do primary care providers order and have documentation of a positive rapid strep antigen detection test before prescribing antibiotics for streptococcal pharyngitis J02.0? The researchers determined how often primary care providers order and have documentation of a positive RADT before prescribing antibiotics for Streptococcal pharyngitis (J02.0). After performing a random convenience sampling of 582 medical records, patients with the diagnosis of Streptococcal pharyngitis accounted for 164 of the charts. Of the patients diagnosed with Streptococcal pharyngitis (J02.0), 96.4% (n = 160) were prescribed an antibiotic. However, only 88.6% of those diagnosed (n = 147) received a positive RADT result.

Appropriateness of prescribing practices. The researchers also sought additional comparative statistical data regarding the appropriateness of the providers

prescribing practices as well as factors influencing prescribing, such as age, gender, race, and insurance type. After performing a random convenience sampling of 582 medical records, data were coded regarding appropriateness to prescribing practices according to the CDC Adult Treatment Recommendations in the treatment of acute uncomplicated bronchitis, acute unspecified pharyngitis, and Streptococcal pharyngitis. If the patient was given a prescription that coincided with the CDC guidelines, they were coded as *Yes Appropriate*. If a patient was given a prescription that did not coincide with the CDC guidelines, they were coded as *Yes Inappropriate*. If the patient did not receive a prescription, they were coded as *No Appropriate* or *No Inappropriate* depending on whether or not a prescription should have been prescribed based on the CDC guidelines. *Yes Inappropriate* is considered overprescribing, and *No Inappropriate* is a missed prescription.

Appropriateness by illness. According to the CDC Adult Treatment Recommendations for acute unspecified pharyngitis and Streptococcal pharyngitis, the appropriate prescribing of antibiotics is when a RADT is positive. On the other hand, for acute uncomplicated bronchitis, treatment should be aimed at controlling symptoms, and antibiotics should not be prescribed regardless of cough duration. Overall frequency of appropriateness of antibiotic prescriptions for each illness is shown in Table 3.

Table 3

Overall Appropriateness of Prescribing Antibiotics by Illness

		Illness		
Rx given?	Appropriate?	% Acute pharyngitis[a]	% Streptococcal pharyngitis[b]	% Acute bronchitis[c]
Yes	Yes	5.4	87.3	N/A
Yes	No	61.5	9.0	85.2
No	Yes	32.7	1.2	14.8
No	No	0.5	2.4	N/A

[a]$n = 205$. [b]$n = 166$. [c]$n = 210$.

Appropriateness by gender and illness. After obtaining and analyzing 582 medical records through random convenience sampling and performing retrospective chart reviews for analysis, the researchers found that there were no statistically significant differences in prescription appropriateness based on gender for acute unspecified pharyngitis as follows: $\chi^2(1, N = 205) = 2.383, p = 0.497$); Streptococcal pharyngitis, $\chi^2(1, N = 166) = 2.042, p = 0.564$); or acute uncomplicated bronchitis, $\chi^2(1, N = 210) = 0.617, p = 0.684$). The differences are shown in Table 4.

Table 4

Overall Appropriateness of Prescribing Antibiotics by Gender and Illness Expressed in Percentages

		Illness					
		% Acute pharyngitis[a]		% Streptococcal pharyngitis[b]		% Acute bronchitis[c]	
Rx given?	Appropriate?	Male	Female	Male	Female	Male	Female
Yes	Yes	4.3	5.9	84.9	88.5	N/A	N/A
Yes	No	59.4	62.5	11.3	8.0	83.6	86.1
No	Yes	34.8	31.6	0.0	1.8	16.4	13.9
No	No	1.4	0.0	3.8	1.8	N/A	N/A

Note. N/A = Not applicable. [a]$n = 205$. [b]$n = 166$. [c]$n = 210$.

Appropriateness by race and illness. After obtaining and analyzing 582 medical records through random convenience sampling and performing retrospective chart reviews for analysis, the researchers determined there was a statistically significant difference in appropriateness of prescribing antibiotics and race for a diagnosis of acute unspecified pharyngitis, $\chi^2(6, N = 205) = 12.988, p = 0.0.43$. African American patients were more likely to be given an inappropriate prescription compared to Caucasian patients. The researchers found there were no statistically significant differences in prescription appropriateness based on race for Streptococcal pharyngitis,

χ^2 (3, *N = 166)* = 3.980, p = 0.264), or acute uncomplicated bronchitis, χ^2 (3, *N = 210)* = 1.603, p = 0.659. Table 5 summarizes the impact of race on appropriate prescribing.

Table 5

Overall Appropriateness of Prescribing Antibiotics by Race and Illness

		Acute pharyngitis[a]			Streptococcal pharyngitis[b]			Acute bronchitis[c]		
Rx given	Appropriate?	W	H	B	W	H	B	W	H	B
Yes	Yes	9.7	3.1	0.0	82.3	90.4				

Note. B = Black, W = White, H or L = Hispanic or Latino. [a]*n* = 205. [b]*n* = 166. [c]*n* = 210.

