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Inappropriate Antibiotic Use: A Survey of Provider Prescribing Behaviors

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INAPPROPRIATE ANTIBIOTIC USE: A SURVEY OF PROVIDER PRESCRIBING BEHAVIORS

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INAPPROPRIATE ANTIBIOTIC USE: A SURVEY OF PROVIDER PRESCRIBING BEHAVIORS

An Abstract of the Scholarly Project by
Brice I. Saunders

Antibiotics save lives and are one of the most widely used medications of modern medicine. However, the widespread use of antibiotics has led to the development of antimicrobial resistance (AMR). AMR is a major public health crisis with disastrous consequences on national and global healthcare systems. AMR is associated with increased healthcare costs, increased morbidity and mortality, longer hospital stays, increased readmission rates, and overall poorer patient outcomes. The use of antibiotics is the single most important leading factor involved in the development of resistance. Current estimates suggest that at least 30% and up to 50% of all antibiotics prescribed are unnecessary. The majority of antibiotic consumption takes place in the outpatient setting. Acute upper respiratory infections (URIs) are the most common reason for which antibiotics are prescribed in the outpatient setting. However, the majority of common acute URIs are self-limiting, viral infections that rarely require antibiotic treatment. To determine underlying factors involved in prescribing behaviors, a pre-validated survey adapted from Rodrigues et al. (2016) was used to identify and explore provider's knowledge, attitudes, perceptions (KAPs) and prescribing behaviors regarding antibiotic use and resistance in the primary and secondary care setting. The survey was distributed to 116 providers from three separate practice settings in Southeast Kansas and Southwest Missouri. A total of 54 (N=54; 46.6% response rate) provider responses were analyzed using descriptive statistics and univariate analysis of variance (ANOVA). The findings suggest that inappropriate antibiotic use is not the result of provider ignorance or unfamiliarity with clinical practice guidelines. Rather, inappropriate prescribing may better be explained as the result of complex interactions involving both patient-related and provider-related factors. Patient-related related factors include lack of education, satisfaction, and pressure applied on providers to prescribe antibiotics. Provider-related factors include time constraints, patient workload, gender differences, questionable follow-up, and clinical uncertainty. Based on these findings, targeted educational resources and strategies developed by the Centers for Disease Control and Prevention (CDC) were identified and included in the scholarly project.

Keywords: antibiotic overuse, antibiotic resistance, acute upper respiratory tract infections, antimicrobial stewardship, knowledge, attitudes, perceptions, and prescribing practice surveys

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Introduction/Purpose

Description of Clinical Problem/Issue

Antibiotics are one of the most widely used pharmacotherapeutic interventions of modern medicine (Centers for Disease Control and Prevention [CDC], 2013). In the early 20th century, before the discovery of antibiotics, infectious diseases were rampant with pneumonia, tuberculosis, and enteritis representing the three leading causes of death and accounting for more than one third of all deaths in the United States (CDC, 1999). The early 1940's marked the dawn of the golden age of antibiotic discovery (Davies, 2006). Today, acute and chronic non-infectious conditions, such as coronary heart disease, cancer, and chronic obstructive pulmonary disease, account for the leading causes of death in the United States (CDC, 2017). The epidemiological transition from infectious disease to non-infectious disease as the major cause of morbidity and mortality can be traced back to the advent of antimicrobials, widespread vaccination efforts, and advances in healthcare (Mercer, 2014).

However, the widespread use of antibiotics has not come without consequence. The increasing use of antibiotics has led to the development of antimicrobial resistance (Davies, 2006). Antimicrobial resistance (AMR) is described as the phenomenon by which microbes develop the ability to evade the bactericidal effects of antibiotics thereby rendering them ineffective (World Health Organization [WHO], 2017). AMR has been identified as an urgent global issue that threatens the effectiveness of many medical treatments and potentially disrupting the overall integrity of the US health care system. As stated by the WHOs Director-General Chan (2015), “antimicrobial resistance threatens the very core of modern medicine and the sustainability of an effective, global public health response to the enduring threat from infectious disease” (p. 7).

Antibiotic use has been identified as a leading factor involved in the development of resistance (CDC, 2013). The prescription of antibiotics in situations that do not warrant their use must be contained in an overall effort to reduce antibiotic consumption rates. Controlling the rates of antibiotic consumption is the first step in the direction of reducing the incidence and prevalence of antimicrobial resistance (Ritterman, 2006). The identified problem of this DNP scholarly project is the inappropriate use of antibiotics in the primary and secondary care setting leading to the development of resistance.

Significance

Inappropriate antibiotic use is a leading cause of preventable antimicrobial resistance development (CDC, 2013). AMR has disastrous effects on all healthcare systems at the national and international level. AMR has been associated with increased costs, longer hospital stays, post-surgical complications, decreased effectiveness of standard treatments, and increased morbidity and mortality resulting in poorer patient outcomes. In 2013, the CDC estimated the overall cost burden of AMR equated to more than 20 billion a year. In addition, the CDC found that AMR significantly increased morbidity and mortality, estimating that over two million illnesses and 23,000 deaths result from AMR-associated infections every year in the United States alone (CDC, 2013).

It is estimated that 50% or more of all antibiotics prescribed in the United States are unnecessary. Oral antibiotics are most commonly prescribed in the primary care setting, followed by ambulatory prescriptions given in urgent and emergent care settings (Yates et al., 2018). Acute respiratory tract indications (RTIs), a term used to describe a constellation of common presenting symptoms and diagnoses that include the common cold, acute cough, rhinitis, rhinosinusitis, sore throat, and acute bronchitis (Dekker, Verheij, and Van Der Velden, 2015). RTIs are the most common reasons for which antibiotics are prescribed in the primary and secondary care setting (Dekker et al., 2015).

Historically, when exploring the cause and solution to antibiotic misuse, most studies have primarily focused on factors involving the patient (Teiexeira-Rodrigues, Roque, Falcao, Fingueiras, Herdeiro, 2013; Yates et al., 2018). However, the source of antibiotic use is not singular, it involves both the prescribing provider and the receiving patient. It is the ethical responsibility of the provider to prescribe or not prescribe an antibiotic based on the patient's presenting symptoms and diagnosis. Despite numerous clinical guidelines promoting the appropriate use of antibiotics for common respiratory conditions, providers continue to inappropriately and excessively prescribe antibiotics for RTIs (Dekker et al., 2015). More studies are needed to provide greater insight into the complex relationship of provider-to-patient interactions and how these interactions influence antibiotic use in the primary and secondary care setting.

Specific Aim/Purpose

The purpose of this DNP scholarly project is three-fold: 1) to analyze the knowledge, perceptions, and beliefs of provider prescribing behaviors involving the use of oral antibiotics in primary and secondary care settings, 2) to identify facilitators and barriers to appropriate antibiotic use, and 3) to identify target educational resources and strategies focused on enhancing both the appropriate use of antibiotics and awareness of antimicrobial resistance. The major aim of this project is to support the judicious use of antibiotics and enhance provider's awareness and knowledge regarding the impact of inappropriate antibiotic use and the development of resistance.

To identify the factors involved in antibiotic prescribing practices, a cross-sectional observational research design involving the application of a pre-validated survey was employed. The pre-validated survey, previously tested for its validity and reliability, adapted from Rodrigues et al. (2016) was used to enhance the generalizability of the results. The survey addressed various aspects of provider prescribing behaviors and collected information on the following: 1) demographical information, 2) a visual analog agreement scale addressing attitudes and knowledge of antibiotic use and resistance, 3) sources of knowledge to guide the management of patients and prescription of antibiotics, and 4) a blank open-discussion section, allowing providers to express ideas and views of antibiotic use and resistance (Teixeira-Rodrigues et al., 2016).

Various aspects of the survey also addressed provider's perception of facilitators and barriers to appropriate antibiotic use. Questions that addressed factors involving patient pressures/satisfaction, diagnostic tests, unclear follow-up, time constraints, and the availability of educational resources were analyzed to determine provider's perception of the major causes of antibiotic misuse. In addition, inclusion of an open-ended section at the end of the survey allowed providers to address any aspects the survey may have missed and/or provide an opportunity to add any additional recommendations or input.

Analysis of provider responses were used to identify recommendations for reducing inappropriate antibiotic use. Based on the analysis, areas in need of educational intervention were identified. Identified target educational resources and strategies approved by the CDC are provide in the appendices of this project. The educational material presented in this project are intended to provide useful resources of knowledge that both healthcare providers and patients can utilize. The purpose of the target educational resources and strategies are to enhance the awareness of appropriate antibiotic use, antimicrobial resistance, and inform the clinical management of patients in primary and secondary care settings presenting with common RTIs.

Theoretical Framework

In 1991, the author Icek Ajzen, a Professor of Psychology at the University of Massachusetts Amherst, created “The Theory of Planned Behavior” or TPB. The TPB attempts to provide greater insight into explaining human behavior. The theory is guided by three major considerations or concepts, including: 1) behavioral beliefs, 2) normative beliefs, and 3) control beliefs (Ajzen, 1991). As described by Ajzen, behavioral beliefs are an individuals’ attitude toward behavior, and such behavior is affected by the perceived or likely outcomes of performing a behavior. Normative beliefs are influenced by the subjective “norms” or expectations of others and therefore motivate individuals to comply by performing expectant behaviors. The third major concept, control beliefs, is an individual's perceived behavioral control that either inhibits or facilitates behavioral functioning, thereby influencing the enactment of a certain behavior (Ajzen, 1991).

At the pinnacle of these three major concepts is intention and behavior. Intention and behavior are theorized to be the product of attitudes towards behavior, perceived social pressures to perform certain behaviors, and the individual's perception of control over these factors. As stated by Ajzen (2006), the major theoretical assumption is "the more favorable the attitude and subjective norm, and the greater the perceived control, the stronger should be the person's intention to perform the behavior in question" (p.1). For this reason, intention is thought to exist prior to the performance of any behavior and that the perceived control of such factors influencing behaviors can be used to predict the behavior in question.

The predictive theory of planned behavior can be appropriately applied to the subject of antibiotic prescribing by facilitating the process of investigating "why" behaviors are influenced by personal beliefs, societal norms, and perceived control over one's own behavior. To incorporate a change in behavior will require changing the provider's intention by examining the factors that influence prescribing behaviors. The major consideration of societal norms strongly applies to the concept of patient-satisfaction pressures placed on the provider to prescribe antibiotics in unwarranted clinical situations. The perceived control a provider has in regard to antibiotic prescription, in turn, affects their intentions to treat. Thus, personal beliefs and attitudes held by the provider, societal beliefs, patient satisfaction/pressure, and control over one's own behavior all influence the prescription of antibiotics either appropriately or inappropriately. Lastly, the TPB can be used as a theoretical framework for the purpose of predicting behavior, identifying areas in need of behavioral change, and to incorporate strategies to elicit change for the purpose of positively influencing the outcomes of appropriate antibiotic prescribing in the clinical setting. As evidenced by a literature review, the TPB has been utilized as the theoretical framework in multiple studies attempting to explain the behaviors behind inappropriate antibiotic prescribing for the purpose of identifying strategies to improve the appropriateness of antibiotic prescriptions (Cortoos et al., 2012; McIntosh & Dean, 2015; Milos et al., 2013).

Figure 1. Application of Theory

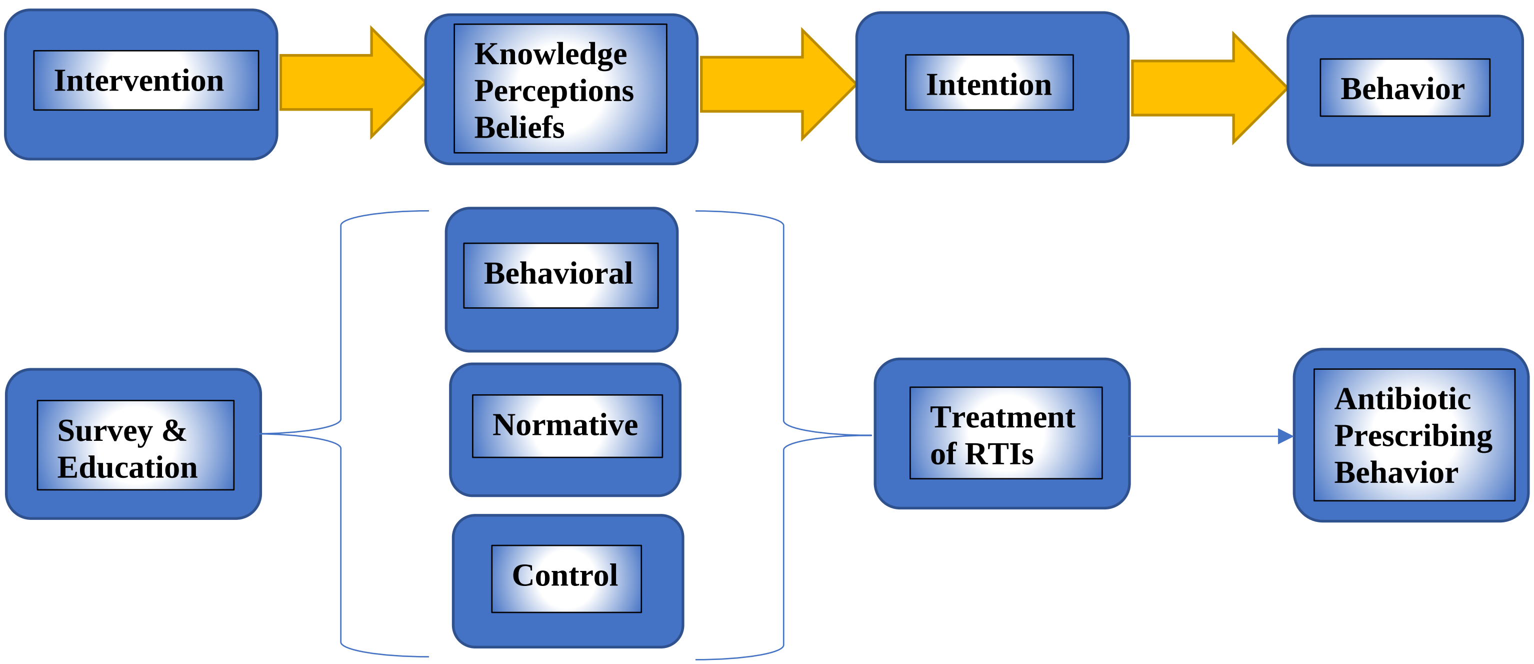

Figure 1: DNP Scholarly project conceptual framework. Demonstrates factors that influence providers prescribing behavior involving the use of antibiotics for common respiratory tract indications (RTIs). Target teaching interventions represent the means by which behavior is changed. Adapted from Icek Ajzen's theory of planned behavior.

Practice Question(s)

- What are the knowledge, attitudes, and perceptions (KAPs) underlying providers prescription of antibiotics for common respiratory indications in the primary and secondary care setting?
- What differences exist between provider characteristics and antibiotic-prescribing behavior and knowledge of antimicrobial resistance in the primary and secondary setting?

Defining Key Terms/Variables

Antibiotic resistance is the phenomenon by which microbes develop the ability to evade the bactericidal effects of antibiotics, thereby rendering them ineffective (World Health Organization [WHO], 2017).

Antimicrobial stewardship is the adoption of principles to ensure responsible antibiotic use through the development of interventional programs committed to using antibiotics only when necessary to preserve the effectiveness and life-saving capabilities of antibiotics for current and future generations (Centers for Disease Control and Prevention [CDC], 2013).

Barriers are perceived obstacles to appropriate antibiotic use.

Educational intervention is the use of pre-approved teaching/educational information from prominent sources, such as the CDC, that is incorporated into the clinical setting to improve the awareness of appropriate antibiotic use and resistance.

Facilitators are perceived catalysts to appropriate antibiotic use.

Inappropriate antibiotic use is the misuse and overuse of antibiotics in the context of prescribing antibiotics against clinical guideline recommendations.

Knowledge, Attitude and Perception (KAP) surveys are focused evaluations using open and closed-ended questions to analyze the beliefs, pre-conceived ideas, and unique experiences of participants to describe a clinical behavior. KAP surveys are useful in providing insight into knowledge gaps, misconceptions, and potential barriers belonging to a particular clinical problem for the purpose of developing focused interventions (WHO, 2008).

Patient Pressure and satisfaction is the provider's feeling of being pressured into prescribing an antibiotic to align with the belief's or expectation of the patient and/or complying with such expectations for the purpose of providing satisfactory care.

Providers include nurse practitioners, physician assistants, and physicians.

Primary and secondary care settings denote the settings in which providers work including primary care offices, community clinics, and secondary acute care settings such as urgent and emergent care departments.

Respiratory Tract Indications (RTIs) are common acute respiratory conditions for which guidelines and recommendations are available to facilitate providers in their treatment and management. RTIs include both common presenting symptoms and actual diagnoses commonly encountered in primary and secondary care settings. RTIs include, acute otitis media, acute sore throat, common cold, acute rhinosinusitis, acute cough/bronchitis (National Institute for Health and Clinical Excellence [NICE] Clinical Guideline, 2008). For the purpose of this project, the term RTI(s) are synonymous and may be used interchangeably with acute upper respiratory tract infections (URTIs) or acute upper respiratory conditions throughout this paper.

Figure 2. Logic Model of Proposed Project

PURPOSE: Explore factors that influence the antibiotic prescribing practices of providers working in primary and secondary care settings caring for patients with common respiratory tract indications (RTIs).

INPUTS

Evidence
Develop a greater understanding of antibiotic prescribing behavior.

Explore knowledge, attitudes and practices (KAP) among providers regarding antibiotic use and resistance.

Interventions to enhance provider awareness of appropriate antibiotic use and resistance.

- Provider Education
- Clinical Practice Guidelines

Major Barriers
Hospital regulations

Provider time-constraints

Major Facilitators
Academic advisors (project committee members)

Emergent & urgent care providers

INTERVENTIONS

KAP Survey
Previously used valid and reliable tool to qualitatively assess provider's antibiotic prescribing behaviors, knowledge of resistance, and preferred clinical management tools to guide practice.

Identify barriers and facilitators to appropriate antibiotic prescribing

Identify target education in need of addressing

Teaching/Education
Dissemination of education based on a needs assessment identified via the KAP survey

OUTPUTS

Participants
Health care providers (NP, PA, DO, MD)

Site
Primary care offices and urgent and emergent care settings located in rural areas of South-East Kansas and a small metropolitan area of South-West Missouri.

Population-Focus
Patients of all ages seeking care for common & acute RTIs.

Estimated Time-Frame
1-2 months

Collection Method
Qualitative surveys

Persons Collecting Data
Student investigator & project committee members

Informed Consent
Obtained from all providers who volunteer to participate in survey

EFFECTS

Outcomes to be measured with valid and reliable tool

Knowledge, attitudes and practices involved in antibiotic prescribing behaviors of providers assessed through the use of a KAP survey developed by Teixeira-Rodrigues et al. (2016).

Statistical Analysis
Frequency distributions of all variables, including provider demographics

P values based on 2-sided test

Chi-squared analysis to test differences in proportions of provider responses

Application of Survey Results
Dissemination of educational material provided by the CDC targeting key variables identified in the analysis of survey responses.

Summary of Chapter I.