Appropriateness by insurance type. After obtaining and analyzing 582 medical records through random convenience sampling and performing retrospective chart reviews for analysis, the researchers determined there was a statistically significant difference in appropriateness of prescribing antibiotics based on insurance type for a diagnosis of acute unspecified pharyngitis, χ^2 (12, *N=205)* = 45.451, $p <$ 0.001). Medicaid patients were more likely to receive an inappropriate prescription compared to other patients. However, the researchers determined there were no statistically significant differences in prescription appropriateness based on insurance type for Streptococcal pharyngitis, χ^2(12, *N =166)* = 9.569, p = 0.654), or acute uncomplicated bronchitis, χ^2 (4, *N = 210)* = 2.940, p = 0.568). Table 6 represents the overall appropriateness of prescribing by insurance type for acute unspecified pharyngitis.

Table 6

Overall Appropriateness by Insurance Type for Acute Pharyngitis Expressed in Percentages

		Acute Pharyngitis[a]				
Rx Given?	Appropriate?	Medicaid	Medicare	Commercial	Private pay	None
Yes	Yes	7.1	5.7	3.9	0.0	22.2
Yes	No	83.3	54.3	55.3	56.3	66.7
No	Yes	9.5	40.0	40.8	43.8	0.0
No	No	0.0	0.0	0.0	0.0	11.1

[a] $n = 205$.

Appropriateness by provider type and illness. After obtaining and analyzing 582 medical records through random convenience sampling and performing retrospective chart reviews for analysis, the researchers identified that there was a statistically significant difference in appropriateness of prescribing antibiotics based on primary care provider type for a diagnosis of acute unspecified pharyngitis: χ^2 (6, $N = 205$) = 13.560, $p = 0.035$; Streptococcal pharyngitis, χ^2 (3, $N = 166$) = 28.778, $p < 0.001$; and acute uncomplicated bronchitis, χ^2(1, $N = 210$) = 8.494, $p = 0.004$. The researchers determined that nurse practitioners (NP) were significantly more likely to give an inappropriate prescription for acute unspecified pharyngitis, whereas Medical Doctors (MD) were more likely to give an inappropriate prescription for Streptococcal pharyngitis and acute uncomplicated bronchitis. A small sample size was gathered

from Doctors of Osteopathic Medicine (DO), specifically from the acute pharyngitis subtype. Only 33% of cases were given an antibiotic inappropriately. Ultimately, the researchers determined there was no significant relationship between appropriate prescribing and age of the patient. Table 7 illustrates the overall appropriateness of antibiotic prescribing in relation to primary care provider type and diagnosis.

Table 7

Overall Appropriateness by Provider Type for Illness Expressed in Percentages

		Acute pharyngitis[a]			Streptococcal pharyngitis[b]		Acute bronchitis[c]	
Rx given	Appropriate?	MD	DO	NP	MD	NP	MD	NP
Yes	Yes	2.1	0.0	6.5	63.4	95.2	N/A	N/A
Yes	No	45.8	33.3	66.9	26.8	3.2	98.0	81.3
No	Yes	52.1	66.7	26.0	2.4	0.8	2.0	18.8
No	No	0.0	0.0	0.6	7.3	0.8	N/A	N/A

Note. N/A = Not applicable. [a]$n = 205$. [b]$n = 166$. [c]$n = 210$.

Summary of Findings

Chapter IV presented the researchers' findings from the retrospective review of 582 patient charts from six clinics in Mississippi. Findings from the demographics and research questions were presented in figures. The results of this analysis revealed noncompliance among primary care providers regarding how frequently the CDC's Adult Treatment Recommendations were followed during diagnosis and treatment of acute uncomplicated bronchitis and pharyngitis. The CDC advises against treatment

with antibiotics for acute uncomplicated bronchitis, regardless of cough duration. The researchers found that primary care providers prescribed an antibiotic for the treatment of acute uncomplicated bronchitis for 85.2% of the charts reviewed with MDs being the most likely to inappropriately prescribe inappropriate antibiotic for bronchitis. Also, the CDC recommends against treatment with an antibiotic for pharyngitis if the RADT is negative. Of the charts reviewed, primary care providers treated acute pharyngitis inappropriately (61.5%) and Streptococcal pharyngitis inappropriately (11.4%). Nurse practitioners were more likely to prescribe an inappropriate antibiotic for Acute pharyngitis 66.9% of the time, while MDs were most likely to inappropriately prescribe an antibiotic for Streptococcal pharyngitis 26.8% of the time. These conclusions highlight the need for further provider education regarding the CDC Adult Treatment Recommendations, as well as the opportunity for development of antibiotic stewardship programs within clinics to monitor providers' adherence.