Antibiotics play an essential role in the treatment of infectious disease and are one of the most commonly prescribed medications in modern medicine (CDC, 2013). Oral antibiotic consumption is highest in the primary care setting with excessively high rates also being noted in secondary care settings, including urgent and emergent care. In these settings, respiratory tract indications (RTIs), an umbrella of common and acute presenting symptoms and diagnoses, account for the most common reason for which antibiotics are prescribed. Even though the majority of these conditions belong to a viral etiology, it is estimated that over 50% of all antibiotics prescribed for RTIs is unnecessary (Yates et al., 2018).

The use of antibiotics is the single most important factor leading to the development of resistance (CDC, 2013). Antimicrobial resistance (AMR) is a global crisis that has devastating effects on healthcare. AMR is associated with excessive healthcare costs and increased morbidity and mortality, all of which threaten the provision of quality care and adversely affect patient outcomes (CDC, 2013). Decreasing the inappropriate use of antibiotics is essential to controlling the global threat of AMR. To develop effective antimicrobial stewardship interventions, the factors involved in influencing antibiotic use must be identified. Historically, patient factors leading to the misuse of antibiotics have been the focus of many studies (Teiexeira-Rodrigues et al., 2013; Yates et al., 2018). However, inappropriate antibiotic use is not the result of a single factor. It is the provider's responsibility to provide appropriate patient education and prescribe antibiotics judiciously and only when indicated. Furthermore, even though numerous clinical practice guidelines exist, providers continue to inappropriately prescribe antibiotics for common respiratory tract indications at excessively high rates (Sanchez, Roberts, Albert, Johnson, & Hicks, 2014).

Exploring the knowledge, attitudes, and prescribing practices of providers involving the use of antibiotics for patients presenting to primary and secondary care settings with common respiratory tract indications is the purpose of this DNP scholarly project. Through the use of a valid and reliable KAP survey as a measurement tool (Teixeira-Rodrigues et al., 2016), the researcher attempted to identify major factors involved in influencing provider prescribing behaviors, distinguish barriers and facilitators to appropriate antibiotic use, and apply this information to identify target educational resources and strategies. Through the identification of target educational needs, the researcher sought to provide informative information that can be utilized in the clinical setting for the purpose of enhancing provider and consumer awareness of appropriate antibiotic use and antimicrobial resistance.

Chapter II.

Evidence/Integrated Review of Literature

Descriptive literature, relevant studies, and clinical practice guidelines were identified by searching various databases including National Guideline Clearinghouse, PubMed, Cochrane Database of Systematic Reviews, ProQuest Nursing and Allied Health Database, and Cumulative Index to Nursing and Allied Health Literature (CINAHL). The majority of literature reviewed was obtained from PubMed. Search criteria included publications between the dates of 2007 to 2018, peer-reviewed articles, quantitative and qualitative data, and practice guidelines. Additional studies were obtained by reviewing citations provided in the text of the various literature sources reviewed. Although the majority of the studies obtained were conducted in the United States, the search was expanded to include studies from other countries as well. In addition, a variety of educational material was obtained from the CDC's website. Various keywords were used to search for relevant literature within the databases, including: antibiotic resistance, antimicrobial resistance, inappropriate or overuse use, acute upper respiratory tract indications/infections or illnesses, ambulatory or outpatient or primary care settings, acute or urgent or emergency or secondary care settings, knowledge and attitude and perception/practice (KAP) survey, patient satisfaction or pressure, primary care provider, general practitioner, physician, nurse practitioner, prescribing behaviors, evidenced based guideline, and clinical practice guideline.

A total of 36 references (24 articles, eight studies, four guidelines) were included in the integrative review of literature (see Appendix A). The following review of literature is divided into 4 major sections, including: 1) descriptive, 2) critical appraisal of previous studies, 3) clinical practice guidelines, and 4) antimicrobial stewardship and recommendations for providers. The descriptive section includes 23 articles that provides an overview of the discovery and benefits of antibiotics, antibiotic resistance, and the overuse of antibiotics specific to common respiratory tract indications including acute bronchitis, acute rhinosinusitis, acute pharyngitis, and acute otitis media. The second section, critical appraisal of previous studies, includes a total of eight research studies of varying methodology including quantitative, qualitative, and mixed methods research. The third section, clinical practice guidelines, includes four evidence-based guidelines that provide the most current widely accepted recommendations involving the use of antibiotics for acute upper respiratory tract indications. Lastly, the fourth and final section, antimicrobial stewardship and recommendations for providers, includes the CDC's most recent publication on outpatient antimicrobial stewardship program recommendations in the United States.

Antibiotics: Discovery and Benefits

The 1940's was a period of great advancement, expansion of research, and improved therapeutics essential to the progression of modern medicine today. This essential time in medical history, often referred to as the "Golden Era of Antibiotics", marked the introduction of penicillin as the first antibiotic used to treat serious infections.

Since this time, antibiotics have saved millions of lives around the world and have transformed modern medicine (CDC, 2013).

The impact of antibiotics on modern medicine can be demonstrated by retrospectively analyzing epidemiological trends in major morbidity and mortality before and after the introduction of antibiotics. During the 1920's, before the introduction of antibiotics, the average life expectancy was 56.4 years of age and the major cause of morbidity and mortality belonged to infectious diseases (Ventola, 2015). Today, the average life expectancy in the United States is 80 years of age with major morbidity and mortality attributed to chronic diseases including coronary artery disease, malignancies, and chronic lower respiratory disease (Ventola, 2015). Antibiotics save lives and represent a vital component of healthcare in their attribution to the major decreases in morbidity and mortality and increased life expectancy that has occurred over the last century.

The major epidemiological shift in all-cause mortality from the 1920s to today provide a testament to the pivotal role that antibiotics play in the prevention and treatment of infectious disease. The continued effectiveness of antibiotics is essential to many aspects of healthcare. Today, antibiotics play an important role in preventing and treating infections of cancer patients receiving chemotherapy, treating acute infections (especially pneumonia and sexually transmitted infections), as well as the treatment of infections in patients with chronic diseases causing alterations in immunity to fight infections that would commonly resolve in otherwise healthy persons. In addition, the prophylactic use of antibiotics remains essential to improving outcomes of complex surgeries that carry a high risk for infection (organ transplants, joint replacements, and cardiac surgeries). Lastly, antibiotics continue to play an important role in treating and preventing food-borne and poverty-related infections which are often endemic to many developing countries with poor sanitation (Ventola, 2015).

Antibiotic Resistance

The discovery of antibiotics was one of the greatest medical breakthroughs in history and remains a cornerstone of modern medicine (George Washington University, 2017). However, the widespread use of antibiotics has not come without consequence. Antibiotic resistance occurs through a process by which certain strains of bacteria develop the ability to mutate and survive the killing effects of antibiotics thereby becoming resistant to the effects of antibiotics (George Washington University, 2018). Today, antibiotic resistance is one of the greatest public health threats of our time (George Washington University, 2018).

Soon after the discovery of antibiotics and before the introduction of their use in medicine, resistant strains of bacteria to penicillin were noted as early as the 1920's (Ventola, 2015). In the 1950's, substantial development of penicillin-resistance was noted that subsequently led to the development of beta-lactam antibiotics. In 1962, the first case of methicillin-resistant *staphylococcus aureus* (MRSA) was identified. The MRSA threat continued to wreak havoc on the healthcare system, becoming widespread, and eventually leading to the introduction of the antibiotic vancomycin in 1972 for the purpose of treating MRSA infections. In 1979, the first case of bacterial resistance to vancomycin was identified (Ventola, 2015).

Antimicrobial resistance (AMR) is regarded as a natural and expected consequence that occurs in every antibiotic after a period of extended use (George

Washington University, 2018). Just as the resistance developed against penicillin, over the past 70 years, bacteria have shown the ability to develop resistance to nearly every antibiotic that have been introduced into medicine (CDC, 2013). In 2013, in response to the growing threat of AMR the CDC developed a document that categorized various bacterial resistant threats according to their urgency. At the global level, gram-positive resistant bacteria, including MRSA and vancomycin-resistant enterococci (VRE), pose the greatest threat (Ventola, 2015). In the U.S., MRSA kills more persons than HIV/AIDS, Parkinson’s disease, emphysema, and homicide each year combined (Ventola, 2015).

The burden of AMR on the healthcare system and the population as a whole is terrifically disturbing in itself. AMR significantly contributes to increased morbidity and mortality, with more than two million deaths and 23,000 illnesses being attributed to AMR infections each year (CDC,2013). The Antibiotic Resistance Action Center (ARAC) at the Milken Institute of Public Health of George Washington University (2018) stated: “in the next 30 years, antibiotic resistance infections are expected to overtake cancer as a leading cause of death worldwide, and experts predict that based on current estimates, could kill one person every 3 seconds” (p.1). The ARAC predicts that by 2050, an estimated 10 million people will die each year from AMR infections (George Washington University, 2017).

In addition to the major burden on morbidity and mortality, AMR contributes significantly to increased healthcare costs. In the U.S. alone, the economic burden of AMR contributes to $20 billion in excess healthcare costs and $35 billion in lost productivity each year (CDC, 2013). Based on current estimates the ARAC predicts that by 2050, over a $100 trillion in global economic productivity will have been lost due to AMR infections (George Washington University, 2017). AMR also contributes significantly to longer hospital stays and results in higher incidence of long-term disability and reduced patient outcomes (CDC, 2013). Lastly, AMR limits the usefulness of first and second-line therapies resulting in the use of alternative agents that are more expensive and more toxic to the patient (Ventola, 2015).

Multiple factors contribute to the emergence of antibiotic resistance including the following: 1) overuse, 2) inappropriate prescribing, 3) extensive agricultural use, 4) lack of availability of new antibiotics, and 5) regulatory barriers (Ventola, 2015). The overuse of antibiotics is the single most important factor leading to the development of resistance (CDC, 2013) and will be further discussed in the following section. The inappropriate prescription of antibiotics significantly contributes to the overuse of antibiotics and is the focus of this scholarly project. The extensive use of antibiotics for agricultural purposes to promote growth is a central issue that is often the focus of agenda produced by the U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) that is beyond the scope of this scholarly project. The lack of antibiotic research and development and regulatory barriers placing strains on pharmaceutical companies that impede the introduction of new antibiotics being placed on the market are additional contributory factors that will briefly be discussed in the next paragraph.

In response to the growing concerns for AMR, the 1960's to 1980's saw a surge of antibiotic research and development by pharmaceutical companies to address the resistance problem. The periodic introduction of new antibiotics enhances the access of antimicrobials practitioners have at their disposal and allows providers, clinics, and hospitals to alter their use of antimicrobials resulting in lower resistance rates and better clinical outcomes (Livermore, 2004). However, as Ventola (2015) states: "the number of new antibiotics developed and approved has decreased steadily over the past three decades, leaving fewer options to treat resistant bacteria" (p. 279). Major pharmaceutical companies are abandoning the antibiotic field largely due to economic and regulatory obstacles. Antibiotics, which are often curative for acute conditions, are seen as a poor investment for pharmaceutical companies due to their lack in need for extended use and low profitability when compared to drugs used to treat chronic conditions. In addition, for the few pharmaceutical companies interested in developing new antibiotics, regulatory barriers enforced by current practices of regulatory bodies such as the FDA represent a major barrier for newly developed antibiotics to receive approval. To summarize, lack of economic relevance, obstacles posed by regulatory bodies, and a lack of consistency in policies and incentives to promote the introduction of new antibiotics all contribute to a decline in antibiotic research and development (Ventola, 2015).

Overuse of Antibiotics

As previously stated, the overuse of antibiotics is the leading factor involved in the development of resistance (CDC, 2013). AMR is a natural and expected consequence that occurs in every antibiotic after a period of continued use (Merk, 2015). Antibiotics are a highly effective but limited resource. Epidemiological studies show a direct relationship between antibiotic consumption and the development of resistant strains of bacteria (Ventola, 2015). Historically, epidemiological studies reveal that the more antibiotics are used, the more quickly bacteria develop resistance, and the less likely antibiotics will remain effective in the future (CDC, 2013).

Antibiotics are the most common medications prescribed in modern medicine today. However, an estimated 50% of all antibiotics prescribed are unnecessary and the use of antibiotics has been found to be the single most important factor leading to AMR (CDC, 2013). The exposure of antibiotics to bacteria can induce resistance spontaneously through mutations in genes and alterations in surface proteins (Ventola, 2015). These mutated genes can be transferred to other bacteria causing them to become resistance. Strains of antibiotic resistant bacteria can be passed from person-to-person, can cross international boundaries, and spread between continents with remarkable speed and ease (CDC, 2013).

Antibiotic resistance has been described as "nightmare bacteria" that "pose a catastrophic threat" to persons in every country around the world (CDC, 2013, p.11). As antibiotics continue to be overused and AMR is allowed to continue, antibiotics used to treat once common and non-threatening infections are beginning to lose their effectiveness and may soon not work at all. The CDC (2013) describes that when the ability of antibiotics to effectively fight infections is lost, the ability to offer "many life-saving and life-improving modern medical advantages will be lost with it" (p. 24).

In 2010, the U.S. population consumed an estimated 22.0 units (one unit equaling one pill or ampule) of antibiotics per person. Astonishingly in some states, the number of antibiotics prescribed per year exceeded the entire population of that state (Ventola, 2015). Despite recent efforts to curtail the overuse of antibiotics, trends of continued inappropriate antibiotic use continue to occur at high rates. It is estimated that 80-90% of antibiotic consumption by volume occurs in the outpatient setting (CDC, 2018). In 2016, 270.2 million courses of antibiotics were dispensed to outpatient pharmacies, equally 836 prescriptions per every 1,000 persons in the U.S. (CDC, 2018). Of these antibiotics prescribed in the various outpatient settings, one in three were unnecessary, equally 47 million inappropriate prescriptions per year (PEW Charitable Trust, 2017).

Local outpatient prescribing practices contribute significantly to local resistance patterns (CDC, 2018). Evidence collected via local outpatient isolates and anti-biogram data reveal that areas with greater rates of antibiotic consumption have higher rates of bacterial resistance (Sorensen, 2018). Antibiotic consumption is highest in the South-Central region of the U.S. and decreases as you move towards the Western region (CDC, 2018). The CDC found that prescribing is greatest in the winter months and acute respiratory tract indications (RTIs) are the most common reason for which antibiotics are prescribed, including: acute rhinosinusitis, acute bronchitis, common cold or non-specific upper respiratory tract infections (URI), pharyngitis, and acute otitis media (AOM) (CDC, 2018). The two most common antibiotics prescribed in the outpatient setting are Azithromycin and Amoxicillin (CDC, 2018).

In the U.S. acute respiratory indications or infections (RTIs) are the most common reason for which antibiotics are prescribed in the outpatient setting. (CDC, 2018). Most ARIs are due to a self-limited viral etiology and an estimated two-thirds of primary care visits for ARIs are not necessary for appropriate antibiotic management (Renati & Linder, 2016). Despite most RTIs being attributed to a viral origin, antibiotics are prescribed in 40% to 50% of patient encounters presenting with upper respiratory complaints (Hart, 2007). The following paragraphs will briefly address the etiology and epidemiology of common acute respiratory indications seen in primary and secondary care settings. Recommendations and current clinical practice guidelines addressing the various RTIs will also be included in a later section.

The “common cold” is a benign non-specific viral infection predominantly affecting the upper respiratory tract (Hart, 2007). It is the most frequently encountered acute illness in the U.S. (Sexton & McClain, 2019). This viral syndrome produces variable degrees of nasal congestion, rhinorrhea, sneezing, sore throat, cough, headache, malaise and low-grade fever (Sexton & McClain, 2019). Less than two percent of cases are complicated by bacteria and the use of antibiotics have not been shown to shorten the course of the illness (Hart, 2007). Despite evidence strongly discouraging their use, antibiotics continue to be prescribed in practices throughout the U.S. for this self-limited condition (Sexton & McClain, 2019). A retrospective study of over 180,000 patients presenting with non-specific respiratory complaints found that the majority of these complaints were due to the common cold, yet 46 percent of these patients received a prescription for an antibiotic (Silverman et al., 2017).

Acute Rhinosinusitis; commonly known as “sinusitis” or simply a sinus infection; is defined as an inflammation of the nasal mucosa and paranasal sinuses lasting less than four weeks in duration (Hart, 2007). It is one of the most common conditions treated in the ambulatory care settings and the fifth most common diagnosis for which antibiotics are prescribed in the U.S. (Aring & Chan, 2016). Most cases of acute rhinosinusitis are attributed to a viral etiology with less than two percent from a bacterial origin (Aring & Chan, 2016). In a study of 33,273 patients presenting with RTI complaints, 1,150 were found to have acute rhinosinusitis. Of these 1,150 patients, results revealed that over 50 percent received an inappropriate prescription for an antibiotic (defined as mild symptoms for less than 5 days with or without fever) (Jorgensen, Christensen, Currea, Llor, & Bjerrum, 2013).

Acute Bronchitis is defined as a clinical diagnosis with predominant symptom of cough lasting two to three weeks caused by inflammation of the trachea and large airways in the absence of pneumonia (Kinkade & Long, 2016). Acute bronchitis is a very common condition encountered in the clinical setting. In the U.S., it is among the top ten most common acute illnesses accounting for 10 percent of ambulatory care visits (Singh & Zahn, 2018). Peak incidence occurs in late fall and winter when transmission of respiratory viruses is highest (File, 2018). An estimated 95 percent of acute bronchitis cases are due to a viral etiology (Singh & Zahn, 2018). Studies show that only one to 10 percent of cases are due to bacterial infection (Kinkade & Long, 2016). For this reason, current guidelines recommend against the prescription of antibiotics for uncomplicated acute bronchitis. Despite these recommendations, antibiotics continue to be prescribed at excessively high rates. In a study conducted on 3,616 visits for uncomplicated acute bronchitis from the years 2011 to 2016, results found that 2,244 (62.1%) of these visits resulted in a prescription of an antibiotic (Grigoryan et al., 2017).

Acute pharyngitis is a common acute upper respiratory illness with the predominate symptom of sore throat and accounts for 12 million (1-2%) of ambulatory care visits each year in the United States (Chow & Doron, 2018). Acute pharyngitis is most common in the pediatric population with 50% of all cases occurring before the age of 18 years (Chow & Doron, 2018). Respiratory viruses are the most common cause, with approximately 25 to 45 percent of cases being due to a viral etiology (Chow &

Doron, 2018). Group A Streptococcus (GAS) is the most common bacterial etiology accounting for five to 15 percent of cases (Chow & Doron, 2018).

Distinguishing between the two most common causes is essential to the management of acute pharyngitis because GAS is treated with antibiotics and viral pharyngitis is treated with supportive measures. In a large study of 1,644 patients of two major health centers in Indonesia, 226 patients (13.77%) were diagnosed with strep pharyngitis, 1,179 patients (71.85%) were infected by viruses, and in 236 (14.38%) patients the etiology could not be determined (Yuniar, Anggadiredja, & Islamiyah, 2017). Results of the study revealed that 50 percent of all antibiotics prescribed for these 1,644 patients were given to patients with viral pharyngitis (Yuniar, Anggadiredja, & Islamiyah, 2017). Suspected cases of GAS should be evaluated with the use of a rapid antigen test (RADT) to confirm a bacterial etiology and avoid the inappropriate use of antibiotics (Chow & Doron, 2018). RADT negative results should be treated with supportive measures only (Chow & Doron, 2018).

Acute Otitis Media (AOM) is an infection or inflammation of the middle ear and structures (Harmes et al., 2013). AOM is a leading cause of episodic visits in the ambulatory care setting and is the most common reason for which antibiotics are prescribed in children (Pelton, 2019). A study examining the incidence of AOM from the years 2008 to 2014 in the U.S. found the overall annual rate of AOM-related visits to be 60.5 per 1000 persons-years with the majority of visits taking place in the office/outpatient setting (55.7 per 1000 persons-years) (Tong, Amand, Kieffer, & Kyaw, 2018). Peak incidence of AOM occurs between six to 18 months of age, and declines thereafter becoming increasingly infrequent after age seven (Pelton, 2019). The most common pathogens involved in AOM infections are *Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis*, and *Group A Streptococcus* (Leibovitz, Broides, Greenberg, & Newman, 2010). Due to the high incidence of antibiotic consumption for AOM, antibiotic resistance has become a major concern with an estimated 30 to 70% of *S. pneumoniae* strains being resistant to penicillins and macrolides, and an estimated 20 to 40% of *H. influenzae* strains being beta-lactamase-producing (Leibovitz et al., 2010).

Due to the concerns for development of high rates of resistance in common pathogens responsible for AOM, stringent guidelines have been developed that call for clinicians to carefully consider specific criteria before prescribing an antibiotic (Pelton, 2019). Most notably, is the concept of "watchful waiting" or delayed prescribing. Using this strategy, the parent is given a prescription for an antibiotic and is told to fill and initiate the prescription only if their child's symptoms persist or worsen over a 48 to 72-hour period (Pelton, 2019).

Inappropriate Prescribing & Clinician's Knowledge, Attitudes, and Perceptions (KAP)

The following section represents an analysis of previous studies and their findings. Three quantitative studies that analyze rates of inappropriate antibiotic prescribing, four qualitative studies analyzing clinician's knowledge, attitudes, and perceptions (KAP) regarding antibiotic prescribing, and one mixed-method study of both antibiotic prescribing rates and clinician's KAPs will be included in this analysis. The order of the following sections is as follows: quantitative, mixed-methods, then qualitative studies.

A study published in 2016 titled "Prevalence of Inappropriate Antibiotic Prescription Among U.S. Ambulatory Care Visits, 2010-2011" used a quantitative observational design to examine population-adjusted antibiotic (ABX) prescribing rates in the United States from the years 2010 to 2011 (Fleming-Dutra et al., 2016). The objective of the study was to estimate total rates of oral antibiotic prescriptions and determine the proportion of annual inappropriate antibiotic prescriptions per 1000 persons in the U.S. ambulatory care setting. The method of measuring antibiotic prescription rates was done via the analysis of U.S. ambulatory care visits (n = 184,032) using two national surveys, including: 1) the 2010-2011 National Ambulatory Care Survey (NAMCS), and 2) the 2010-2011 National Hospital Ambulatory Medical Care Surveys (NHAMCS) (Fleming-Dutra et al., 2016). Annual numbers and population-adjusted rates of ambulatory visits with oral antibiotic prescriptions by age, geographical region, and diagnoses were estimated. The data was then analyzed against national guidelines and regional variations in prescribing to determine proportions of antibiotic prescriptions and their appropriateness.

Of the 184,032 visits, 12.6% resulted in an antibiotic prescription. Acute respiratory conditions had the highest absolute ABX prescriptions, with the diagnosis of sinusitis having the most ABX prescriptions per 1000 population followed by otitis media, then acute pharyngitis. A total of 221 ABX prescriptions were given annually for acute respiratory disorders, but only 111 were estimated to be appropriate (50%) (Fleming-Dutra et al., 2016). Combining all ages and conditions in 2010-2011, an estimated 506 ABX prescriptions were given annually and only 353 were considered appropriate (69%) (Fleming-Dutra et al., 2016). Thus, the authors concluded that 50% of all antibiotics prescribed for acute respiratory conditions were unnecessary, and 31% of all ABX prescribed annually for all ages and diagnoses were inappropriate (Fleming-Dutra et al., 2016). The estimate results of the study provide evidence supporting the urgency of ABX misuse, supports the notion that most inappropriate antibiotic use occurs in acute respiratory conditions, and reinforces the need for establishing out-patient antibiotic stewardship programs (Fleming-Dutra et al., 2016).

A study titled “Outpatient Antibiotic Prescribing Among United States Nurse Practitioners and Physician Assistants” also employed the use of the NAMCS and NHAMCS national surveys to collect data on outpatient antibiotic prescribing (Sanchez, Hersh, Shapiro, Cawley, & Hicks, 2016). However, this quantitative study analyzed antibiotic prescribing rates in the U.S. ambulatory care setting according to specific provider type (Nurse Practitioners [NP], Physician Assistant [PA], and Physician). Using the NAMCS/NHAMCS, data collected from 1998 to 2011 was used to assess trends in ambulatory visits by provider type. Data collected from 2006-2011 was used to assess both overall proportions of antibiotic prescribing rates for all ambulatory care visits as well as antibiotic prescribing rates for acute respiratory tract infection (ARTI) visits (Sanchez et al., 2016).

A total of 1,301,474 visits were sampled, of this sample 6.3% involved NPs or PAs. Over the study period, the proportion of NP/PA visits more than doubled in the ambulatory care setting and more than tripled in the emergency care setting (ED or ER) (Sanchez et al., 2016). The observed increase in non-physician visits provides a testament to the rapid expansion of the NP and PA role in ambulatory and emergency care settings.

The study also found that higher proportions of visits resulted in antibiotic prescription when a non-physician provider was involved.

When compared to physicians, NPs/PAs are more likely to prescribe antibiotics in all ambulatory care visits (17% for NP/PA vs 12% for physicians). In visits involving ARTI diagnoses, NPs/PAs are more likely to prescribe antibiotics when compared to physicians (61% for NP/PA vs 54% for physicians). Even after using a multi-variable logistic regression analysis controlling for patient and practice-level variables, the authors still found that NPs or PAs had independently higher odds of prescribing antibiotics (odds ratio = 1.13) (Sanchez et al., 2016). The importance of prescribing behaviors as a leading difference in the proportions of antibiotics prescribed by non-physician providers was emphasized by the authors Sanchez et al. (2016) in the following remark:

> Elements of antibiotic stewardship are often included in NP, PA, and physician curricula, suggesting that potential differences in antibiotic prescribing are more likely due to practice environment, learned clinical behaviors, or differences in patient communication rather than medical education. (p.2).

A study published in 2019 titled "Variability of Antibiotic Prescribing in a Large Healthcare Network Despite Adjusting for Patient-Mix: Reconsidering Targets for Improved Prescribing" used a quantitative cross-sectional design to study patient encounters presenting with diagnoses of acute respiratory infections (ARIs) in 15 primary care clinics belonging to a large healthcare network located in Atlanta, Georgia between the years 2015 to 2017 (Jung, Sexton, Owens, Spell, & Fridkin). The objective of the study was to identify predictors of inappropriate antibiotic prescribing for ARIs in the outpatient setting (Jung et al., 2019). Variables included ARIs diagnoses distinguished by

ICD-10 codes, patient-level variables categorized by age, race, and comorbid conditions, as well as provider-level variables categorized by professional training (physicians, NPs and PAs, and resident physicians) (Jung et al., 2019). To evaluate the appropriateness of antibiotics, antibiotic-appropriate ICD-10 codes were excluded, including sinusitis, pharyngitis, and tonsillitis (Jung et al., 2019).

Over the course of the two-year study period, a total of 9,600 patient visits (N=9,600) were seen by a total of 109 providers. A multi-variable logistic regression analysis was used to identify predictive characteristics of antibiotic prescribing. Of the 9,600 patient encounters, more than half (53.4%) resulted in an antibiotic prescription. Median provider prescribing rates remained high (43%) even after modifying variables to include only ARI ICD-10 codes that were deemed antibiotic-inappropriate (Jung et al., 2019). Using an adjusted odds ratio (aOR), antibiotic prescribing rates were found to be higher whites (aOR=1.59), patients 51 years or older (aOR=1.32), and those with comorbid conditions (aOR=1.19). According to provider-type, antibiotic prescribing rates were lowest in resident physicians, while no difference was found to exist between NPs/PAs and physicians (Jung et al., 2019).

The study found that significant predictors of antibiotic prescribing included: 1) Caucasian race, 2) older age, and 3) presence of comorbid conditions (Jung et al., 2019). More than 50% of patients with a diagnosis of ARI received an antibiotic during the two-year study period. Based on an ARI target prescribing rates of 20% or less, the data suggests that 30% or more of these 9,600 patients unnecessarily received an antibiotic. The authors commented on the finding of prescribing rates being lowest in resident physicians, stating that this was likely the result of required rotations with infectious disease specialists' that residents must fulfill during their training through this particular healthcare network. The authors indicate further investigations should be sought on provider knowledge, beliefs, and attitudes (KAPs) as the evidence suggests these factors may play a significant role in the appropriateness of antibiotic prescribing (Jung et al., 2019).

A mixed-methods observational/research study titled "Inappropriate Antibiotic Prescription for Respiratory Tract Indications: Most Prominent in Adult Patients" aimed to both quantify and qualify inappropriate antibiotic prescriptions for respiratory tract indications (RTIs) among general practitioners (GPs) caring for adults in the primary care setting (Dekker, Verheij, & Van Der Velden, 2015). During a two-year study period in the years 2008 to 2010, data was obtained from a total of 2,724 RTI visits (n=2,724) with GPs from 48 Dutch primary care clinics. GPs were asked to provide various aspects of clinical data via an online registry for patients presenting with RTIs. All patients presenting with acute RTIs in which specific evidence-based guidelines (AOM, ARS, sore throat, and acute cough) were included. Recommendations from national guidelines were used as a benchmark to classify GPs prescribing decisions as correct or incorrect. In addition to clinical practice guidelines used to benchmark data, presenting signs and symptoms, patient characteristics (age, medical history, expectations of antibiotics, etc.), and disease severity were also considered in an analysis of the results (Dekker, Verheij, & Van Der Velden, 2015).

The results revealed that of the 2,724 RTI visits, 46% received an antibiotic that was not indicated by clinical practice guidelines. Over-prescribing was highest in ICD diagnoses bronchitis and tonsillitis. Adults aged 18 to 65 years received the highest proportion of antibiotic over-prescriptions and this trend was found to increase with age. Amoxicillin was the most commonly prescribed antibiotic in children and doxycycline was most commonly prescribed in the elderly. In terms of qualitative data, GPs cited the most common reasons for which an antibiotic was prescribed was due to patient expectations of an antibiotic, presence of fever, and symptom duration greater than one week. Of these three qualitative measures, patient pressures from expectations of receiving an antibiotic was the strongest determining factor in the inappropriate prescription of an antibiotic (Dekker, Verheij, & Van Der Velden, 2015).

In a qualitative study sponsored by the CDC titled "Effects of Knowledge, Attitudes, and Practices of Primary Care Providers on Antibiotic Selection, United States" conducted open-ended interviews with 36 primary care providers to explore their knowledge, attitudes, and self-report practices and the influence these factors have on the appropriateness and selection of antibiotic drugs (Sanchez, Roberts, Albert, Johnson, & Hicks, 2014). Participants included 27 physicians, five NPs, and four PAs. Interview questions addressed the following factors: self-reported antibiotic prescribing practices, attitudes towards clinical practice guidelines (CPGs), knowledge of narrow versus broad-spectrum antibiotics, preferred educational resources utilized in practice, and attitudes towards antimicrobial resistance (Sanchez et al., 2014). Participants were asked to rank 12 factors that influence their prescription of antibiotics from greatest to least influence. Lastly, clinical scenario questions were asked to assess compliance with CPGs and clinicians were asked to provide input on strategies to improve antibiotic prescribing (Sanchez et al., 2014).

An analysis of responses revealed that providers were aware of the antimicrobial resistance (AMR) threat and had a good understanding of CPGs, yet many admitted to intermittent non-compliance with these recommendations when prescribing antibiotics. Provider concerns for patient satisfaction and pressures was the most commonly perceived reason for inappropriate antibiotic prescribing (Sanchez et al., 2014). Fear of complications and low-confidence in prescribing abilities were factors commonly cited that lead to the prescription of broad-spectrum antibiotics. There was a consensus agreement among the providers that AMR is a major health care issue, however, resistance is not commonly considered when selecting antimicrobial therapy. Lastly, the majority of providers agreed that the best way to change prescribing behaviors is to alter the expectations of patients to reduce the pressures applied on providers to prescribe antibiotics (Sanchez et al., 2014).

In a research study titled “Physicians’ Attitudes and Knowledge Concerning Antibiotic Prescription and Resistance: Questionnaire Development and Reliability” the authors aimed to develop a reliable and valid questionnaire instrument to assess the attitudes and knowledge underlying physician antibiotic prescribing behaviors in both primary and hospital-based care settings (Teixeira Rodrigues et al., 2016). The study was conducted in September 2013, using a convenience sample of 61 primary care physicians and 50 hospital physicians (N=111) located in Portuguese. The survey’s development and validation process was divided into two major steps, including: 1) content and face validation, and 2) reliability analysis. Content validity was achieved through a literature review and an analysis of previous qualitative studies conducted by a panel of experts (n=10). To achieve face validity, a panel of clinical psychologists and linguist experts reviewed the selected literature. To analyze the reliability of the survey, a pilot study was conducted, and a re-test study was performed two to four weeks later (Teixeira Rodrigues et al., 2016).

The response rate of primary care physicians included, 1) pre-test 64% (n=39), and 2) re-test 49% (n=30). The response rate of hospital care physicians included, 1) pre-test 66% (n=33), and 2) re-test 60% (n=30). Using strategies to ensure content validity resulted in nine changes to the professional concepts section of the questionnaire. Face validity resulted in a total of 19 changes to the linguistic and interpretive terms of the questionnaire. Results of the reliability analysis included: 1) internal validity via Cronbach alpha value (α >0.70) was considered satisfactory, and 2) intraclass correlation coefficient (ICC) values indicated fair to good reproducibility (ICC >0.4). The final questionnaire included the five following sections: Section 1—instructions for completion of questionnaire, Section 2—17 statements on agreement via visual analog scale (VAS) regarding attitudes and knowledge of antibiotic prescribing, use, and resistance, Section 3—nine statements regarding the importance of various sources of knowledge used for antibiotic prescribing, Section 4—demographic and professional information of the physician completing the survey, and Section 5—a blank section allowing participants to express ideas and views of antibiotic use and resistance (Teixeira Rodrigues et al., 2016).

Historically, many questionnaires have been used to assess physician attitudes and knowledge regarding antibiotic use and resistance, however most lack full validation. The authors aimed to develop a reliable and valid measurement tool to identify underlying factors regarding antibiotic prescriptions and resistance. Using the strategies outlined above, analysis of the questionnaire revealed content and face validity was reliable in terms of internal consistency and reproducibility (Teixeira Rodrigues et al., 2016). For these reasons, the questionnaire developed by Teixeira Rodrigues et al. (2016) (see Appendix B) was adapted and used for the purpose of this DNP scholarly project for collecting data on the knowledge, attitudes, and perceptions (KAP) of provider prescribing behaviors (see Appendix C).

In a study titled "Not a Magic Pill: A Qualitative Exploration of Provider Perspectives on Antibiotic Prescribing in the Outpatient Setting" the authors used a qualitative phenomenological perspective design through semi-structured interviews with key informants to examine provider antibiotic prescribing behaviors (Yates et al., 2018). The key informants interviewed included a total of 17 outpatient providers, including 10 physicians and seven advanced care practitioners covering a large healthcare system in North Carolina. The three objectives identified in the study included the following: 1) investigate the factors involved in influencing provider prescribing decisions, 2) identify potential strategies recommended by providers to address the issue of inappropriate antibiotic use, and 3) inform clinical management of patients with infections that do not require an antibiotic prescription in the outpatient setting (Yates et al., 2018).

The results were divided into themes based on a consensus of recurring provider responses. Key factors in antibiotic decision making included: clinical presentation with acute signs and symptoms, best practices based on current evidence, the age of the patient and presence of comorbidities, and workflow of the clinical setting. Factors considered essential in communicating with patients included: viral versus bacterial infections, the disease course, role of symptomatic relief, signs and symptoms to watch for and report, and follow-up. Recommended factors to assist patients in the relief of symptoms included: the use of over-the-counter (OTC) medications, personal care, and increased fluids and rest. All of the providers perceived that patient expectations of receiving an antibiotic is high and believe most patients deem antibiotics are necessary for a quick fix regardless of the etiology causing their illness. Identified barriers to appropriate antibiotic prescribing included: patient education and expectations, concerns of system-level demands to see more patients, and time-constraints. The source of knowledge providers used to make prescribing decisions included clinical practice guidelines and decision support tools. Lastly, the majority of the providers believed antibiotic resistance was a major issue and believed requirements of antibiotic use reporting and system-wide strategies to improve prescribing behaviors would be well received by most practicing clinicians (Yates et al., 2018).

Based on the study's findings, the authors concluded a myriad of factors are involved in influencing provider's antibiotic prescribing decisions. In regard to inappropriate antibiotic prescribing, among the most influential factors involved patient satisfaction, pressures, and expectations. The authors recommend education targeting both patients and providers is essential to the success of any antimicrobial stewardship program (Yates et al., 2018).

In the last study examined, titled "Clinicians' Beliefs, Knowledge, Attitudes, and Planned Behaviors on Antibiotic Prescribing in Acute Respiratory Infections", a qualitative study design was used to examine provider perceptions regarding appropriate antibiotic use as well as to identify provider acceptability of proposed ASP interventions aimed to improve the use of antibiotics for the treatment of ARIs in the outpatient setting

(Hruza et al., 2018). The authors collected data using one-on-one interviews with providers (n=20) working in emergency departments, primary care, and community-based clinical settings of five VA Medical Centers in the U.S. conducted in May-July 2017. The semi-structured interview questions were developed using the Theory of Planned Behavior (TPB) to assess providers' beliefs and attitudes, behavioral control, perceptions of societal norms, and planned future behaviors for managing ARIs (Hruza et al., 2018).

Results on beliefs and attitudes revealed that providers positively perceived ASP efforts and believed strategies such as audit-feedback and tools to improve antibiotic prescribing practices would be well received. Perceived barriers to appropriate antibiotic prescribing included patient demands, time constraints, and resource limitation. In terms of behavioral control, providers felt they had full control over either prescribing or withholding antibiotics. Regarding societal norms, providers perceived that poor peer practices and lack of patient education are factors that potentiate patient demands for antibiotics. Provider's perceived that patient demands have the greatest role in inappropriate prescribing and believed viable solutions to address this issue need to include audit-feedback and communication strategies (Hruza et al., 2018).

The study found that providers often intend on prescribing antibiotics appropriately. However, gaps in patient knowledge and perceived patient demands were identified as significant barriers influencing appropriate antibiotic prescribing practices, particularly in the treatment of ARIs. The authors concluded that ASP efforts should utilize audit-feedback and Shared Decision-Making/Communication strategies specifically tailored to consider time constraints, available resources, and perceived patient demands (Hruza et al., 2018).

ARI Clinical Practice Guidelines & Recommendations

The following section will examine four clinical practice guidelines and their recommendations. All of the clinical practice guidelines included here are intended to guide clinicians in the appropriateness of antibiotics for acute respiratory tract indication. One guideline specifically focuses on acute otitis media, the leading cause for antibiotic consumption in the pediatric population (Pelton, 2019). The following sections are not comprehensive, rather the information presented here will cover the key recommendations that are relevant and applicable to the DNP scholarly project. It is also important to note that the first guideline covered is dated as it was published in 2008. However, the guideline remains applicable and is frequently utilized in current clinical practice settings and research and for these reasons it will be included in the following overview.