CHAPTER V

Summary, Conclusions, and Recommendations

According to the Centers for Disease Control and Prevention (CDC) (2017), about 2 million people in the United States become infected with antibiotic resistant bacteria each year, and at least 23,000 people die from those infections. Overuse of antibiotics leads to antibiotic resistance, allergic reactions, and adverse events such as *Clostridium difficile*. The CDC launched the Get Smart: Know When Antibiotics Work campaign in 2003 which provides outpatient adult treatment recommendations for providers to follow for appropriate prescription and prevention of resistance of certain diagnoses. The CDC lists the diagnosis of uncomplicated bronchitis and pharyngitis as the most common reasons for patients to visit an outpatient medical setting. Antibiotic resistance infections are associated with greater health care costs, costing the United States $60 billion annually (Lee et al., 2014). The purpose of this study was to determine if primary care providers in Mississippi are following the CDC Adult Treatment Recommendations for antibiotic use in the treatment of acute uncomplicated bronchitis and pharyngitis. According to the CDC, an antibiotic should not be prescribed for acute uncomplicated bronchitis regardless of cough duration. Also, antibiotic treatment is not recommended for patients with negative rapid antigen detection test (RADT) results. Patients should only receive a RADT if they have two or more Centor criteria, such as fever, tonsillar exudates, tender cervical lymphadenopathy, and absence of cough. Each patient encounter is an opportunity for providers to educate patients regarding antibiotic overuse and appropriate prescribing practices. Providers who adhere to the CDC's treatment recommendations for acute uncomplicated bronchitis and pharyngitis will assist in the prevention of future

complications and deaths regarding antibiotic resistant infections. The current research allowed knowledge expansion of antibiotic overuse and providers' prescribing habits. The researchers formulated research questions based on the CDC Adult Treatment Recommendations for the diagnosis and treatment of acute uncomplicated bronchitis and pharyngitis. The purpose of the research project was to determine compliance with the selected recommendations. Compliance was evaluated by the following research questions:

1. How frequently do primary care providers follow the CDC Adult Treatment Recommendations when prescribing antibiotics to adult patients with bronchitis and pharyngitis?
2. How frequently do primary care providers prescribe antibiotics to patients with diagnoses of J20.9 (acute bronchitis) or J02.9 (acute unspecified pharyngitis)?
3. How frequently do primary care providers order and have documentation of a positive rapid strep antigen detection test before prescribing antibiotics for pharyngitis J02.0?

This research was guided by previous studies related to the antibiotic stewardship. Nola J. Pender's Health Promotion Model was the theoretical framework used to guide the current research. One Nola J. Pender study suggests that the majority of deaths in the United States are related to unhealthy behaviors. Pender stated that significant improvements could be made through illness prevention and health promotion. Therefore, providers have a responsibility in educating their patients regarding antibiotic overuse in hopes to prevent antibiotic resistance. Several articles were reviewed regarding the topic of Antibiotic Stewardship. Cocker et al. (2013)

performed a study on clients treated for upper respiratory infections (URI), sinusitis, and pharyngitis to determine practices of overprescribing antibiotics. This study mentioned several factors that may have caused such a low rate of guideline adherence to prescribing antibiotics. These factors included providers possibly disagreeing with the guidelines, providers not having enough time to adequately assess patients, and providers worrying about patient satisfaction results. Arizpe et al. (2016) provided research to identify regional variations and costs of antibiotic prescribing among Medicare Part D beneficiaries. Arizpe et al. found that the highest antibiotic prescription claims were found in Mississippi, and the highest antibiotic prescription cost was also found in the South. Shapiro et al. (2013) performed an analysis of ambulatory care antibiotic prescriptions. Shapiro et. al (2013) provided research to identify the conditions where antibiotics are the most frequently used for respiratory conditions in which antibiotics should not be received. In their study, broad-spectrum antibiotics were chosen > 60% of the time when a prescription for antibiotics was received. Hicks et al. (2015) used regression modeling to examine the association between socioeconomic factors, population health factors, and antibiotic prescribing rates. Hicks et. al hypothesized that health of the population and access to healthcare may explain the geographic variations in antibiotic prescriptions. Hicks et al. (2015) found that counties with higher proportions of obese individuals were more likely to have higher prescription rates and females seek more healthcare attention. Barlem et al. (2015) performed a retrospective analysis to determine predictors of unnecessary antibiotic prescribing for acute respiratory tract infections (ARTIs). This study showed that emergency departments had more visits with ARTIs than hospital and community practices but with less prescribed antibiotics. Barlem et al. (2015) suggested this may