In 2008 the National Institute for Health and Clinical Excellence (NICE) developed a clinical practice guideline titled "Respiratory Tract Infections—Antibiotic Prescribing: Prescribing of Antibiotics for Self-limiting Respiratory Tract Infections in Adults and Children in Primary Care". The guideline was developed for the purpose of providing the best clinical advice regarding the care of adults and children three months or older with respiratory tract infections (RTIs) for whom immediate antibiotic prescribing is not indicated (NICE, 2008). The guideline recommends that parents' and/or patients' concerns and expectations should be determined and addressed when agreeing on the use of one of the three antibiotic prescribing strategies, including: no prescribing, delayed prescribing, and immediate prescribing (NICE, 2008).

The guideline recommends that a no antibiotic prescribing or a delayed antibiotic prescribing strategy should be utilized for the following conditions: 1) acute otitis media (AOM), 2) acute sore throat/pharyngitis/tonsillitis, 3) common cold, 4) acute rhinosinusitis (ARS), and 5) acute cough/acute bronchitis (NICE, 2008). Depending on severity and duration, an immediate antibiotic prescribing or a delayed prescribing strategy should be considered for the following conditions: 1) bilateral AOM in children younger than two years of age, 2) AOM in a child with otorrhea, and 3) acute sore throat/pharyngitis/tonsillitis if three or more Centor criteria are present (NICE, 2008). Immediate antibiotic prescription and possibly further evaluation should be considered in the following scenarios: 1) patient with systemic signs and symptoms (e.g. high-grade fever, toxic-appearing, shortness of breath), 2) signs and symptoms suggestive of serious illness/condition (e.g. pneumonia, peritonsillar abscess, mastoiditis), 3) patients at high-risk for serious complications due to pre-existing comorbidities, including significant heart, lung, kidney, liver or neuromuscular disease, immunosuppression, long-term corticosteroid use, diabetes, cystic fibrosis, or premature infants, and 4) patients 65 years with acute cough with two or more of the following, including: recent hospitalization, diabetes, history of congestive heart failure, or current use of systemic corticosteroids (NICE, 2008).

For all antibiotic prescribing strategies, the patient and/or parents should be educated on the following: 1) the natural course of the illness and the expected average length of symptoms (e.g. AOM 4 days, sore throat 1 week, common cold 1 ½ weeks, ARS 2 ½ weeks, and acute bronchitis 3 weeks), and 2) symptom management including antipyretics and analgesics (NICE, 2008). If a no antibiotic prescribing strategy is utilized, the patient and/or parents should be offered the following: 1) reassurance and why antibiotics are not needed, and 2) return visit if condition worsens or continues past expected resolution time-frame (NICE, 2008). And lastly, when a delayed antibiotic prescribing strategy is adopted, the patient and/or parents should be advised on initiating the antibiotic if symptoms worsen or do not improve within 24 to 48hrs after initial visit and following up with a return visit if symptoms worsen despite initiating the delayed antibiotic (NICE, 2008).

In 2013, the American Academy of Pediatrics published a guideline that specifically examined the appropriateness of antibiotics for acute otitis media (AOM) titled “Clinical Practice Guideline: The Diagnosis and Management of Acute Otitis Media” (Lieberthal et al., 2013). The guideline is intended to provide recommendations to assist primary care providers in the diagnosis and management of uncomplicated AOM in children six months to 12 years of age (Lieberthal et al., 2013).

The diagnosis of AOM requires the presence of moderate to severe bulging of the tympanic membrane (TM) or new onset of otorrhea not caused otitis externa (Lieberthal et al., 2013). The provider may diagnose AOM in the presence of mild TM bulging accompanied by recent onset of otalgia (ear pain less than 48 hours in duration) or intense erythema of the TM (Lieberthal et al., 2013). Additionally, the diagnosis of AOM should not be made in the absence of middle ear effusion (MEE) (Lieberthal et al., 2013).

Regardless of age, antibiotic therapy is always recommended in the presence of severe AOM (i.e. unilateral or bilateral moderate to severe otalgia for at least 48 hours with high-grade fever of 102.2 F or higher). Antibiotic therapy is recommended for children six months to 23 months of age in the presence of non-severe bilateral AOM. Non-severe unilateral AOM in children six to 23 months of age should be offered either antibiotic therapy or observation with close follow-up. Lastly, children six months or older with bilateral non-severe AOM should prescribed an antibiotic or offered observation with close follow-up (Lieberthal et al., 2013).

The decision to either prescribe an antibiotic or closely observe should be based on the joint decision-making between the provider and parent (Lieberthal et al., 2013). If observation is chosen, the provider should provide a delayed antibiotic prescription or ensure close follow-up and begin antibiotic therapy if the child fails to improve or worsens within 48 to 72 hours (Lieberthal et al., 2013). If an antibiotic is prescribed and the child has not received amoxicillin in the last 30 days, oral amoxicillin is the treatment of choice. If the child has received amoxicillin in the last 30 days, amoxicillin-clavulanate (Augmentin) should be given to reduce resistance rates. Regardless of whether antibiotic therapy was initiated, all parents should be instructed to provide symptomatic relief for pain control with either acetaminophen or an NSAID (Lieberthal et al., 2013).

Due to high resistance rates, prophylactic antibiotics to reduce the frequency of recurrent AOM is not recommended. Prevention of AOM should focus on following recommended immunization schedules, with particular attention to ensure children receive the pneumococcal conjugate and annual influenza vaccine. Other preventative measures include exclusive breastfeeding for the first six months of life and avoiding exposure of the child to cigarette smoke (Lieberthal et al., 2013).

A clinical practice guideline published by the American College of Physicians titled "Appropriate Antibiotic use for Acute Respiratory Tract Infection in Adults: Advice for High-Value Care From the American College of Physicians and the Centers for Disease Control And Prevention" intended to provide the best practices for antibiotic use in healthy adults presenting with acute respiratory tract infection (ARTIs) (Harris, Hicks, & Qaseem, 2016). The authors define "healthy adults" as those 18 years of age or older without chronic lung disease or immunocompromising conditions (Harris, Hicks, & Qaseem, 2016).

After a meta-analysis of recent and most relevant evidence-based clinical practice guidelines, the authors developed four high-value clinical recommendations (see Appendix D). Recommendation 1: providers should not perform diagnostic tests or initiate antibiotic therapy for patients with acute bronchitis unless pneumonia is suspected (Harris, Hicks, & Qaseem, 2016). Recommendation 2: patient's with suspected group A streptococcal pharyngitis should be tested using a rapid antigen detection swab and/or culture and antibiotic therapy should only be initiated if group A strep is confirmed positive by such testing (Harris, Hicks, & Qaseem, 2016). Recommendation 3: in the treatment of acute rhinosinusitis, antibiotic therapy should be reserved for persistent symptoms present greater than 10 days, severe symptoms (i.e. high fever 102.2 or greater coupled with purulent discharge or facial/jaw pain) for three or more consecutive days, or for double-sickening defined as the "onset of worsening symptoms following a typical viral illness that lasted 5 days that was initially improving" (Harris, Hicks, & Qaseem, 2016, p. 1). And lastly, recommendation 4: providers should not prescribe antibiotics for the common cold regardless of perceived or actual patient expectations (Harris, Hicks, & Qaseem, 2016).

The fourth and final clinical practice guideline examined is titled “Diagnosis and Treatment of Respiratory Illness in Children and Adults” (Short et al., 2017) and was published by the Institute for Clinical Systems Improvement (ICSI) in 2017. The guideline provides algorithms for non-specific upper respiratory infections, acute pharyngitis, non-infectious rhinitis, and acute sinusitis (see Appendix E). The purpose of the guideline was to provide the best evidence-based clinical recommendations for common acute upper respiratory infections with a specific focus on the appropriateness of antibiotic therapy. The algorithms included in the guideline were intended to provide clinicians with step-wise clinical support recommendations to aid in the diagnosis, management, and determine the appropriateness of antibiotic therapy (Short et al., 2017).

Antimicrobial Stewardship

The term “Antibiotic Stewardship” refers to efforts aimed at improving and measuring antibiotic prescribing. “Antimicrobial Stewardship Programs” or ASPs are the interventions designed to ensure antibiotics are prescribed only when needed, and to ensure the right drug, dose, and duration are selected when antibiotics are prescribed (Sanchez, Fleming-Dutra, Roberts, & Hicks 2016) In response to the growing problem of antibiotic overuse and the emergence of resistant infections, the CDC developed the *Core Elements of Outpatient Antibiotic Stewardship* (Sanchez et al., 2016). These core elements are intended provide a framework on the guidance of establishing, developing, and monitoring ASPs in the outpatient setting.

The four core elements of outpatient antibiotic stewardship (see Appendix F) include the following: 1) commitment, 2) action for policy and practice, 3) tracking and reporting, and 4) education and expertise (Sanchez et al., 2016). The use of these four core elements is intended for any entity that uses antibiotics in the outpatient setting, including primary care physicians, NPs/PAs, emergency departments, urgent cares, community care clinics, dental clinics, and outpatient specialty and subspecialty clinics (Sanchez et al., 2016).

The first core element of commitment defined by Sanchez et al. (2016) means to "demonstrate dedication to and accountability for optimizing antibiotic prescribing and patient safety" (p. 15). A commitment by all health care team members to prescribe antibiotics appropriately and actively participate in ASP efforts collectively represents an essential first-step in reducing the overuse and inappropriate prescription of antibiotics (Sanchez et al., 2016). Clinicians' and health care settings can demonstrate the core element of commitment through the following: 1) displaying public posters and commitment pledges to appropriate antibiotic prescribing in support of antibiotic stewardship, 2) identify facility ASP team leaders to direct stewardship activities, 3) include ASP duties in position descriptions and in criteria for evaluating job requirements, and 4) consistent antibiotic prescribing behaviors through clear communication with all staff members and patients about the indications for antibiotics (Sanchez et al., 2016).

The second core element of action for policy and practice, the authors Sanchez et al. (2016) recommend that outpatient settings "implement at least one policy or practice to improve antibiotic prescribing, assess whether it is working, and modify as needed" (p.

15). Clinicians can achieve this core element by employing evidence-based diagnostic criteria and treatment recommendations or using watchful waiting or delayed prescribing practices when prescribing antibiotics (Sanchez et al., 2016). Outpatient healthcare settings can assist clinicians in prescribing efforts through the following: 1) providing communication skills training for providers to help manage patient expectations, 2) require written justification in the patient's medical record when antibiotics are given for a non-recommended condition or diagnosis, 3) provide clinicians with clinical decision support systems to assist in appropriate management of common acute conditions, and 4) utilizing nurse triage visits, call centers, and pharmacist consultations to minimize unnecessary provider visits (Sanchez et al., 2016).

The third core element of tracking and reporting, the authors Sanchez et al. (2016) recommend "monitoring antibiotic prescribing practices and offer regular feedback to clinicians, or have clinicians assess their own antibiotic prescribing practices themselves" (p. 15). Providers can achieve this core element by either self-evaluating their own antibiotic prescribing practices or participating in continual education and quality improvement activities aimed at tracking and improving antibiotic prescribing (Sanchez et al., 2016). Outpatient clinical settings can employ programs such as the National Healthcare and Safety Network (NHSM) survey's that require clinicians to report antibiotic usage and allow for the tracking of resistance data. Such data can be used for the purposes of providing audit and feedback allowing for the assessment and sharing of prescribing performance, setting of realistic goals, and promote quality measures that address the appropriateness of antibiotic prescriptions within the setting (Sanchez et al., 2016).

The fourth and final core element of education and expertise is defined by Sanchez et al. (2016) as the ability to "provide educational resources to clinicians and patients on antibiotic prescribing and ensure access to needed expertise on optimizing antibiotic prescribing" (p. 15). This core element can be accomplished by performing and implementing the following: 1) utilize effective communication strategies aimed at educating patients on when antibiotics are and are not indicated, 2) ensuring patients are educated about the potential harms of antibiotic treatment including adverse events and *C. difficile* associated diarrhea, 3) provide patients with recommended educational materials, 4) provide opportunities for multi-disciplinary face-to-face educational training, 5) provide continuing education activities for providers, and 6) ensure timely access to persons with expertise to improve antibiotic prescribing for patients who require specialty care (Sanchez et al., 2016).

Chapter III.

Methodology & Plan

The following chapter will discuss the plan and methodology of the DNP scholarly project. The research design of the project used a cross-sectional observational approach which will be discussed in this section. The target population, recruitment process, and inclusion and exclusion criteria will be addressed. The Institutional Review Board (IRB) process and the protection of participants will be discussed. The student used a pre-validated survey to collect data on participants. The instrument used to conduct the survey, as well as the procedure and administration of the survey, will be examined. Lastly, the intended outcomes of conducting this project and the plan for sustainability will be included at the end of this chapter.

Project Design

For the scholarly project, the student desired to follow a quantitative design strategy. A cross-sectional observational research design was used to identify and explore healthcare provider’s knowledge, attitudes, and prescribing practices concerning antibiotic use and resistance. Using this design, the researcher gathered objective data and examined it statistically in order to attempt to answer the identified research questions:

- What are the knowledge, attitudes, and perceptions (KAPs) underlying providers prescription of antibiotics for common respiratory indications in the primary and secondary care setting?
- What differences exist between provider characteristics and antibiotic-prescribing behavior and knowledge of antimicrobial resistance in the primary and secondary setting?

A pre-validated semi-structured survey developed by Rodrigues et al. (2016) was used to obtain provider demographic information, assess factors that influence prescribing behaviors, and identify common sources of knowledge used to guide antibiotic prescribing in clinical practice. The focus of the survey questions mainly concerned the use of oral antibiotics for common acute respiratory infections in the primary and secondary care setting. Analysis of healthcare provider's responses was translated into statistical data using Qualtrics XM (Qualtrics, Provo, UT, 2020) statistical analysis software to identify educational needs of the practice setting. Identified target educational resources and strategies aimed at enhancing the awareness of appropriate antibiotic use and resistance of both healthcare providers and consumers can be found in the appendices of the project.

A descriptive cross-sectional study is an observational study design used to research different groups of a sample population who differ in the variable of interest (knowledge, attitudes, and prescribing behaviors) but share a common characteristic (educational background/practice setting) for the purpose of determining the prevalence of the outcome of interest . In a cross-sectional design, data on the variable of interest is collected at one specified period of time and can be used to characterize the prevalence of an outcome in a given sample population (Alexander, Lopes, Ricchetti-Masterson, & Yeatts, 2013). The goal of this research project was to identify factors involving provider antibiotic prescribing practices. The variables of interest consisted of antibiotic prescribing behaviors and knowledge of resistance. In addition, significant differences between provider responses regarding the variables of interest were investigated. A pre-validated survey (Rodrigues et al., 2016) that included both closed and open-ended questions allowed for the collection of quantitative and qualitative data. The data was analyzed for the purpose of identifying the prevalence of antibiotic prescribing practices of the sample population in an effort to identify educational needs and generalize findings to the target population.

The pre-validated survey (Rodrigues et al., 2016) selected for this project included primarily closed-ended questions with the exception of one open-ended question at the end of the survey. A total of 23 statements measured on an unnumbered continuous visual analog scale and nine questions on sociodemographic characteristics of the provider allowed for the collection of quantitative data. Lastly, one open-ended discussion question at the end of the survey allowed for the collection of qualitative data.

Target Population

The target population for this project was healthcare providers; including physicians (DO or MD), physician-assistants (PAs), and nurse practitioners (NPs); working in primary and secondary care settings of Southwest Missouri and Southeast Kansas. A power analysis was performed and determined that 85 participants was necessary for statistical significance. Using Cohen’s Statistical Power Analysis, the student investigator used .05 alpha, medium effect size (r =0.30), and 0.80 statistical power (β =0.20) to make a determination of estimated sample size (Chuan, 2006).

Target Population Recruitment

The project utilized a convenience sampling methodology to gather data on the target population. Using the inclusion and exclusion criteria identified below (Table 1), the researcher obtained data from physicians, NPs, and PAs working in both primary and secondary care settings. The student collected data on healthcare providers providing primary care services in a rural access community health center in Southeast Kansas. For the collection of data from secondary care settings, the student administered the survey to healthcare providers working in emergency care services at 339-bed teaching hospital in Southwest Missouri. The student also administered the survey to a group of healthcare providers employed by an agency that provides emergent healthcare services in various locations throughout the Southeast Kansas and Southwest Missouri area. All surveys were completed on a voluntary basis via electronic submission through an anonymous link that was disseminated to the provider's work email. No monetary rewards or incentives were used in the collection of data.

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were pre-determined before the administration of the survey. The following (Table 1) represents the inclusion and exclusion criteria of the research study:

Table 1. Inclusion and exclusion criteria for a cross-sectional survey of healthcare provider's antibiotic prescribing practices.	
Inclusion criteria	**Exclusion criteria**
• Healthcare providers working in primary and secondary care settings (i.e. community clinic, emergency care, and urgent care) • Emergency medicine physicians, primary care physicians (including both DO and MD), physician assistants, and nurse practitioners who prescribe medications • Voluntary participation and informed consent	• Out-patient surgical centers, in-patient hospital admissions, and out-patient specialty care services (e.g. cardiology, nephrology, neurology) • Registered nurses and other healthcare workers who do not directly prescribe medications • Refusal to give informed consent

Institutional Review Board and Site Approval

The DNP scholarly project proposal was submitted to Pittsburg State University (PSU) Irene Ransom Bradley School of Nursing (IRBSON) Institutional Review Board (IRB) on October 22nd, 2019. On October 30th, 2019 the formal DNP scholarly project proposal took place at Pittsburg State University. During the proposal, a review of the project's methodology with the project advisor and committee chairs determined that the project required data collection from a pre-validated survey and posed minimal risk to participants. On December 3rd, 2019 the Institutional Review Board (IRB) at Pittsburg State University granted and approved the project as being exempt for research involving human subjects (see Appendix G).

Before obtaining IRB approval through IRBSON, the student made contact with the clinical directors overseeing the various practice settings. A site approval letter was manifested. After obtaining IRB approval through PSU, the student again made contact with the various clinical directors. Signatures were obtained from these individuals granting site approval to conduct the survey on providers employed in these settings (see Appendix H).

Protection of Human Subjects

Informed consent was provided in an introductory explanation delivered in the email containing the anonymous link to the survey and was also stated in an explanatory paragraph provided at the beginning of the survey. The introductory paragraph included information about the research project, purpose of the survey, potential risks and benefits, the meaning of voluntary participation, and how the data will be used to analyze the prevalence of antibiotic prescribing behaviors, knowledge, and attitudes.

All participation was voluntary and involved adults over 18 years of age. Data from the provider surveys was obtained via a secure online anonymous link provided through an email distributed by the three clinical site directors. To ensure no identifying information was obtained by the researcher, the student sent an email containing the anonymous link to the survey to the clinical directors overseeing the research sites. The clinical directors sent out the anonymous link to the survey to the providers of the clinical settings via a secure work email database. De-identification was used to distribute the online survey so that no association of responses could be linked back to the respondent. No identifying personal information was obtained, and all surveys were completed anonymously on a voluntary basis. To limit breach in confidentiality, all data obtained from the surveys was stored on an encrypted USB drive. After completion of the project, the USB drive was secured in a locked file cabinet at Pittsburg State University School of Nursing. The USB drive will remain secured at this site for a period of two years, after which data on the drive will be permanently deleted.