be due to the fact that providers in this area are not as worried about patient satisfaction results as primary care providers who have an established relationship with their patients. This study also showed that patients with a higher education level lead to less inappropriate antibiotic prescriptions. Also, Barlem et al. (2015) found that tobacco users and privately insured patients were more likely to obtain unnecessary prescriptions for antibiotics than those who were non-tobacco users and paid out-of-pocket. Gonzales et al. (2013) performed a cluster randomized study for the purpose of determining the effects of implementing a clinical algorithm in two ways to reduce the number of acute bronchitis cases that were treated with antibiotics. These included PDS (printed decisional support), CDS (computer-assisted decision support), and control. Gonzales et al. (2013) determined there was a decrease in antibiotic prescriptions at both CDS and PDS sites. Vinnard, et al. (2013) performed a quasi-experimental pre-post study with concurrent control groups to identify interventions that would help reduce antibiotic prescribing for upper respiratory infections. They studied the intervention of providers meeting with a pharmacist and an opinion leader in antibiotic use to review literature and provider specific data regarding prescribing practices. Another intervention was mailing educational brochures to selected patients of providers who had the highest number of visits for the diagnoses of acute bronchitis, bronchitis, not specified, cough, acute pharyngitis, and upper respiratory infection not otherwise specified. Rattinger et al. (2012) performed a retrospective observational study for the purpose of assessing the effects of a clinical decision support system (CDSS) on congruence of antibiotic prescribing with acute respiratory tract infection treatment guidelines targeting gatifloxacin and azithromycin. The use of these antibiotics congruent with the guidelines increased. Hingorani et al. (2015) performed a

quality improvement study in an effort to reduce rates of inappropriate antibiotic use for upper respiratory infections, sinusitis, and pharyngitis using a Plan-Do-Study-Act (PDSA). The researchers concluded that simple low-cost interventions led to significant improvement in regard to antibiotic stewardship for ARIs and identified that provider and patient education is a vital part in the progress (Hingorani et al., 2015). Schroeck et al. (2015) performed a retrospective chart review in order to identify if antibiotic prescribing practices for upper respiratory infections (URI) in the outpatient veteran population were adhering to the CDC recommendations set forth in the Get Smart Campaign which aimed to decrease antibiotic resistance. Schroeck et al. provided evidence that current efforts are not efficient in curbing inappropriate antibiotic use. Fleming-Dutra et al. (2016) used the 2010-2011 NAMCS and the NHAMCS to obtain baseline data and estimates in order to determine the rate of outpatient oral antibiotic prescriptions in relation to age and diagnosis. Fleming-Dutra et al. (2016) determined that antibiotics were prescribed to 506 out of 1,000 patients, and half of those were proved to be inappropriate. These previous studies established a foundation that guided the principles of this current research study.

A random convenience sampling of 582 medical records was reviewed to complete this retrospective chart review. Inclusion criteria were as follows: patients with a confirmed diagnosis of acute uncomplicated bronchitis, pharyngitis, or Streptococcal pharyngitis, 18 years of age or older, and in the United States. Data were collected and analyzed in the results section and will be discussed in the following sections: summary and discussion of the findings, conclusions, implications, limitations, and recommendations. The study determined whether or not the selected primary care

providers were following CDC Adult Treatment Recommendations for prescribing antibiotics for diagnoses of acute uncomplicated bronchitis and pharyngitis.

Summary of the Findings

The sample project consisted of 582 patient records. The sample charts were gathered from six primary care clinics in Mississippi during March 2018. The sample consisted of 210 charts with a diagnosis of J02.9 (acute pharyngitis, unspecified), 164 charts with a diagnosis of J02.0 (Streptococcal pharyngitis), and 208 charts with a diagnosis of J20.9 (acute uncomplicated bronchitis). Of the total records reviewed, 66.5% (n = 387) were female patients, while 33.5% (n = 195) were male patients. Ages ranged from 18 to 97 years, with an average age of 48.69 years (SD =18.09). Ethnicity of the patients consisted of White at 60% (n = 352), Black or African American at 38.7% (n = 225), Hispanic at 0.5% (n = 3), and American Indian or Alaskan Native at 0.3% (n = 2). Patients used a variety of payment methods including Commercial insurance 45.2% (n = 263), Medicare 25.3% (n = 147), Medicaid 18.7% (n = 109), Private pay 5.5% (n = 32), and no insurance 5.3% (n = 31). Charts were pulled from a variety of providers including nurse practitioners 75.4% (n = 439), medical doctors 24.1% (n = 140), and Doctors of Osteopathic Medicine 0.5% (n = 3).