Instrument

The two major variables of interest included the following: 1) antibiotic prescribing practices, and 2) providers knowledge of antibiotic resistance. To collect data on these variables, a pre-validated survey developed by Rodrigues et al. (2016) (see Appendix B) was adapted and used (see Appendix C). The questionnaire was specifically designed to assess providers' attitudes and knowledge of antibiotic prescribing, antibiotic use and antimicrobial resistance, as well as the usefulness of various sources of knowledge/resources utilized in guiding antimicrobial use in the clinical setting (Rodrigues et al., 2016).

The questionnaire took the form of a two-page document made up of the following five sections:

- Section 1 ("Filling Instructions"): instructions on completing the survey;
- Section 2 ("About Antibiotics and Resistances"): 17 statements assessing provider knowledge and attitudes concerning antibiotic use, antibiotic resistance, and antibiotic prescribing practices;
- Section 3 ("In The Treatment of Respiratory Infections, How Would You Rate The Usefulness of Each of These Sources of Knowledge?"): 9 statements concerning the providers' perception involving the importance and usefulness of various sources of knowledge for guiding the prescription of antibiotics in clinical practice;
- Section 4 ("Some questions about sociodemographic data and about your clinical practice"): collection of provider sociodemographic information including age,

gender, practice type, work settings, average number of patients seen per day, and average time spent per patient;

- Section 5 (“Do You Have Some Suggestions About Antibiotic Use and Resistance?”): a final free-space open-discussion section allowing for providers to express ideas and views on antibiotic use and resistance (Rodrigues et al., 2016).

Section 2 and 3, measured the providers’ agreement with the 26 statements using an unnumbered continuous visual analogue scale (VAS), scoring their response from full disagreement to full agreement (Rodrigues et al., 2016). Section 4 collected pertinent sociodemographic information used to define professional attributes of the respondent. Lastly, section 5 provided an opportunity to collect qualitative data from respondent’s in a free-text, open-discussion format intended to expand on any variable not addressed in the questionnaire’s statements, as well as provide an opportunity for respondents to include any recommendations or suggestions on the topic of antibiotic use and resistance.

Rodrigues et al. (2016) developed a validated survey -in terms of face validity, content validity and reliability- to be used as an instrument to assess the attitudes and knowledge underlying provider antibiotic prescribing behaviors in both the hospital and primary-care setting. Development of the instrument consisted of a literature review that the authors used to construct the concepts of interest. After determining the concepts of interest, the questionnaire was pre-tested by a panel of physicians to provide content validity. Face validity was provided through an assessment of grammar, syntax, organization, and logical sequence of the questionnaire’s statements by an expert panel consisting of university professors, a clinical psychologist, and a linguistic expert. Reliability of the survey was assessed through a test-retest methodology during a pilot study using Cronbach's alpha (α >0.70) for internal consistency and interclass correlation coefficient (ICC >0.4).

Under the Creative Commons Attribution 4.0 International License terms, the questionnaire was considered open access allowing for unrestricted use. Therefore, providing the user appropriately referenced the original authors Rodrigues et al. (2016), permission to use the survey was not required. Regardless of the unrestricted nature of the survey, the student did attempt to contact the author of the survey on February 4th, 2019 via email, but no response to this effort resulted.

It is important to note that the original survey developed by Rodrigues et al. (2016) was adapted for the purpose of this study. The original survey can be found in Appendix B and the adapted survey found in Appendix C. The adapted survey represents the instrument that was sent out to the target population. Three adaptations to the original survey were made. The first adaptation included the omission of wording to statement number 13 of the original survey. The words "at the pharmacy" were omitted from this statement to reduce respondent confusion as oral antibiotics cannot be obtained from a pharmacy without a prescription in the United States. The second adaption was the exclusion of the sociodemographic question asking the respondent to specify their area of specialization. This was omitted for the purpose of reducing the occurrence of repetitive questioning. The third and final adaptation includes the omission of an additional sociodemographic question stated as the following: "Approximately, what is the number of patients seen per day at the emergency service?" (Rodrigues et al., 2016). As the target population of this study included both primary and secondary care providers, the decision to omit this item was made to avoid issues with provider non-response to a question that applies only to those working in emergency care services.

Procedure

After the project's proposal on October 30th, 2019, the researcher and board committee members considered the proposed project to be feasible and sustainable. Due to the relative ease of administering a pre-validated survey, limited resources needed to disseminate and receive survey information, and the lack of financial resources necessary for completion of the project, the researcher and board committee members deemed that the means of performing the project justified the need.

No funding was necessary for the administration of the survey. No physical paper copies of the survey were administered, and all data was sent and received electronically via a secured online database. All data of provider responses were anonymous to ensure no identifying information would be included, obtained, or could be traced back to a specific respondent. To limit breach in confidentiality, all data obtained from the surveys was stored on an encrypted USB drive.

The original survey developed by Rodrigues et al. (2016) was adapted into an online survey using Qualtrics XM (Qualtrics, Provo, UT, 2020). Access to the online survey software was provided free-of-charge to the researcher through Pittsburg State University. Using this software, the pre-validated survey developed by Rodrigues et al. (2016) was adapted into an online format and was distributed via an anonymous link that was emailed to the three clinical site directors. Following a convenience sampling methodology, the clinical site directors distributed the anonymous link to the survey via a secured work email database to the healthcare providers of the three target clinical settings on December 12th, 2019.

The anonymous link was distributed to the three clinical settings and was first open to responses on December 12th, 2019 and was closed to responses on January 6th, 2020. However, due to a low response rate, the student and committee members agreed to reopen the survey. The survey was reopened on January 14th, 2020 and was closed to responses for a final time on February 1st, 2020. During the time when the survey was reopened, two reminders were sent out to the providers in the form of an email that was distributed by the clinical site directors. In its entirety, the survey was open to responses for exactly 45 days. The occurrence of major holidays during the month of December and the beginning of January was thought to have contributed to the low response rate that was experienced during the initial opening of the survey.

After collecting the data, the anonymous provider responses were analyzed using Qualtrics XM crosstabulations statistical analysis (Qualtrics, Provo, UT, 2020). Through the use of this software, the provider responses were transformed into statistical data that allowed for the information to be analyzed for averages and differences pertaining to the variables of interest. Data analysis of provider responses took place during the month of February 2020. After an analysis and interpretation of the data, results were evaluated during the months of February and March 2020. The evaluation and discussion of the results can be found in chapter four and chapter five, respectively.

Outcomes

The primary outcome measure(s) of the DNP project included provider attitude/knowledge, prescribing practices, and sources of knowledge concerning antibiotic use and antimicrobial resistance. The secondary outcome of this project was to determine whether any differences between provider prescribing practices and provider characteristics exist (i.e. age, gender, type of activity, workplace, and provider workload). A pre-validated survey developed by Rodrigues et al. (2016) was used to assess the variables of interest and collect outcome data. The survey was selected for this project for its ability to show content validity, face validity, and reliability as a tool for assessing provider's attitudes, knowledge, and prescribing behaviors regarding antibiotic use and resistance. The main objective of the DNP project was to identify the factors underlying antibiotic prescription and antimicrobial resistance in the context of the primary and secondary care setting.

The survey included 17 statements assessing provider fear (consequence if antibiotics are not prescribed), perception of patient expectations and pressure, deficits in knowledge, indifference, and perceived responsibility of others; and nine statements evaluating provider's perceived usefulness of sources of knowledge utilized for guiding antibiotic use in clinical practice (Brown, 2017). Using an unnumbered ten-centimeter horizontal continuous visual analogue scale (VAS), each provider response was measured from full disagreement (0%) to full agreement (100%). The score of each response was recorded as a number, ranging from zero to 100. Lower scores ($\leq$ 49) delineate a greater disagreement with the statement while higher scores (>50) indicate a greater agreement.

Using the Qualtrics XM program as the tool for statistical analysis, cross tabulations were used to quantitatively analyze provider responses. Univariate analysis allowed for the grouping of variables to understand the correlation between provider responses to determine descriptive statistics (mean, standard deviation) measuring the level of agreement with statements regarding attitudes, knowledge, antibiotic prescribing behaviors, resistance, and the usefulness of sources of knowledge to guide antibiotic use in the primary and secondary case setting. The average (mean) level of agreement with survey statements were measured using a continuous unnumbered VAS from zero (totally disagree) to 100 (totally agree), where measures ≤ 49 delineate a greater disagreement with the statement, measures of 50 indicating an indifference level of agreement, and measures > 50 delineating a greater agreement. Using analysis of variance (ANOVA) as the statistical test, relationships between categorical (demographic data) and numerical variables (statement agreement) was tested for differences between means. All statistical tests used exact *p* values ($p \leq 0.05$) with 95% confidence intervals (CI) (Qualtrics, Provo, UT, 2020).

Plan for Sustainability

The main objective of the DNP project was to identify the factors underlying antibiotic prescription and knowledge of resistance. Thus, the sustainability of the DNP project relies heavily on identifying the factors that underly inappropriate antibiotic use and provide education based on evidenced-based research highlighting interventions and knowledge emphasizing appropriate antibiotic use. Listed as one of the CDC's four core elements of antimicrobial stewardship, education is a key aspect to any antimicrobial stewardship effort (Prinzi, 2019).

Provider reluctance to change antibiotic prescribing behaviors presents as a major challenge to sustainability. One of the purposes of this project was to identify reasons 'Why' antibiotics are prescribed inappropriately in an effort to provide a basis for the development of antimicrobial stewardship education and interventions. Appropriate antibiotic prescribing education must be tailored to the practice setting and involve the support from site management and administration. Financial resources would be necessary to continue the dissemination of evidenced-based, up-to-date recommendations and education pertaining to antimicrobial use and resistance.

Chapter IV.

Evaluation of Results

The overall purpose of this project was to identify and explore provider's knowledge, attitudes, and prescribing practices regarding antibiotic use and resistance. A questionnaire adapted from a pre-validated survey developed by Rodrigues et al. (2016) was anonymously distributed to a total of 116 providers from three separate practice settings located in Southeast Kansas and Southwest Missouri. Using a cross-sectional observational research design and pre-validated survey, the researcher sought to answer the two identified research questions:

- What are the knowledge, attitudes, and perceptions (KAPs) underlying providers prescription of antibiotics for common respiratory indications in the primary and secondary care setting?
- What differences exist between provider characteristics and antibiotic-prescribing behavior and knowledge of antimicrobial resistance in the primary and secondary setting?

The following chapter will provide a description of the sample and population surveyed, including the timeline, number of subjects, and demographic information of the respondents. A description of major key variables will be discussed. Statistical analyses included descriptive statistics (frequency, means, standard deviation), univariate analysis, and analysis of variance (ANOVA) to determine statistically significant differences of the sample population. Results of the survey will be provided in the form of tables and an evaluation and interpretation of these findings will be discussed.

Description of Sample/Population

The timeframe of the survey spanned from December 12th, 2019 to February 1st, 2020. The survey was originally set to open on December 12th and close January 6th. However, due to a low response rate the survey was reopened on January 14th and closed to responses for a final time on February 1st, 2020.

Table 2 provides a description of the population of focus. Distributed via an anonymous link, a total of 116 providers were invited to take the adapted pre-validated survey. To maintain full anonymity, an anonymous link was sent to the providers' work email by the clinical site coordinators of the target settings. The three target settings and the number of providers invited to take the survey at each of these settings were as follows: 1) 39 (33.6%) emergency care providers in Southwest Missouri, 2) 18 (15.5%) emergency care providers in Southeast Kansas, and 3) 59 (50.9%) primary care providers in Southeast Kansas.

Table 2. Study Population		
116 Total Providers Invited	**#**	**%**
Emergency Care Providers in Southwest Missouri	39	33.6%
Emergency Care Providers in Southeast Kansas	18	15.5%
Primary Care Providers in Southeast Kansas	59	50.9%

Table 3 provides a visual depiction of participant responses and response rates of the sample population. Out of the 116 providers invited to take the survey, 70 responded. A total of 16 responses were excluded for non-response and partial completion. Partial completion was determined and defined as participants who responded to less than 75% of the survey questions. After exclusion of non-responses and partial responses, a total of 54 responses (N=54) were included, resulting in an overall response rate of 46.6%.

Table 3. Participant Responses				
Response Type	**Total**	**Excluded**	**Included (N)**	**Response Rate (%)**
Anonymous Link	70	16	54	46.6%

Table 4 provides a visual depiction summarizing the sociodemographic characteristics of the provider participants (N=54) through the use of frequencies (percentages [%]). The majority of the providers were between the ages of 31 to 50 years of age (n=35; 68.6%). There was an equal distribution of males (n=27; 50%) versus female (n=27; 50%) providers. The majority of providers reported they practiced in a public practice (n=45; 83.3%), with only six from private practice (11.1%) and three from both public and private practice (5.6%). The majority of providers reported they worked in the hospital setting (n=28; 51.9%), followed by 21 providers working in the primary care setting (38.9%), and five working in both settings (9.3%). Out of the 54 providers, a total of 33 providers reported they worked in emergency medicine services (61.1%). The majority of providers reported a workload of 11 to 20 patients per day (n=35; 76%), with only two (4.3%) seeing less than 11 to 20 patients per day and nine (19.5%) seeing more than 11 to 20 patients per day. The majority of providers reported that an average of 10 to 25 minutes (n=38; 71.7%) of time was needed to attend to one patient.

Table 4. Sociodemographic Characteristics of Participating Providers		
Sociodemographics	*n*	%
How old are you? (years) (N=51)		
26-30	8	15.7
31-40	25	49
41-50	10	19.6
51-68	8	15.7
Gender (N=54)		
Male	27	50
Female	27	50
What type of activity? (N=54)		
Public Practice	45	83.3
Private Practice	6	11.1
Both	3	5.6
In which workplace? (N=54)		
Hospital Care	28	51.9
Primary Care	21	38.9
Both	5	9.3
Do you work at the emergency service? (N=54)		
Yes	33	61.1
No	21	38.9
Approximately, what is the number of patients seen per day? (patients per day) (N=46)		
5-10 patients/day	2	4.3
11-15 patients/day	10	21.7
16-20 patients/day	25	54.3
21-25 patients/day	4	8.7
26-30 patients/day	3	6.5
≥ 31 patients/day	2	4.3
Approximately, how much time do you need to attend to one patient? (minutes per patient) (N=52)		
10-15 min	16	30.2
20-25 min	22	41.5
30 min	6	11.3
45 min	2	3.8
≥ 60min	6	11.3

Table 5 provides a visual depiction of the frequencies of reported patient workload of both providers working in primary care and hospital care. In terms of number of patients seen per day, the results were similar for both providers working in the hospital setting and the primary care setting. Out of the 25 providers reporting they worked in the hospital setting, 76% reported an average workload of 11 to 20 patients per day.

Similarly, 77.8% of providers working in the primary care setting reported an average workload of 11 to 20 patients per day. In terms of the amount of time needed to attend to one patient, only slight differences were noted between the hospital and primary care setting. Of the providers who reported they worked in the hospital setting (n=27), 26% reported an average of 10 to 15 minutes was needed to attend to one patient and 44.4% reported an average of 20 to 30 minutes was needed. Conversely, of the providers who reported they worked in the primary care setting (n=21), all either reported an average of 10 to 15 minutes (33.3%) or 20 to 25 minutes (66.7%) was needed to attend to one patient.

Table 5. Patient Workload in Primary Care V.S. Hospital Care			
# Of Patients Seen Per Day (N=46)	**Hospital Care (*n*=25)**	**Primary Care (*n*=18)**	**Both (*n*=3)**
5-10 patients/day	0 (0%)	1 (5.6%)	1 (33.3%)
11-15 patients/day	7 (28%)	3 (16.7%)	0 (0%)
16-20 patients/day	12 (48%)	11 (61.1%)	2 (66.7%)
21-25 patients/day	3 (12%)	1 (5.6%)	0 (0%)
26-30 patients/day	2 (8%)	1 (5.6%)	0 (0%)
≥31 patients/day	1 (4%)	1 (5.6%)	0 (0%)
Minutes Needed Per Patient (N=52)	**Hospital Care (*n*= 27)**	**Primary Care (*n*=21)**	**Both (*n*=4)**
10-15 min	7 (26%)	7 (33.3%)	2 (50%)
20-25 min	6 (22.2%)	14 (66.7%)	2 (50%)
30 min	6 (22.2%)	0 (0%)	0 (0%)
45 min	2 (7.4%)	0 (0%)	0 (0%)
≥60 min	6 (22.2%)	0 (0%)	0 (0%)

Description of Key Variables

The pre-validated survey adapted from Rodrigues et al. (2016) was used to collect data for the purpose of measuring four major variables. The first variable was the sociodemographic information of the respondents described in the previous section and depicted in tables 2-5. For the purpose of analysis, this data was treated as categorical, defining the demographic characteristics of the sample population in terms of age, gender, workplace activity, workplace setting, and workload (i.e., number of patients per day and average amount of time needed per patient).

The second major variable measured included 17 statements collecting data on the knowledge, attitudes, and perceptions (KAPs) of providers regarding antibiotic use and antimicrobial resistance. This data was treated as numeric and was measured via the use of an unnumbered 10cm horizontal continuous visual analog scale (VAS). Each provider response was measured using this technique and was scored from full disagreement (0) to full agreement (100). Scores were recorded from zero to 100, where lower scores ($\leq$ 49) indicated greater disagreement, median scores (50) indicated agreement indifference, and higher scores (>50) indicated greater agreement with the statement. The 17 KAPs statements were intended to assess provider fear (fear if an antibiotic is not prescribed), complacency (perception of patient expectations/pressure), ignorance (knowledge deficits), indifference (neither agree or disagree), and responsibility of others (Brown, 2017).

The third major variable included nine statements evaluating the usefulness of sources of knowledge for guiding the prescription of antibiotics. Measured using the same VAS technique previously described, providers rated their level of agreement with nine various sources of knowledge they deemed as being useful in guiding the use of antibiotics in the clinical setting. The nine statements were intended to collect data on common sources of knowledge providers use when making clinical decisions regarding the use of antibiotics. The fourth and final major variable included a section placed at the end of the survey intended to collect qualitative data. The blank section was included under the question “Do you have some suggestions about antibiotic use and resistance?” allowing providers to comment using a free-text answer format.

Analysis and Results

All analyses were completed via the use of Qualtrics XM survey developer and statistical analysis software (Qualtrics, Provo, UT, 2020). Using this program, descriptive statistics using cross tabulation were performed to determine the average (mean) provider level of agreement and standard deviation (SD) with the 17 KAPs statements and nine sources of knowledge statements. After determining the mean level of agreement with each of the 26 survey statements, univariate analysis of variance (ANOVA) was performed to determine if any statistically significant differences existed between mean scores and categorical data (sociodemographic characteristics).

According to Qualtrics XM, analysis of variance (ANOVA) is used to test the relationship between a categorical and numeric variable by examining differences between two or more means (Qualtrics, Provo, UT, 2020). The ANOVA was used to determine whether any statistically significant differences existed between provider mean scores and sociodemographic characteristics categorized by age, gender, type of practice activity, practice setting, and provider workload. The goal of the project was to determine provider KAPs in terms of antibiotic use and resistance, identify facilitators and barriers to appropriate antibiotic use, and determine useful sources of knowledge for guiding antibiotic use in both the primary and secondary care setting. With those objectives in mind, the use of descriptive statistics to determine mean levels of agreement and standard deviations (SD), and univariate analysis using ANOVA were determined to be appropriate statistical analyses and tests that were well-aligned with the overall purpose of the project and research questions of interest.