The CDC recommends that patients who meet two or more Centor criteria should receive a RADT. Of the patients diagnosed with pharyngitis, 62% (n = 127) received a RADT. For those diagnosed with pharyngitis and received a RADT, 49.6% (n = 63) presented zero Centor criteria, 29.9% (n = 38) presented one Centor criteria, 19.7% (n = 25) presented two Centor criteria, and 0.8% (n = 1) presented three Centor criteria. Of those diagnosed with pharyngitis and did not receive a RADT, 43.6% (n = 34) presented zero Centor criteria, 39.7% (n = 31) presented one Centor criteria, 12.8%

(n = 10) presented two Centor criteria, and 3.8% (n = 3) presented three Centor criteria. The CDC routinely recommends against the prescription of antibiotics with a negative RADT result. Antibiotic treatment was used for 91.7% (n = 11) of patients with a positive RADT, 62.1% (n = 72) patients with a negative RADT result, and 11.9% (n = 54) of patients with no RADT at all. For patients with a diagnosis of acute uncomplicated bronchitis, 85.2% (n = 172) were prescribed an antibiotic. The CDC recommends against treatment of acute bronchitis with antibiotics regardless of cough duration.

Discussion of Findings

A total of 582 charts were reviewed to determine how frequently primary care providers in Mississippi followed the CDC's Adult Treatment Recommendations for Acute pharyngitis, Streptococcal pharyngitis, and acute uncomplicated bronchitis. The researchers also sought to determine how frequently these providers prescribed antibiotics to patients diagnosed with these conditions. To receive an antibiotic with a diagnosis of acute pharyngitis, a RADT must be positive. To receive an antibiotic with a diagnosis of streptococcal pharyngitis, a RADT must be positive. The CDC does not recommend the treatment of uncomplicated bronchitis with an antibiotic regardless of cough duration. A total of 205 cases of acute pharyngitis were reviewed. In 5.4% of cases, an antibiotic was given appropriately for acute pharyngitis. In 61.5% of cases, an antibiotic was given inappropriately for Acute pharyngitis. A total of 166 cases were reviewed for Streptococcal pharyngitis. In 87.3% of cases an antibiotic was given appropriately for Streptococcal pharyngitis. In 9% of cases, an antibiotic was given inappropriately for Streptococcal pharyngitis. This could be likely to the misuse of the Centor criteria scoring. Lastly, in 85.2% of cases, an antibiotic was prescribed

inappropriately for Uncomplicated bronchitis with only 14.8% of providers not prescribing an antibiotic from the 210 cases reviewed.

A random sampling of 582 medical charts was reviewed. The sample population was comprised of more females than males. The gender distribution was 66.5% female (n = 387) and 33.5% male (n = 195). There were no statistically significant differences in prescription appropriateness based on gender for Acute pharyngitis, Streptococcal pharyngitis, or Uncomplicated bronchitis. Of the sample population, 439 of the providers were nurse practitioners, 140 were MDs, and 3 were DOs. There was a statistically significant difference in appropriateness of prescribing antibiotics based on the type of primary provider. Nurse practitioners were more likely to give an inappropriate antibiotic for acute pharyngitis, whereas MDs were more likely to give an inappropriate prescription for bronchitis. There were no significant relations between appropriateness of prescription and the age of the patient.

Limitations

Limitations readily identifiable prior to performing data collection were identified as small sample size, geographically limited data collection, and the use of convenience sampling. As recognized in the methodology section of this study, data were obtained by performing a retrospective chart review from six primary care clinics in Mississippi. The population consisted of adults ages 18 years and older. Data were collected and analyzed from a sample of 582 charts. The study was designed to examine the adherence of primary care providers in Mississippi to the CDC's Adult Treatment Recommendations regarding antibiotic prescribing practices.

The sample size of 582 charts was relatively small and potentially decreased the reliability of generalizing to the entire populous. The study could be repeated to obtain

a larger sample size. The larger sample would most likely represent the actual trend in adherence to the CDC's Adult Treatment Recommendations. Obtaining information from a larger sample consisting of multiple states across the nation would also be beneficial. The study was geographically limited and was unlikely to represent adherence to the CDC's Adult Treatment Recommendations across the nation.

The final limitation known prior to data collection was due to the use of convenience sampling. As it pertains to research, convenience sampling is the weakest form of sampling. Convenience sampling is often a beginning point to lead to further research. In this study, data were obtained from a random sample of charts. This method may not represent the entire population of the clinic nor is it likely to provide strong assumptions of other clinics. However, the method of chart review may be stronger than data obtained by volunteers.

During data collection and analysis, the researchers recognized that a few other limitations existed. The researchers did not assess whether the providers were aware of the CDC's Adult Treatment Recommendations which could have skewed the results. If the provider was not aware the adult treatment recommendations existed, then they could not treat based on the guidelines. Another limitation included the data collection tool. The tool did not take into account the history of the patient. The researchers could not determine if it was an initial or follow-up visit based on the tool. The researchers were also not able to document a history of symptoms, such as fever; the results may have been skewed since the tool based the treatment on presenting symptoms. Another limitation identified with the data collection tool was the order in which the Centor criteria were assessed. Based on the CDC Adult Treatment Recommendations, patients with two or more Centor criteria should receive a RADT. Therefore, the Centor criteria

question should have been prior to the RADT question on the data collection tool. The final limitation which could have skewed the results was the presence of a secondary diagnosis or comorbidities in which an antibiotic was prescribed.