Table 6 provides a visual depiction of the results of provider mean levels of agreement with the 17 statements relating to knowledge, attitudes, and perceptions about antibiotic use and resistance. Using univariate analysis of variance (ANOVA) as the statistical test, any statistically significant differences between mean scores and sociodemographic categorical data (age, gender, type of activity, workplace, emergency service, number of patients per day, and minutes per patient) are given in the form of a *p*-value. Using Qualtrics XM, all statistical tests used exact *p* values ($p \leq 0.05$) with 95% confidence intervals (CI) (Qualtrics, Provo, UT, 2020).

Table 6. Knowledge, Attitudes, and Perceptions (KAPs) About Antibiotic Use and Resistance*										
Statement	**Avg. or Mean (μ)**	**Standard Deviation (SD or σ)**	**Age**	**Gender**	**Type of Activity**	**Workplace**	**Emergency Service**	**# of Patients Per Day**	**Minutes Per Patient**
1. Antibiotic resistance is an important Public Health Problem. (n=54)	90.5	14.4	____	____	____	____	____	0.028	____
2. In a primary-care context, one should wait for the microbiology results before treating an infectious disease. (n=54)	41.3	21.8	____	____	____	____	____	____	____
3. Rapid effective techniques are required for diagnosis of infectious disease. (n=54)	57.0	27.2	____	____	____	____	____	____	<0.00001
4. The prescription of antibiotics does not influence the possible appearance of resistance. (n=47)	17.9	24.4	____	0.036	____	____	____	____	____
5. I am convinced new antibiotics will be developed to solve the problem of resistance. (n=53)	36.5	28.9	____	____	____	____	____	____	____
6. The use of antibiotics on animals is an important cause of the appearance of new resistance to pathogenic agents in humans. (n=53)	50.2	29.8	____	____	____	____	____	____	0.013
7. In case of doubt, it is preferable to use a wide-spectrum antibiotic to ensure that the patient is cured of an infection. (n=52)	41.6	31.5	____	____	____	____	____	____	____
8. I frequently prescribe an antibiotic in situations where it is impossible for me to conduct a systematic follow-up of the patient. (n=52)	49.8	32.1	____	____	____	0.017	0.039	____	____
9. In situations of doubt as to whether a disease might be of	30.9	29.9	____	0.010	____	____	____	____	0.049

bacterial etiology, it is preferable to prescribe an antibiotic. (n=50)									
10. I frequently prescribe antibiotics because patients insist on it. (n=48)	15.9	23.6	___	____	______	<0.00001	______	______	______
11. I sometimes prescribe antibiotics so that patients continue to trust me. (n=46)	13.1	23.3	___	____	______	<0.00001	_______	______	______
12. I sometimes prescribe antibiotics, even when I know they are not indicated because I do not have the time to explain to the patient the reason why they are not called for. (n=44)	15.2	25.7	___	0.027	______	_______	_______	______	______
13. If a patient feels that he/she needs antibiotics, he/she will manage to obtain them without a prescription, even when they have not been prescribed. (n=52)	31.7	29.8	___	____	______	_______	_______	______	______
14. Two of the main causes of the appearance of antibiotic resistance are patient self-medication and antibiotic misuse. (n=52)	67.8	27.0	___	0.015	______	_______	0.043	______	0.049
15. Dispensing antibiotics without a prescription should be more closely monitored. (n=51)	69.2	32.3	___	____	______	______	______	______	______
16. In a primary-care context, amoxicillin is useful for treating most respiratory infections. (n=53)	39.0	30.6	___	____	______	______	______	______	______
17. The phenomenon of resistance to antibiotics is mainly a problem in the hospital setting. (n=48)	19.8	23.0	___	0.041	0.040	______	0.019	______	______

*Avg. or Mean (μ) is the Level of Agreement with the Statement measured from zero (totally disagree) to 100 (totally agree) [≤ 49 greater disagreement, =50 neither agree or disagree, and > 50 greater agreement]; Standard Deviation (SD or σ); Statistically Significant *p* ≤ 0.05 with 95% CI; ----- Non-Significant

The following sections will discuss the findings presented in Table 6. The providers mean level of agreement with the 17 KAPs statements and any statistically significant differences identified via analysis of variance will discussed. For the purpose of organization, the 17 KAPs statements will be divided into statements that had a consensus of agreement and those where there was a consensus of disagreement. All statistical tests were done via the use Qualtrics XM, using exact p-values (p= <0.05) and a confidence interval (CI) of 95% (Qualtrics, Provo, UT, 2020).

KAP Statements: Consensus of Agreement

Statement 1: The providers strongly agree that antibiotic resistance is an important public health problem (Statement 1; μ score= 90.5). Using 90.5 as the mean score, a statistically significant difference was found in terms of patients seen per day (p= 0.028). Providers who reported seeing approximately 5 to 10 patients per day had a mean level of agreement of 60.0 and providers who reported seeing greater than 31 patients per day reported a mean level of agreement of 70.5.

Statement 3: There was a mean level of agreement (μ score= 57.0) with statement 3 ("Rapid effective techniques are required for diagnosis of infectious disease"). A statistically significant difference (p= <0.00001) was noted in providers who needed 45 minutes ($\bar{x}$ score= 27.0) or greater ($\bar{x}$ score= 46.7) to attend to one patient.

Statement 6: There was a weak mean level of agreement (μ score=50.2) bordering indifference with statement 6 ("The use of antibiotics on animals is an important cause of the appearance of new resistance to pathogenic agents in humans"). A statistically significant difference (p= 0.013) was noted in providers reporting they needed approximately 30 minutes to attend to one patient ($\bar{x}$ score= 81.6). In contrast, providers requiring either more or less than 30 minutes to attend to one patient generally disagree with statement 6, signified by a mean score of 49 or less.

Statement 14: The providers had a mean level of agreement (μ score=67.8) with statement 14 ("Two of the main causes of the appearance of antibiotic resistance are patient self-medication and antibiotic misuse"). Using an overall mean score of 67.8, three statistically significant differences were found in terms of gender (*p*= 0.015), emergency service (*p*= 0.043), and minutes per patient (*p*= 0.049). There was a greater level of agreement with statement 14 reported by female providers ($\bar{x}$ score= 76.2) compared to male providers ($\bar{x}$ score= 59.4). Providers who worked in emergency services reported a lower level of agreement ($\bar{x}$ score= 61.4) compared to those who did not ($\bar{x}$ score= 78.0). Lastly, providers who reported they needed approximately 60 minutes or greater to attend to one patient had a mean level of disagreement ($\bar{x}$ score= 42.3) with statement 14.

Statement 15: There was a mean level of agreement (μ score=69.2) with statement 15 ("Dispensing antibiotics should be more closely monitored"). No statistically significant differences among provider characteristics was found.

KAP Statements: Consensus of Disagreement

Statement 2: A mean level of disagreement (μ score=41.3) with statement 2 ("In a primary-care context, one should wait for the microbiology results before treating an infectious disease") was noted. No statistically significant differences among provider characteristics was found.

Statement 4: On average, the providers strongly disagree (μ score= 17.9) with statement 4 ("The prescription of antibiotics does not influence the possible appearance of resistance"). A statistically significant difference in the level of agreement was noted in terms of gender (*p*= 0.036). Although both genders disagree with the statement, there was a stronger level of disagreement from female providers ($\bar{x}$ score= 13.2) when compared to male providers ($\bar{x}$ score= 23.2).

Statement 5: A mean level of disagreement (μ score= 36.5) with statement 5 ("I am convinced new antibiotics will be developed to solve the problem of resistance") was noted among the providers. No statistically significant differences among provider characteristics was found.

Statement 7: The providers generally disagreed (μ score= 41.6) with statement 7 ("In case of doubt, it is preferable to use a wide-spectrum antibiotic to ensure that the patient is cured of an infection"). No statistically significant differences among provider characteristics was found.

Statement 8: A weak mean level of disagreement (μ score= 49.8), bordering indifference, was noted among providers when answering statement 8 ("I frequently prescribe an antibiotic in situations where it is impossible for me to conduct a systematic follow-up of the patient"). Two statistically significant differences in provider characteristics was noted in terms of workplace (*p*= 0.017), and emergency service (*p*= 0.039). Primary care providers had a strong level of disagreement with statement 8 ($\bar{x}$ score= 31.4), whereas providers in the hospital setting had a mean level of agreement with statement 8 ($\bar{x}$ score= 63.2). To note, of the five providers who reported working in both the primary care and hospital setting, a mean level of disagreement with statement 8 was found ($\bar{x}$ score= 44.2). Providers who reported they did not work in emergency services had a mean level of disagreement with statement 8 ($\bar{x}$ score= 36.6). In contrast, emergency service providers had a mean level of agreement with statement 8 ($\bar{x}$ score= 57.3).

Statement 9: On average, a mean level of disagreement (μ score= 30.9) with statement 9 (“In situations of doubt as to whether a disease might be of bacterial etiology, it is preferable to prescribe an antibiotic”) was noted. There was a statistically significant difference noted in provider characteristics with statement 9 in terms of gender (p= 0.010), and minutes per patient (p= 0.049). Although both genders had a mean level of disagreement with statement 9, female providers had a greater level of disagreement ($\bar{x}$ score= 20.0) when compared to male providers ($\bar{x}$ score= 40.8). Providers who reported the need for approximately 45 minutes per patient ($\bar{x}$ score= 66.0) and 60 minutes or greater to attend to a patient ($\bar{x}$ score= 47.7) had a higher level of agreement with statement 9 when compared to the overall average of the sample (μ score= 30.9).

Statement 10: There was a strong level of disagreement (μ score= 15.9) noted among providers with statement 10 (“I frequently prescribe antibiotics because patients insist on it”). A statistically significant difference was noted in the provider characteristic regarding workplace (p= <0.00001). When compared to providers working in either the hospital setting ($\bar{x}$ score= 13.3) or primary care alone ($\bar{x}$ score= 13.0), providers working in both settings had a higher level of agreement with statement 10 ($\bar{x}$ score= 46.8).

Statement 11: A strong level of a disagreement was noted among providers (μ score= 13.1) when measuring the level of agreement with statement 11 (“I sometimes prescribe antibiotics so that patients continue to trust me”). A statistically significant difference was noted in provider characteristics in terms of workplace (p= <0.00001). Similar to the finding for statement 10, when compared to providers working in either the hospital setting ($\bar{x}$ score= 7.7) or primary care alone ($\bar{x}$ score= 13.3), providers working in both settings had a higher level of agreement with statement 11 ($\bar{x}$ score= 43.5).

Statement 12: There was a strong level of disagreement (μ score= 15.2) noted in providers when rating statement 12 ("I sometimes prescribe antibiotics, even when I know they are not indicated because I do not have the time to explain to the patient the reason why they are not called for"). There was a statistically significant difference noted in provider demographics in terms of gender (p= 0.027). Female providers had a stronger level of disagreement ($\bar{x}$ score= 7.3) with statement 12, when compared to male providers ($\bar{x}$ score= 24.0).

Statement 13: On average, a mean level of disagreement (μ score= 31.7) was noted among providers when measuring the level of agreement with statement 13 ("If a patient feels that he/she needs antibiotics, he/she will manage to obtain them without a prescription, even when they have not been prescribed"). In an analysis of variance (ANOVA), no statistically significant differences among provider characteristics was found.

Statement 16: A mean level of disagreement (μ score= 39.0) was noted among provider when measuring the level of agreement with statement 16 ("In a primary-care context, amoxicillin is useful for treating most respiratory infections"). No statistically significant differences among provider characteristics was found.

Statement 17: There was a strong mean level of disagreement (μ score= 19.8) noted with statement 17 ("The phenomenon of resistance to antibiotics is mainly a problem in the hospital setting"). Three statistically significant differences were noted in provider characteristics in terms of gender (*p*= 0.041), type of activity (*p*= 0.040), and emergency service (*p*= 0.019). Although both genders had an average level of disagreement with statement 17, female providers had a stronger level of disagreement ($\bar{x}$ score= 13.8) when compared to male providers ($\bar{x}$ score= 25.9). Out of the three types of activity reported, providers working in both public and private practice had the highest level of disagreement ($\bar{x}$ score= 1.7) with statement 17 when compared to providers who reported working in private practice ($\bar{x}$ score= 17.6) or public practice ($\bar{x}$ score= 21.5) alone. Lastly, providers who reported working in the emergency setting had a weaker mean level of disagreement ($\bar{x}$ score= 24.7) with statement 17 when compared to providers who do not work in the emergency setting ($\bar{x}$ score= 10.8).

Table 7 provides a visual depiction of the findings pertaining to the providers level of agreement with nine statements regarding the usefulness of various sources of knowledge for guiding antibiotic use in clinical practice. Methods of descriptive statistics (means, SD) were used to identify major source of knowledge. Using univariate analysis of variance (ANOVA) as the statistical test, any statistically significant differences found between mean scores and provider characteristics (sociodemographic data) were identified in the form of a p-value.

Table 7. In the Treatment of Respiratory Tract Infections, Rate the Usefulness of Resources of Knowledge*									
Statement	**Avg. or Mean (μ)**	**Standard Deviation (SD or σ)**	**Age**	**Gender**	**Type of Activity**	**Workplace**	**Emergency Service**	**# of Patients Per Day**	**Minutes Per Patient**
18. Clinical practice guidelines. (n=54)	85.9	17.6	____	0.043	____	____	____	____	____
19. Documentation furnished by the Pharmaceutical Industry. (n=53)	46.0	28.1	____	0.013	____	____	____	____	____
20. Courses held by the Pharmaceutical Industry. (n=52)	40.6	25.7	____	____	____	____	____	0.017	____
21. Information furnished by Medical Information Officers. (n=52)	54.3	24.7	____	____	____	____	____	0.005	____
22. Previous clinical experience. (n=54)	71.5	20.7	____	____	____	____	____	____	____
23. Continuing Education courses. (n=54)	79.8	18.0	____	0.003	____	____	____	____	____
24. Others, e.g., contribution of specialists (microbiologists, infectious disease specialist, etc.). (n=54)	79.2	23.5	____	____	____	____	____	0.005	____
25. Contribution of peers (of same specialization). (n=54)	63.9	26.9	____	____	____	____	____	0.003	____
26. Data collected via the internet. (n=53)	39.9	27.3	____	____	____	____	____	____	____

*Avg. or Mean (μ) is the Level of Agreement with the Statement measured from zero (totally disagree) to 100 (totally agree) [≤ 49 greater disagreement, =50 neither agree or disagree, and > 50 greater agreement]; Standard Deviation (SD or σ); Statistically Significant $p \leq 0.05$ with 95% CI; ----- Non-Significant

The following sections will discuss the findings presented in Table 7. The providers mean level of agreement with the nine statements pertaining to the usefulness of sources of knowledge and any statistically significant differences identified via analysis of variance will be discussed. For the purpose of organization, the nine statements will be divided according to those where there was a consensus of agreement and those where there is a consensus of disagreement. All statistical tests were done via the use Qualtrics XM, using exact p-values ($p = <0.05$) and a confidence interval (CI) of 95% (Qualtrics, Provo, UT, 2020).

Useful Resources of Knowledge Statements: Consensus of Agreement

Statement 18: Providers were asked to rate their level of agreement with nine statements pertaining to the usefulness of resources of knowledge used to guide clinical decisions involving the use of antibiotics in the practice setting. Statement 18 (“Clinical practice guidelines”), on average had the highest level of agreement among the 54 providers surveyed (μ score= 85.9). One statistically significant difference was found in provider characteristics regarding gender ($p = 0.043$). Female providers had a higher overall level of agreement with statement 18 ($\bar{x}$ score= 90.8) when compared to male providers ($\bar{x}$ score= 81.0).

Statement 21: There was a weak level of agreement (μ score= 54.3) with statement 21 (“Information furnished by medical information officers”) pertaining to the perceived usefulness of this information as a knowledge resource. One statistically significant difference was noted in the provider characteristic pertaining to the number of patients per day ($p = 0.005$). Providers who reported seeing approximately five to ten patients per day ($\bar{x}$ score= 27.5) and 31 or more patients per day ($\bar{x}$ score= 15.0) had an overall mean level of disagreement with statement 21 compared to the other providers.

Statement 22: On average, there was a mean level of agreement (μ score= 71.5) among providers with statement 22 ("Previous clinical experience"). No statistically significant differences among provider characteristics were found pertaining to the level of agreement with statement 22.

Statement 23: A strong mean level of agreement (μ score= 79.8) among providers was noted when rating statement 23 ("Continuing education courses"). One statistically significant difference in the provider characteristics of gender was found (p= 0.003). Female providers had an overall higher level of agreement ($\bar{x}$ score= 87.1) with statement 23 when compared to male providers ($\bar{x}$ score= 72.6).

Statement 24: There was a strong mean level of agreement (μ score= 79.2) among providers concerning statement 24 ("Others, e.g., contribution of specialists [microbiologists, infectious disease specialists, etc.]"). One statistically significant difference was noted in the provider characteristic concerning the number of patients seen per day (p= 0.005). Similar to the finding noted in statement 21, providers who reported seeing approximately five to ten patients per day ($\bar{x}$ score= 48.0) and those who saw 31 or greater patients per day ($\bar{x}$ score= 33.5) had an overall mean level of disagreement with statement 24 concerning its usefulness as a knowledge source for guiding antibiotic use.

Statement 25: A mean level of agreement (μ score= 63.9) among providers was found to be associated with statement 25 ("Contribution of peers [of the same specialization]"). One statistically significant difference was found in the provider characteristic regarding the number of patients seen per day (*p*= 0.003). Again, providers who reported seeing five to ten patients per day ($\bar{x}$ score= 54.0) and those who reported seeing 31 or greater patients per day ($\bar{x}$ score= 10.0) had an overall lower mean level of agreement with statement 25 as a useful resource for knowledge pertaining to antibiotic use.

Useful Resources of Knowledge Statements: Consensus of Disagreement

Statement 19: Providers reported a weak mean level of disagreement (μ score= 46.0) to statement 19 ("Documentation furnished by the pharmaceutical industry") as a useful source of knowledge. A statistically significant difference was found among provider characteristics pertaining to gender (*p*= 0.013). It was found that female providers tended to agree with statement 19 as a useful source of knowledge ($\bar{x}$ score= 56.1). In contrast, male providers tended to disagree with statement 19 as a useful source of knowledge ($\bar{x}$ score= 35.5).

Statement 20: An overall mean level of disagreement with statement 20 ("Courses held by the pharmaceutical industry") was found among providers (μ score= 40.6). There was a statistically significant difference noted in the provider characteristics pertaining to the number of patients seen per day (*p*= 0.017). Providers who reported seeing 31 patients or greater per day had an overall higher level of disagreement with statement 20 ($\bar{x}$ score= 16.5) when compared to all other reported provider workloads.

Statement 26: Lastly, a mean level of disagreement (μ score= 39.9) was found among provider regarding statement 26 ("Data collected via the internet") as a useful resource of knowledge for guiding antibiotic use. No statistically significant differences among provider characteristics were found pertaining to statement 26.

Qualitative Data: Provider Comments Regarding Antibiotic Use & Resistance

The last section of the survey asked the providers the following question "Do you have some suggestions about antibiotic use and resistance". This was provided in an optional free-text answering format intended to collect qualitative data from providers that would allow for anonymous disclosure of questions, comments, and/or recommendations regarding antibiotic use and resistance.