Conclusions

The purpose of this study was to determine if primary care providers in Mississippi were treating acute uncomplicated bronchitis and pharyngitis in accordance with the CDC Adult Treatment Recommendations for antibiotic use in the treatment of acute respiratory tract infections. The study evaluated the charts of patients 18 years of age or older. The study design was a retrospective chart review of 582 charts that were selected based on applicable acute uncomplicated bronchitis, acute pharyngitis, and streptococcal pharyngitis diagnoses in patients treated. Based on research data, the majority of primary care providers in Mississippi were not consistently following CDC guidelines for antibiotic use in the treatment of acute respiratory tract infections. It is plausible that the primary care providers were unaware of CDC's Adult Treatment Recommendations for the diagnosis and treatment of acute uncomplicated bronchitis and pharyngitis. However, it should be noted that ignorance is not accepted by governing bodies, such as the Board of Medicine, the Board of Nursing, and the Drug Enforcement Agency (DEA). The researchers concluded that primary care providers in Mississippi demonstrate a need for heightened awareness and education regarding the CDC Adult Treatment Recommendations for antibiotic prescribing guidelines.

Implications

The incidence of antibiotic overuse has continuously risen to unprecedented levels, which led to the investigation of the epidemiology of the aforementioned trend. This is apparent at the state level as evidenced by inappropriate prescription rates and

the need for continued NP and MD education on prescription recommendations. The problem has gained attention of multiple federal and state agencies. In 2003, the CDC launched The Get Smart: Know When Antibiotics Work campaign which set guidelines for antibiotic prescribing. While the new guidelines are not rule, regulation, or law, prudent medical judgment should be carefully considered when prescribing outside of the CDC recommended criteria.

Previous research has suggested other interventions through using the electronic health record. Some of these interventions previously studied are as follows. One suggested alternative intervention provided a pop-up screen for each patient diagnosed with acute respiratory tract infection stating that antibiotics are not generally indicated for a certain diagnosis. The medical record would then suggest alternative treatment options for the patient. A subsequent alternative included a template for dismissing patients from work, prescription medications such as decongestants, and over-the-counter medications. This behavioral intervention reminded the primary care providers that alternative interventions besides prescribing antibiotics could be utilized. The accountable justification intervention prompted the providers while in the EHR by asking them to free text their treatment decision if an antibiotic was prescribed for a diagnosis of acute respiratory tract infection. The prompt would not be dismissed unless the provider acknowledged it, but the provider could dismiss the antibiotic order which would not create a justification note. This behavioral intervention improved providers' decision-making accuracy on inappropriate antibiotic prescribing due to their accountability and reputation. The peer comparison intervention allowed providers to be ranked from the most to least in appropriate antibiotic prescribing using the EHR data. The providers with the lowest rates of inappropriate antibiotic prescribing

received an email each month stating that they were *Top Performers*. The remaining providers of inappropriate antibiotic prescribing received an email each month stating that they were *Not a Top Performer*. The emails included the amount of prescribed antibiotics that were inappropriate for acute respiratory tract infections compared to those listed by the top performers.

These interventions may be helpful in improving provider adherence to the CDC's Adult Treatment Recommendations. Decreasing the number of antibiotic prescriptions written will help to decrease the overuse that is leading to antibiotic resistance. This research project yielded findings that are incongruent with evidence-based best practice as outlined in the CDC Adult Treatment Recommendations. The implications are that non-adherence continues to place patients at risk for antibiotic resistance.

Recommendations

The researchers advise that this study be repeated with a larger population throughout multiple regions in the United States. The researchers also think it would be appropriate to make sure all providers are aware of the CDC's Adult Treatment Recommendations. The researchers also recommend that the study be repeated annually to determine if there was an increase in adherence to the CDC guidelines. The timeframe for a newly established guideline to be implemented into common practice is typically 2 years. This amount of time should pass before repeating the study. Therefore, the spring of 2020 would be an appropriate delay before a new set of data could be obtained to analyze. This particular research design could be repeated exactly to determine if there was increased adherence in the same region. Any future study should correct the limitations as described above.

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APPENDIX A

Adult Treatment Recommendations

Adult Treatment Recommendations

The table below summarizes the most recent recommendations for appropriate antibiotic prescribing for adults seeking care in an outpatient setting. Antibiotic prescribing guidelines establish standards of care and focus quality improvement efforts.

The table also offers information related to over-the-counter medication for symptomatic therapy. Over-the-counter medications can provide symptom relief, but have not been shown to shorten the duration of illness. They also have a low incidence of minor adverse effects. Providers and patients should weigh the potential for benefits and minor adverse effects when considering symptomatic therapy.

Condition	Epidemiology	Diagnosis	Management

Acute rhinosinusitis[1,2]	• About 1 out of 8 adults (12%) in 2012 reported receiving a diagnosis of rhinosinusitis in the previous 12 months, resulting in more than 30 million diagnoses
	• Ninety–98% of rhinosinusitis cases are viral, and antibiotics are not guaranteed to help even if the causative agent is bacterial.
		• Diagnose acute bacterial rhinosinusitis based on symptoms that are:
		  • **Severe (>3–4 days)**, such as a fever ≥39°C (102°F) and purulent nasal discharge or facial pain;
		  • **Persistent (>10 days) without improvement**, such as nasal discharge or daytime cough; or
		  • **Worsening (3–4 days)** such as worsening or new onset fever, daytime cough, or nasal discharge after initial improvement of a viral upper respiratory infections (URI) lasting 5–6 days.
		• Sinus radiographs are not routinely recommended.
			If a bacterial infection is established:
			• Watchful waiting is encouraged for uncomplicated cases for which reliable follow-up is available.
			• Amoxicillin or amoxicillin/clavulanate is the recommended first-line therapy.
			• Macrolides such as azithromycin are not recommended due to high levels of *Streptococcus pneumoniae* antibiotic resistance (~40%).
			• For penicillin-allergic patients, doxycycline or a respiratory fluoroquinolone (levofloxacin or moxifloxacin) are recommended as alternative agents.

Acute uncomplicated bronchitis[3–5]	• Cough is the most common symptom for which adult patients visit their primary care provider, and acute bronchitis is the most common diagnosis in these patients.	• Evaluation should focus on ruling out pneumonia, which is rare among otherwise healthy adults in the absence of abnormal vital signs (heart rate ≥ 100 beats/min, respiratory rate ≥ 24 breaths/min, or oral temperature≥ 38 °C) and abnormal lung examination findings (focal consolidation, egophony, fremitus). • Colored sputum does not indicate bacterial infection. • For most cases, chest radiography is not indicated.	Routine treatment of uncomplicated acute bronchitis with antibiotics is not recommended, regardless of cough duration. Options for symptomatic therapy include: • Cough suppressants (codeine, dextromethorphan); • First-generation antihistamines (diphenhydramine); • Decongestants (phenylephrine). Evidence supporting specific symptomatic therapies is limited.
Common cold or non-specific upper respiratory tract infection (URI)[6,7]	• The common cold is the third most frequent diagnosis in office visits, and most adults experience two to four colds annually.	• Prominent cold symptoms include fever, cough, rhinorrhea, nasal congestion, postnasal drip, sore throat, headache, and myalgias.	• Decongestants (pseudoephedrine and phenylephrine) combined with a first-generation antihistamine may provide short-term symptom

	• At least 200 viruses can cause the common cold.		relief of nasal symptoms and cough. • Non-steroidal anti-inflammatory drugs can be given to relieve symptoms. • Evidence is lacking to support antihistamines (as monotherapy), opioids, intranasal corticosteroids, and nasal saline irrigation as effective treatments for cold symptom relief. Providers and patients must weigh the benefits and harms of symptomatic therapy.
Pharyngitis[8,9]	• Group A beta-hemolytic streptococcal (GAS) infection is the only common indication for antibiotic therapy for sore throat cases. • Only 5–10% of adult sore throat cases are caused by GAS.	• Clinical features alone do not distinguish between GAS and viral pharyngitis; a rapid antigen detection test (RADT) is necessary to establish a GAS pharyngitis diagnosis • Those who meet two or more Centor criteria (e.g., fever, tonsillar exudates, tender cervical lymphadenopathy, absence of cough) should receive a RADT. Throat cultures are not routinely recommended for adults.	• Antibiotic treatment is NOT recommended for patients with negative RADT results. • Amoxicillin and penicillin V remain first-line therapy due to their reliable antibiotic activity against GAS. • For penicillin-allergic patients, cephalexin, cefadroxil, clindamycin, or macrolides are recommended. • GAS antibiotic resistance to azithromycin and clindamycin are increasingly common. • Recommended treatment course for all oral beta lactams is 10 days.

APPENDIX B

IRB Approval of Mississippi University for Women

The W Mississippi University for Women
A Tradition of Excellence for Women and Men

Provost and Vice President for Academic Affair
1100 College Street MUW-160
Columbus, MS 39701-580
(662) 329-714
Fax (662) 329-7141

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March 29, 2018

Sueanne Davidson, Ph.D.
Mississippi University for Women
College of Nursing and Health Sciences
1100 College Street, MUW- 910
Columbus, Mississippi 39701

Dear Dr. Davidson:

I am pleased to inform you that the members of the Institutional Review Board (IRB) have reviewed the following proposed research and have approved it as submitted:

Name of Study:	Antibiotic Stewardship Among Primary Care Providers in Mississippi
Research Faculty/Advisor:	Sueanne Davidson, Ph.D.
Investigators:	Foley Graham, Hayden Kilgore, Kali Rogers, Sierra Cain, Brittany Dickerson, and Kayla Warner

I wish you much success in your research.