Given in bullet points and quotation marks, the following is a representation of the comments and recommendations that were provided by the respondents of this survey:

- "Be judicious."
- "Decrease the use of antibiotics in both the hospital and out-patient setting. Incentives to pharm companies to research and develop new antibiotics. Alter the perception of that patient's want/need an antibiotic. Decrease patient loads to improve education provided to individual patients."
- "Better public education regarding viral URIs and their treatments."
- "Follow local antibiotic resistance trends from your local hospitals. Our facility publishes antibiograms every 2 years."
- "We live in a quick-fix society and patients often do not understand and get very mad/upset when not given what they perceive they need. Often these complaints come back on the provider. More education to the public is needed."
- "Practice evidence-based medicine."
- "More public education. Consistency among providers from one practice and the use of the same up-to-date guidelines should be followed."

- "Stop prescribing antibiotics for the common cold and mild ear infections in children. Patient's need to complete the course of antibiotics that are prescribed, and patients should refrain from sharing antibiotics. Having access to more rapid testing for viral illnesses (unfortunately have to "prove" to parents that it is a virus) would help decrease prescribing in my opinion. Better access and distribution of evidence-based medicine to providers would help as well. Urgent care providers need to be taught that not everyone needs to leave with a prescription for antibiotics!"
- "Public awareness is limited, especially in rural, lower socioeconomic areas like ours. Physicians have a role in education, but others can and should be helping overcome the general populations ignorance of this growing problem."
- "Allow physicians to use their own judgment and not checkboxes. Put information out, and then physicians should be the one to make the decision."

Summary of Chapter IV.

The overall purpose of this project was to identify and explore provider's knowledge, attitudes, perceptions, and prescribing practices regarding antibiotic use and resistance. A pre-validated survey developed by Rodrigues et al. (2016) was adapted and used to assess providers working in the primary care and secondary care setting. The survey included the following: 1) 17 statements assessing the provider's level of agreement concerning knowledge, attitudes, and prescribing practices regarding antibiotic use and resistance; 2) nine statements assessing the provider's level of agreement with various sources of knowledge and their usefulness in guiding antibiotic use in the clinical setting; 3) seven questions concerning sociodemographic provider characteristics (age, gender, care activity, workplace, emergency service, and workload); and 4) one open-format question intended to collect qualitative data concerning provider's suggestions regarding antibiotic use and resistance.

116 providers from three clinical settings in Southeast Kansas and Southwest Missouri were anonymously invited to take the survey. After accounting for non-response and partial completion, a total of 54 (N=54) provider responses were included in the analysis, resulting in an overall response rate of 46.6%. Analysis of the results were completed via the use of Qualtrics XM survey developer and statistical analysis software (Qualtrics, Provo, UT, 2020). Using this program, descriptive statistics using cross tabulation was performed to determine the average (mean) provider level of agreement and standard deviation (SD) with the 17 KAPs statements and nine sources of knowledge statements. After determining the mean level of agreement with each of the 26 survey statements, univariate analysis using the statistical test analysis of variance (ANOVA) was performed to determine if any statistically significant differences existed between mean scores and provider characteristics (e.g., age, gender, type of activity, workplace, emergency service, and workload). Results of the analysis were provided in the form of tables with mean scores, standard deviation, and any statistically significant findings using exact p values ($p \leq 0.05$) and 95% confidence intervals (CI). A discussion of the findings in relation to the outcomes of this project and the identified research questions will be addressed in detail in the following section (Ch. 5 Discussion).

Chapter V.

Discussion

Chapter five, the final chapter of this DNP project, will focus on the discussion of results related to the outcomes of this research project. General observation pertaining to the project's findings and the relation to the target population of primary and secondary care healthcare providers will be discussed. A discussion of the results related to the theoretical framework and logic model of this project will be included. The limitations of the research project will be identified and discussed. Implications for future research, practice, health policy, and education will be addressed. Lastly, a conclusion summarizing the overall study purpose, outcomes, and contributions to nursing in terms of knowledge and practice will be provided at the end of this chapter.

Relationship of Outcomes to Research

The overall purpose of this project was to identify and explore provider's knowledge, attitudes, perceptions, and prescribing practices regarding antibiotic use and resistance. The following section is organized by the two identified research questions this project set out to answer. The researcher will attempt to answer each research question by summarizing the knowledge discovered from survey results. By weighing the findings of this project to evidence found in the literature review, the researcher will attempt to determine how the results either support or refute previous research findings.

Lastly, the researcher will address how the outcomes of this project's research findings match the intended purpose the researcher set out to accomplish.

Research Question #1: What are the knowledge, attitudes, and perceptions (KAPs) underlying providers prescription of antibiotics for common respiratory indications in the primary and secondary care setting? Aligned with the project's purpose, the primary outcome of measure was to determine the mean level of provider's agreement with statements regarding attitude/knowledge, prescribing practices, and sources of knowledge concerning antibiotic use and antimicrobial resistance. To answer research question one, descriptive statistical analysis using Qualtrics XM software to create cross tabulations were completed to examine provider means scores and standard deviations with each of the 26 survey statements pertaining to antibiotic use and resistance.

Knowledge & Attitudes

Antibiotic resistance is considered to a global health crisis and has been deemed one of the greatest public health threats of our time (George Washington University, 2018; WHO, 2017). In a study in 2018 measuring outpatient antibiotic use, an estimated 80-90% of antibiotic consumption by volume occurred in the outpatient setting (CDC, 2018). Showing a good overall understanding of the gravity and scope of the problem, the providers of this study were aware and agreed that antibiotic resistance is a major public health problem (μ score= 90.5) and understood that antibiotic resistance is not a phenomenon confined to the hospital setting (μ score= 19.8)

The providers strongly disagree that prescription of antibiotics has no influence on the appearance of resistance (μ score= 17.9), and strongly agree that two major causes of resistance are the product of patient misuse and self-medication (μ score= 67.8). The provider's knowledge regarding the use of antibiotics and resistance is well-aligned with the findings from the CDC (2013) who stated: "the use of antibiotics is the single most important factors leading to antibiotic resistance" (p.11). Furthermore, similar previous studies also found that providers generally agree that the main drivers of antibiotic overuse and resistance are likely related to patient satisfaction and patient pressures to prescribe antibiotics (PEW Charitable Trust, 2017).

Although bordering indifference, the providers acknowledged the use of antibiotics for agricultural and farming purposes as an important factor influencing the appearance of new resistant organisms in humans (μ score= 50.2). This finding is congruent with statements made by the CDC warning the food industry that the use of antibiotics in animals and food products can result in resistant bacterium being passed on to human hosts who consume food products that have been treated with antibiotics (CDC, 2013).

Evidenced by a mean score of 36.5 (μ), the providers were not convinced that new antibiotics would be developed to solve the problem of resistance. Although cited as a possible solution to address the antimicrobial resistance crisis, a relative lack of policy initiatives and program funding incentives have resulted in pharmaceutical companies placing low priority in the research and development of antibiotics (Ventola, 2015). To further potentiate the problem, major regulatory barriers imposed on pharmaceutical companies have made the development of new antibiotics difficult (Ventola, 2015).

The providers of this study agree that the dispensing of antibiotics without a prescription should be more closely monitored (μ score= 69.2). Agreement with this statement is aligned with previous research findings urging for greater regulation of antibiotics in other countries where antibiotics can be purchased over-the-counter or even online without a prescription (Ventola et al., 2015). The providers did however disagree that patients will manage to obtain antibiotics without a prescription if he/she feels they need an antibiotic (μ score= 31.7).

Prescribing Practices

The providers disagree that amoxicillin is a useful antibiotic for treating most respiratory infections in the primary care setting (μ score= 39.0). Contrary to this finding, a study in 2018 found that azithromycin and amoxicillin were the most common antibiotics prescribed in the outpatient setting (CDC, 2018). The providers disagreed in waiting for microbiology results before treating an infectious disease in the primary care setting (μ score= 41.3). Although controversial, because traditional microbiology results are often not available for 24 to 72 hours after obtaining a sample, initial therapy for many infections are often empiric and guided by clinical presentation (Leekha, Terrell, & Edson, 2011).

The providers agreed with the usefulness of rapid effective techniques as a diagnostic requirement for infectious disease (μ score= 57.0). Multiple studies support the use of rapid effective diagnostics to guide the proper use of antibiotics, slow the rise of antimicrobial resistance, and improve the overall approach to treating bacterial infections through targeted therapies (O’Neill, 2015). Within a matter of minutes, rapid respiratory panels can be used to detect viral pathogens (i.e. influenza, rhinovirus, adenovirus, RSV, parainfluenza, coronavirus) as the cause of many upper respiratory infections (Abbas et al., 2019). The rapid antigen detection test (RADT) is a recommended diagnostic for all patients presenting with features of Group A Beta-

Hemolytic Strep (GABHS), a common cause of acute pharyngitis (Hart, 2007). These tests, among others, can be used in both the inpatient and outpatient setting to differentiate the etiology of many common acute respiratory conditions while providing evidence that reinforces the proper use and/or withholding of antimicrobial drugs. (O'Neill, 2015).

In situations of doubt, the providers disagreed with the use of wide-spectrum antibiotics to ensure a cure from infection (μ score= 41.6). This finding is contradictory to a similar study that identified a provider knowledge gap in the proper use of broad versus narrow-spectrum antibiotics in clinical practice (Sanchez et al., 2014). Fear of complications and low confidence in prescribing abilities often leads to the prescription of broad-spectrum antibiotics (Sanchez et al., 2014). Evidenced by an overall mean level of disagreement with the use of broad-spectrum antibiotics in situations of doubt, the providers of this survey showed a good understanding pertaining to proper antibiotic selection.

Results showed a mean level nearing indifference (μ score= 49.8) when providers were asked if they frequently prescribed antibiotics in situations where it was impossible to conduct a systemic follow-up of the patient. Previous studies have found that antibiotics are more likely to be prescribed in situations where follow-up with the patient is perceived as unlikely (Hayhoe, Butler, Majeed, & Saxena, 2018). A study in 2014 found a strong correlation between clinical uncertainty and unnecessary antibiotic prescription (Dempsey, Businger, Whaley, Gagne, & Linder, 2014). However, in situations of doubt as to whether a disease might be of bacterial etiology, the providers of this study disagreed with the practice of prescribing antibiotics (μ score= 30.9). This finding shows the providers have a good understanding of withholding antibiotics based on clinical uncertainty alone.

The providers of this study strongly disagreed with frequently prescribing antibiotics based on a patient's insistence (μ score= 15.9) or for the purpose of harboring continued patient trust (μ score= 13.1). The providers also strongly disagreed with prescribing antibiotics, even when they know they are not indicated, because they did not have time to explain to the patient why they were not called for (μ score= 15.2). These three findings provide evidence that the providers of this study do not fall into the fallacy of prescribing antibiotics based on patient pressures, insistence, or perceived lack of knowledge. However, these findings are contradictory to those found by previous studies where clinicians cited patient pressure, customer satisfaction, and lack of time to educate patients as major root causes involved in the inappropriate prescription of antibiotics (Fleming-Dutra, Mangione-Smith, & Hicks, 2016).

Sources of Knowledge

Nine statements representing various sources of knowledge used in guiding antibiotic use in the clinical setting were provided in the survey. In rating these nine statements, providers were given the following instructions, "In the treatment of respiratory infections, rate the usefulness of resources of knowledge". Evidenced by the highest mean level of agreement (μ score= 85.9), results of the survey revealed that clinical practice guidelines represent the major source of knowledge used in guiding antibiotic use. Major sources such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) recommended that the appropriateness of antibiotic prescribing should be determined in accordance with evidence-based national and local clinical practice guidelines (CDC, 2019; WHO, 2020).

Evidenced by an overall mean level of agreement, other sources of knowledge found to have usefulness in guiding antibiotic use in the clinical setting included the following:

- Continuing Education Courses (μ score= 79.8)
- Others, e.g., Contribution of Specialists (microbiologists, infectious disease specialist, etc.) (μ score= 79.2)
- Previous Clinical Experience (μ score= 71.5)
- Contribution of Peers (of same specialization) (μ score= 63.9)
- Information Furnished by Medical Information Officers (μ score= 54.3)

Evidenced by the lowest mean level agreement (μ score= 39.9), results of the survey revealed that data collected via the internet was the least useful source of knowledge for guiding antibiotic use in the clinical setting. Although deemed by the providers as having minimal use in the clinical setting, data collected via the internet can be useful in informing antibiotic use in terms of tracking, surveillance, and antibiogram data (CDC, 2019). Various data sources for tracking and colleting antibiotic use data are available online. Data on antibiotic consumption has been used to identify target interventions designed to improve antibiotic use in the clinical setting (CDC, 2019). Evidenced by an overall mean level of disagreement, other sources of knowledge found to have minimal usefulness in guiding antibiotic use in the clinical setting included the following:

- Courses Held by the Pharmaceutical Industry (μ score= 40.6)
- Documentation Furnished by the Pharmaceutical Industry (μ score= 46.0)

Research Question #2: What differences exist between provider characteristics and antibiotic-prescribing behavior and knowledge of antimicrobial resistance in the primary and secondary setting? The secondary outcome of this project was to determine whether any differences between provider mean scores and provider characteristics existed. To answer research question two, univariate analysis of variance (ANOVA) statistical tests were done to identify whether any differences between numerical data (means scores) and provider characteristics existed (sociodemographics). Using exact p-values ($p \leq 0.05$) and 95% confidence intervals (CI), the following will discuss any statistically significant differences that were found between mean scores and provider characteristics, and how these differences relate to previous evidence.

Age

No statistically significant differences were found between statement mean scores and the provider characteristic of age. This finding implies that differences in the provider's years of age does not have a significant impact on antibiotic prescribing behavior. This finding is contradictory to a study conducted on 898 providers in the Carolinas Healthcare System from 2014 through 2016 (Dall, 2018). The results of this study found that providers aged 51-60 years were more than four times more likely to prescribe antibiotics for upper respiratory infections than providers aged 30 years or younger (Dall, 2018).

Gender

The provider characteristic of gender represented the largest proportion of statistically significant differences noted in an analysis of the surveys' results. A total of eight statistically significant differences were found to exist between male and female providers. Of these eight differences, five were noted in responses pertaining to knowledge, attitudes, and perceptions (KAPs) and three were noted in statements regarding useful resources of knowledge.

Compared to male providers ($\bar{x}$ score= 23.2), female providers ($\bar{x}$ score= 13.2) had a stronger level of disagreement with statement 4 ("The prescription of antibiotics does not influence the possible appearance of resistance") (p= 0.036). When compared to males ($\bar{x}$ score= 40.8), female providers ($\bar{x}$ score= 20.0) more strongly disagreed with the prescription of antibiotics in situations of doubt pertaining to disease etiology (p= 0.010). When compared to male providers ($\bar{x}$ score= 24.0), female providers ($\bar{x}$ score= 7.3) reported a stronger level of disagreement with prescribing antibiotics when facing time constraints as a barrier to explaining antibiotic indications (p= 0.027). When compared to male providers ($\bar{x}$ score= 25.9), female providers ($\bar{x}$ score= 13.8) more strongly disagreed that the phenomenon of antibiotic resistance is mainly a problem confined to the hospital setting (p= 0.041). Lastly, when compared to male providers ($\bar{x}$ score= 59.4), female providers ($\bar{x}$ score= 76.2) more strongly agreed that the two main causes of antibiotic resistance are related to factors involving patient self-medication and antibiotic misuse (p= 0.015).

In terms of rating useful resources of knowledge, female providers had a higher level of agreement pertaining to the use of clinical practice guidelines ($\bar{x}$ score= 90.8, p= 0.043) and continuing education courses ($\bar{x}$ score= 87.1, p= 0.003) as useful resources of knowledge for guiding antibiotic prescriptions in the clinical setting. Female providers reported they were more likely to use documentation furnished by the pharmaceutical industry ($\bar{x}$ score= 56.1), while male providers ($\bar{x}$ score= 35.5) generally disagreed with the usefulness of these resources to guide antibiotic practices in the clinical setting (*p*= 0.013).

In a study published in 2018 on 11,285 general provider (GP) consultations, the authors found that female GPs prescribed antibiotics less often than male GPs (Eggermont, Smit, Kwestroo, Verheij, Hek, & Kunst, 2018). In a study on 95,344 family practitioners, the authors Fleming-Dutra et al. (2017) stated that "male primary care providers aged 40 to 64 years were more likely to be high-volume antibiotic prescribers than their younger female colleagues" (p.2).

Type of Activity

In an analysis of variance (ANOVA), one statistically significant difference (*p*= 0.040) was found between mean scores and provider type of activity with statement 17 ("The phenomenon of resistance to antibiotics is mainly a problem in the hospital setting"). Providers working in both private and public practice had a higher level of disagreement ($\bar{x}$ score= 1.7) with statement 17 when compared to providers who reported working in private practice ($\bar{x}$ score= 17.6) or public practice ($\bar{x}$ score= 21.5) alone.

Although found to be statistically significant, these differences between mean scores and type of activity are negligible and insignificant for the purpose of making generalizations. What can be inferred is that the majority of the providers strongly disagreed that antibiotic resistance is a problem primarily confined to the hospital setting. This inference is well-aligned with previous research findings cited by the CDC and PEW Charitable Fund. In an analysis of key U.S. antibiotic prescribing statistics, the CDC found 80-90% of antibiotic consumption by volume occurs in the outpatient setting

(CDC, 2018). Furthermore, 1 in 3 antibiotics prescribed in U.S. outpatient settings are inappropriate (PEW Charitable Trust, 2017). Thus, it is fair to say that outpatient antibiotic prescribing is a major contributor to the overuse of antibiotics and issues of resistance in the U.S.

Workplace

A total of three statistically significant differences were found in the provider characteristic of workplace. In response to statement 8 ("I frequently prescribe an antibiotic in situations where it is impossible for me to conduct a systematic follow-up"), primary care providers strongly disagreed with this statement ($\bar{x}$ score= 31.4). In contrast, representing a statistically significant difference (p= 0.017), providers in the hospital setting agreed with the prescription of an antibiotic in situations of doubt regarding questionable follow-up ($\bar{x}$ score= 63.2). Current trends in antibiotic prescribing suggest that 80-90% of antibiotic consumption occurs in the outpatient setting (CDC, 2018) and one in three antibiotics prescribed in the outpatient setting are unnecessary (PEW Charitable Trust, 2018). In contrast, over fifty percent (50%) of all patients in the hospital-setting receive antibiotics (PEW Charitable Trust, 2018). However, current reporting on antibiotic use in the hospital setting is voluntary, not mandatory. Thus, with only a small fraction of hospitals currently reporting data on antibiotic usage, determining the appropriateness of antibiotic use in the hospital setting is limited. (PEW Charitable Trust, 2018).

Overall, the providers strongly disagreed with statement 10 ("I frequently prescribe antibiotics because patients insist on it") (μ score= 15.9) and statement 11 ("I sometimes prescribe antibiotics so that patients continue to trust me") (μ score= 13.1).

Providers working in both primary care and hospital settings had weak levels of disagreement with the above statements when compared to providers who worked in either primary care or the hospital setting alone. Although statistically significant (*p*= <0.00001), these differences were negligible. Regardless of workplace, all the providers had an overall mean score of disagreement with these statements. Furthermore, the low number of providers working in both workplace settings (*n*=5) would make it difficult to generalize any significant findings to a larger population.