Sincerely,

Thomas C. Richardson, Ph.D.
Provost and Vice President for Academic Affairs

TCR/tc

pc: Tammie McCoy, Institutional Review Board Chairman

APPENDIX C

Consent to Conduct Study

To Whom It May Concern:

We are graduate students in the Family Nurse Practitioner program at Mississippi University for Women in Columbus, Mississippi. As a program requirement, we are conducting a retrospective chart review to assess adherence to CDC Adult Treatment Recommendations regarding antibiotic stewardship. We will be collecting data regarding the use of these recommendations in patients ages 18 years and older with a recorded diagnosis of Acute Uncomplicated Bronchitis (ICD J20.9), Streptococcal Pharyngitis (ICD J02.0), or Acute Pharyngitis, Unspecified (ICD 10 J02.9). We are requesting permission to review medical records within your practice that meet these criteria. We are aware that we will need to maintain the confidentiality of all information collected from the medical records.

We agree to consent to any HIPPA requirements set forth by your practice regarding patient privacy and confidentiality. The data collected from each chart will be recorded on a data collection worksheet to be kept on a confidential electronic flash drive stored in a secure location, with access only to the researchers. At termination of the research project, this information will be destroyed by incineration of the drive per HIPPA guidelines. No clinic or patient identifiers will be used in the study.

Your participation in this study is strictly voluntary. You may withdraw your consent and participation in this study at any time. The result of the study will be made available to you upon completion and may have such beneficial use as a quality assurance measure for your practice.

If you have any questions concerning this study, please contact the following committee members: Alena Lester at 662.299.2985, Lorraine Gaddis at 662.329.7323, Sueanne Davidson Committee Chair) at (205.399.1433, or Foley Graham (Principal Investigator) at 662.803.4455.

Sincerely,

Foley D. Graham, Kali D. Rogers, Kayla L. Warner, Brittany D. Dickerson, Sierra F. Cain, and Hayden S. Kilgore

---

I have read the above letter of consent and agree to the utilization of this clinic for the above-mentioned research project. I understand that HIPPA regulations will be strictly followed, and the confidentiality of each chart chosen will be maintained. I also understand that the results of the study will be made available to me at the project's end.

_____ _____

Name, Title, Signature Date

APPENDIX D

Data Collection Worksheet

Antibiotic Stewardship

1. Demographics

    a. Age of patient? _____

    b. Gender
    _____ Male
    _____ Female _____

    c. Race
    _____ American Indian or Alaska Native
    _____ Asian
    _____ Black or African American
    _____ Hispanic or Latino
    _____ Native Hawaiian or Other Pacific Islander
    _____ White

    d. Insurance
    _____ Medicaid
    _____ Medicare
    _____ Commercial
    _____ Private Pay
    _____ Other (specify)
    _____ None

2. Who was the primary care provider? (Title)
    _____ MD
    _____ DO
    _____ NP
    _____ PA

3. Was the patient diagnosed with Acute Pharyngitis, Unspecified (ICD10 J02.9)?
    _____ Yes _____ No

4. If *yes* to question 3, was an antibiotic prescribed?
    _____ Yes _____ No

5. If *yes* to question 4, which antibiotic was prescribed?
    _____

6. If *yes* to question 3, was a RADT received?
_____ Yes _____ No

7. If *yes* to question 6, was the RADT positive?
_____ Yes _____ No

8. If *no* to question 7, did the patient have 2 or more of the following centor criteria?

Fever:	_____ Yes	_____ No
Tonsillar exudates	_____ Yes	_____ No
Tender cervical lymphadenopathy	_____ Yes	_____ No
Cough	_____ Yes	_____ No

9. Was the patient diagnosed with Streptococcal Pharyngitis (ICD 10 J02.0)?
_____ Yes _____ No

10. If *yes* to question 9, was an antibiotic prescribed?
_____ Yes _____ No

11. If *yes* to question 10, which antibiotic was prescribed?
_____

12. If *yes* to question 9, was a RADT received?
_____ Yes _____ No

13. If *yes* to question 12, was the RADT positive?
_____ Yes _____ No

14. If *no* to question 13, did the patient have 2 or more of the following centor criteria?

Fever:	_____ Yes	_____ No
Tonsillar exudates	_____ Yes	_____ No
Tender cervical lymphadenopathy	_____ Yes	_____ No
Cough	_____ Yes	_____ No

15. Was the patient diagnosed with Acute Uncomplicated Bronchitis (ICD10 J20.9)?
_____ Yes _____ No

16. If *yes* to question 15, was an antibiotic prescribed?
_____ Yes _____ No

17. If *yes* to question 16, which antibiotic was prescribed?