Emergency Service

A total of three statistically significant differences were found in providers who reported working in emergency services. The first statistically significant difference was noted in the mean level of agreement between non-emergency providers and emergency providers regarding statement 8 ("I frequently prescribe an antibiotic in situations where it is impossible for me to conduct a systematic follow-up of the patient") (*p*=0.039). Regarding situations of doubt involving questionable patient follow-up, non-emergency providers disagreed with the prescription of antibiotics ($\bar{x}$ score= 36.6), whereas emergency providers weakly agreed with the prescription of antibiotics ($\bar{x}$ score= 57.3).

A study published by the Vermont Medical Society (VMS) involving emergency department (ED) providers from 12 separate hospitals found that the most common factors cited in influencing prescribing decisions in the ED included: 1) clinical uncertainty, 2) concern over lack of follow-up, and 3) patient expectations (VMS Education & Research, 2016). The lack of definitive follow-up, inability to reassess patient conditions after discharge, the need to make a definitive diagnosis and treatment plan in a timely manner, and organizational pressures to satisfy patient needs and prevent readmissions are all factors that influence the prescription of antibiotics in the ED (Denny et al., 2019).

Statistically significant differences were found between non-emergency and emergency service providers regarding the level of agreement with statement 17 (“The phenomenon of resistance to antibiotics is mainly a problem in the hospital setting”) (p= 0.019) and statement 14 (“Two of the main causes of the appearance of antibiotic resistance are patient self-medication and antibiotic misuse”) (p= 0.043). However, the overall mean score denoting either agreement (statement 14) or disagreement (statement 17) with these statements remained the same regardless of provider type (emergency versus non-emergency). Thus, these differences noted between emergency and non-emergency providers is likely insignificant in terms of making any generalizations to a larger population.

Number (#) of Patients per day

Intended to assess provider workload, data on the reported number of patients seen per day and time (minutes) needed to attend to one patient was evaluated. A total of four statistically significant differences were noted in the provider characteristic of number of patients per day. Of these four statistically significant findings, one difference was noted among KAP statements and three among useful resources of knowledge.

Of all 17 KAP statements, the greatest overall level of agreement (μ score= 90.5) was noted in statement 1 (“Antibiotic resistance is an important Public Health problem”). Representing a statistically significant difference (p= 0.028), the lowest level of agreement was noted in providers who reported seeing 5-10 patients per day ($\bar{x}$ score= 60.0) and providers who reported seeing 31 patients per day ($\bar{x}$ score= 70.5).

Representing two extremes, providers who saw the least and greatest number of patients per day had a lower overall level of knowledge regarding antimicrobial resistance as a major threat to public health. This finding, although likely insignificant, suggests that low-volume and high-volume patient workloads are possibly related to provider ignorance pertaining to antimicrobial resistance.

In terms of usefulness as a knowledge resource to guide antibiotic use, a statistically significant difference was noted in statement 20 ("Courses held by the Pharmaceutical Industry") ($p = 0.017$). Compared to the average level of agreement (μ score= 40.6), providers who saw the greatest volume of patients per day ($\geq$31) had the highest level of disagreement with statement 20 ($\bar{x}$ score= 16.5). This finding may suggest that providers with higher overall patient workloads lack the time needed to attend continuing education offered by representatives of the pharmaceutical industry.

Compared to an overall mean level of agreement reported by all other providers, statistically significant differences were also noted in statement 21 (p=0.005), statement 24 ($p = 0.005$), and statement 25 ($p = 0.003$). Providers with lowest patient workload (5-10 patients per day) and providers with the greatest workload ($\geq$31 patients per day) disagreed with the following resources of knowledge as being usefulness in guiding antibiotic use in the clinical setting: a) information furnished by medical information officers, b) contributions from other specialties, and c) contributions from peers of the same specialty. The differences noted in the level of agreement of providers with high-volume workloads could be attributed to barriers related to time constraints. However, as time constraints would not be a factor in providers with low-volume workloads, the differences noted here would be difficult explain and therefore would be challenging to imply any generalizations.

Time Needed to Attend to a Patient

Overall, the providers agreed with the use of rapid effective techniques as a requirement for diagnosis of infectious disease (μ score= 57.0). However, providers who reported they needed 45 minutes ($\bar{x}$ score= 27.0) or greater ($\bar{x}$ score= 46.7) to attend to one patient disagreed with use of rapid effective diagnostics (p=<0.00001). In an effort to reduce disruption of existing patient workflows, providers who require more time to attend to a patient may opt to prescribe antibiotics rather than using available diagnostic techniques (Van Hecke, Butler, Mendelson, & Tonkin-Crine, 2019).

Regarding statement 6 ("The use of antibiotics on animals is an important cause of the appearance of new resistance to pathogenic agents in humans"), only the providers who reported they needed approximately 30 minutes to attend to a patient agreed with this statement ($\bar{x}$ score= 81.6) while all other providers requiring either more or less than 30 minutes disagreed ($\bar{x}$ score= $\leq$ 49). This statement specifically measures knowledge relating to the responsibility of others (i.e. agricultural and food industries). The overuse of antibiotics on food and animal products can result in resistant bacteria to contaminate food and serve as a carrier that can be passed on to people who consume these foods (CDC, 2013). The poor mean level of agreement with the use of antibiotics on animals as an important cause to resistance signifies a knowledge gap identified in this provider population. However, regarding this statement it is difficult to explain the differences noted between mean scores and the time needed per patient.

Statement 9 ("In situations of doubt as to whether a disease might be of bacterial etiology, it is preferable to prescribe an antibiotic") was intended to measure an aspect of clinical uncertainty. A statistically significant difference was noted in terms of minutes per patient (p= 0.049). Providers who reported they needed approximately 45 minutes per patient ($\bar{x}$ score= 66.0) and 60 minutes or greater to attend to a patient ($\bar{x}$ score= 47.7) had a higher level of agreement with statement 9 when compared to the overall average level of disagreement of the sample (μ score= 30.9). This finding suggests that providers who need greater amounts of time to attend to a patient may opt to prescribe antibiotics in situations of clinical uncertainty at higher rates when compared to providers who need less time to attend to a patient. In a qualitative study of provider KAPs concerning antibiotic use, the authors found that the most frequent reason cited for over-prescribing antibiotics was clinical uncertainty (VMS Education & Research, 2016). In a study investigating determinants of antibiotic prescribing, the authors Chan, Bin-Ibrahim, Wong, Ooi, and Chow (2019) stated that "despite departmental norms of not prescribing antibiotics for upper respiratory tract infections (URTIs), physicians would prescribe antibiotics when faced with uncertainty in patients' diagnoses, especially under time constraints" (p.1).

Statement 14 ("Two of the main causes of appearance of antibiotic resistance are patient self-medication and antibiotic misuse") was intended to measure a factor related to provider ignorance. Compared to an overall mean score of agreement (μ score=67.8), providers who reported they needed approximately 60 minutes or greater to attend to one patient had a mean level of disagreement ($\bar{x}$ score= 42.3) with statement 14 (p= 0.049). This finding suggests that providers who require greater amounts of time to attend to a patient have a lower level of knowledge pertaining to major causes of antibiotic resistance. As stated by the CDC (2013), "the use of antibiotics is the single most important factor leading to antibiotic resistance" (p.11). Improving the use of antibiotic is a major priority necessary for combatting the antimicrobial resistance crisis (CDC, 2013).

Observations

Knowledge, attitudes, and perception (KAPs) statements and usefulness of clinical resource statements were measured to assess provider-related factors (fear, complacency, ignorance, indifference, and responsibility of others) pertaining to antibiotic use and resistance. Based on overall mean scores, the providers of this sample possessed a strong level of understanding pertaining to knowledge of antibiotic use and resistance. The findings suggest that inappropriate antibiotic use is not the result of provider ignorance or unfamiliarity with clinical practice guidelines. Rather, inappropriate prescribing may be better explained as the result of complex interactions involving both patient-related and provider-related factors. Factors related to patient satisfaction/pressures, time constraints, patient workload, gender differences, questionable follow-up, and clinical uncertainty all appear to be linked with the inappropriate use of antibiotics.

In an analysis of variance (ANOVA) of statement mean scores and sociodemographic data, interesting observations were noted in the provider characteristics of gender, workplace, emergency services, number of patients seen per day, and time needed to attend to a patient. In terms of gender, female providers had an overall greater understanding of appropriate antibiotic use, antimicrobial resistance, and were more likely to utilize multiple knowledge resources in the clinical setting.

Compared to male providers, the findings suggest that female providers are less likely to prescribe antibiotics in situations of doubt and are less likely to give into patient pressures to prescribe antibiotics under time constraints. Female providers showed an overall greater level of knowledge pertaining to the major causes of antimicrobial resistance. Showing a greater level of understanding that the phenomenon of antibiotic resistance is not isolated to the hospital setting, female providers were less likely to displace responsibility of appropriate antibiotic prescribing. Lastly, the findings suggest that female providers are more likely to use various forms of knowledge resources to guide antibiotic use in the clinical setting.

Another interesting finding was noted in providers who worked in emergency medicine and the hospital setting. The findings suggest that providers working in the emergency department and hospital setting frequently prescribe antibiotics in situations of questionable patient follow-up. Additionally, when compared to providers who work in primary care or the hospital setting alone, providers working in both settings were more likely to prescribe antibiotics due to patient pressures and/or insistence.

Regarding provider workload, the findings suggest that providers with high-volume patient workloads are less likely to utilize knowledge resources to guide antibiotic use. In terms of time needed to attend to one patient, the results suggest that providers who need 45 minutes or more are less likely to use rapid effective diagnostic techniques to aid in the diagnosis of infectious disease in the clinical setting. Additionally, providers who need 45 minutes or greater are more likely to prescribe antibiotics in situations of clinical uncertainty and are less likely to recognize antibiotic misuse as a major cause of antimicrobial resistance. These findings suggest that high-volume workloads and time constraints contribute to the inappropriate use of antibiotics, lack of resource utilization, and knowledge-gaps pertaining to the etiology of antimicrobial resistance.

Evaluation of Theoretical Framework

The “Theory of Planned Behavior” or TPB developed by the author Icek Ajzen (1991) was the theoretical framework used for the purpose of this scholarly project (Figure 1). The predictive theory of planned behavior was selected for the purpose of facilitating the process of investigating “why” antibiotic prescribing behaviors are influenced by personal beliefs, societal norms, and perceived control over one’s own behavior. The student used this theoretical framework as the basis for selecting the pre-validated survey used to explore provider’s knowledge, attitudes, and perceptions regarding antibiotic use and resistance.

Personal beliefs of the providers were measured in terms of level of agreement with KAP statements that assessed provider perception of patient pressure, perception of responsibility of others, complacency, and knowledge of antimicrobial use and resistance. The perceived control over one’s own prescribing ability was assessed through statements that addressed clinical uncertainty, use of diagnostic techniques, differentiation of disease etiology, and prescribing in situations of doubt. Lastly, societal norms were assessed through statements addressing perceived patient pressure, knowledge of antimicrobial resistance as a public health crisis, attitudes towards providers of other practice settings, perceptions of antibiotic selection, root causes of resistance, and potential solutions to address issues of resistance. Results of the project support the TPB theory’s suggestion that personal beliefs and attitudes held by the provider, societal beliefs, patient satisfaction/pressure, and control over one's own behavior all influence the prescription of antibiotics either appropriately or inappropriately.

Evaluation of Logic Model

After evaluating the results, the proposed logic model appears to support the overall intended purpose the model intended to accomplish. The logic model (Figure 2) depicted a series of relationships the project set out to define and accomplish. These relationships included inputs, interventions, outputs, and effects. The proposed input was to develop a greater understanding of provider antibiotic prescribing behavior by exploring their knowledge, attitudes, and perceptions. Interventions involved the use of a pre-validated survey to explore provider-level factors involved in antibiotic use and knowledge of resistance. Proposed outputs included the participants, study site, population, time-frame, and collection method. The inputs, interventions, and outputs proposed in the logic model remained the same throughout the progression of the project. The proposed effects of the survey involved outcome measurements of survey results using statistical analysis. One area where the proposed logic model differed from the actual project was the statistical testing methodology used for data analysis. Univariate analysis of variance (ANOVA) replaced the proposed use of the Chi-Square test as the method for determining statistically significant findings. Lastly, as proposed in the logic model, application of survey results was used to identify target educational resources and strategies focused on enhancing both provider and consumer awareness of appropriate antibiotic use and resistance.

Limitations

A major limitation of this study was the sample size. Using a Cohen's Statistical Power Analysis, an estimated sample size of 85 participants was determined to be an appropriate number for determining statistical significance. Despite re-opening the survey and sending out multiple reminders, the researcher was able to include only 54 participant responses in the final product of this scholarly project. The low response rate (46.6%) incurred in this project was in part thought to have occurred due to the timing of the survey's distribution. With the onset of major holidays and vacation-time that are inherent during the months of December and January, the overall response rate of the survey likely could have been enhanced by distributing the survey either before or after these months.

An inherent limitation common in many study's that involve surveys is difficulty in controlling respondent bias. As the survey used in this project sought to identify knowledge gaps pertaining to the proper use of antibiotics, the possibility for demand or socially desirable bias cannot be ruled out. Rather than answering truthfully, the providers may have felt pressured to answer statements in ways they deemed correct, socially acceptable, and/or aligned with evidenced-based medicine. Respondent bias is highly suspected as the overall results of this study show that the providers of this sample obtain a high level of knowledge and understanding pertaining to proper antibiotic use and antimicrobial resistance. In contrast to these findings, current trends in antibiotic use suggest at least 30% and up to 50% of all antibiotics prescribed are unnecessary (CDC, 2018). A consensus of current data show that although providers understand current practice guidelines, antibiotics continue to be prescribed inappropriately at exponentially high rates in both the inpatient and outpatient setting.

While convenience sampling is the most widely used methodology employed in developmental science, it nevertheless constitutes a limitation of this study (Jager, Putnick, and Bornstein, 2017). Relative to probability sampling techniques, convenience sampling is often chosen for its cost-effectiveness, ease of use, and less time required to carry out the sampling process. Compared to probability sampling, data constructed by convenience sampling produces less clear generalizability (Jager et al., 2017). As the sample was not chosen at random, it is therefore important to note that inherent bias in convenience sampling may result in a sample that is less likely to be representative of the population being studied.

The pre-validated survey used in this project employed a continuous unnumbered visual analogue scale. In contrast to the traditional Likert VAS commonly used in similar studies, the continuous unnumbered VAS measurement methodology minimizes the possibility of extreme response and neutral response biases. In addition, rather than simply rating on a scale of 1-to-10 or agree-to-disagree, the continuous unnumbered VAS provides greater versatility for respondents to answer using specific numeric ratings that allows for more accurate statistical data reporting through determination of mean scores. However, as the authors Pincus et al. (2008) stated, the relatively new concept of unnumbered continuous VASs may increase the difficulty in understanding the complexity of the rating methodology and possibly lead to higher rates of respondent non-compliance.

Lastly, it is important to note that the original survey developed by Rodrigues et al. (2016) was adapted for the purpose of this study. A total of three adaptions were made to the original survey. Described in greater detail in chapter three, adaptions included omission of wording and exclusion of two survey statements. The original survey was developed in South America. Differences in laws and regulations having influence on antibiotic prescribing and use exist between countries of South America and are quite different from those in the United States. For example, the general public can obtain an antibiotic without a prescription in many areas throughout South America. For this reason, statements pertaining to the concept of obtaining an antibiotic without a prescription are less applicable to providers in the U.S. Furthermore, wording and sentence structure slightly differ from one country to another. Thus, some of the providers may have found some statements confusing or redundant. Whether these subtle differences reflect any form of limitation is unclear, nevertheless it remains important to note as a potential disadvantage of this study.

Implications for the Future

Current trends in antibiotic use in the U.S. suggest that at least 30% and up to 50% of all antibiotics prescribed are unnecessary (CDC, 2018). Antibiotic misuse is not a phenomenon that occurs in a vacuum and blame can neither be placed fully on the patient nor the provider. The outdated practice of indiscriminate antibiotic prescribing that has taken place for centuries has left current and future providers with major challenges in controlling the expectations and lack of knowledge of the general public pertaining to the appropriateness of antibiotics. However, the prescription of an antibiotic still remains heavily dependent on the clinical knowledge, experience, and discretion of the provider.

Therefore, understanding the knowledge, attitudes, perceptions of the prescribing provider is an essential aspect for developing targeted antimicrobial stewardship education and interventions to address the public health crisis of antimicrobial resistance (CDC, 2013).

Implications for future research pertaining to this project include the wide-spread use of KAP surveys in various clinical settings incorporating large samples sizes following probability sampling techniques. Enhancing the sample size and targeting multiple clinical settings through random sample collections would provide greater value and generalizability of the findings to the population.

The majority of statistically significant findings of this study involved differences in KAPs according to gender and provider workload. Further future research should be done to examine differences between female and male antibiotic prescribing practices, including KAPs, use of clinical decision tools, and overall prescribing rates between both genders. Statistically significant differences in provider KAPs were also noted in reported numbers of patients seen per day and time needed to attend to a patient. Supported by previous studies, provider-related factors including time-constraints and patient workloads have been cited as major factors influencing antibiotic prescribing decisions (VMS Education & Research, 2016). Thus, further research should be done to examine the impact of factors such as the workplace/environment, patient care-load expectations, and time-constraining pressures influence on provider’s antibiotic prescribing rates and behaviors.

Implications for Practice, Health Policy, & Education

Participants of this study recognized that antibiotics are widely over-used. Participants recognized that antimicrobial resistance poses as a major threat to public health. Providers in both the primary and secondary setting recognized the shared responsibility of prescribing antibiotics appropriately and that blame cannot be placed and isolated to one practice setting over another. Participants recognized the usefulness of clinical practice guidelines as the most important tool for guiding decisions related to antibiotic use. Statistically significant differences noted in KAP statements suggest that female providers have an overall greater level of understanding pertaining to appropriate antibiotic use and knowledge of resistance. Compared to primary care providers, the findings suggest that hospital and emergency medicine providers are more likely to prescribe antibiotics in situations of clinical uncertainty and questionable follow-up. Lastly, providers with high-volume patient workloads were less likely to utilize rapid diagnostic techniques, less likely to utilize clinical decision resources, more likely to experience greater clinical uncertainty, and had an overall poorer level of understanding pertaining to major root causes of antimicrobial resistance.

A comprehensive literature review revealed that the most common factors cited in influencing inappropriate antibiotic use include: 1) patient pressures of expectation and satisfaction, 2) clinical uncertainty, and 3) concerns over the lack of follow-up (Dekker et al., 2015; Hruza et al., 2018; PEW Charitable Trust, 2017; Sanchez et al., 2014; VMS Education & Research, 2016; Yates et al., 2018). Major findings of participant responses suggest that inappropriate antibiotic selection is not caused by lack of knowledge of clinical practice guidelines or evidence-based practice. Rather, the findings of this project suggest that inappropriate prescribing may better be explained as the result of complex interactions between both the prescribing provider and the patient seeking care. Analysis of variance (ANOVA) revealed that provider characteristics including gender, clinical uncertainty, concerns over lack of follow-up, and time constraints influence the appropriate use of antibiotics. Lastly, qualitative data of provider responses suggest that patient-related factors pressure providers into inappropriately prescribing antibiotics. Provider cited patient-related factors included the following: 1) lack of education, 2) false perceptions of proper antibiotic use, 3) ignorance of viral self-limiting etiology versus bacterial etiology, and 4) poor balance of patient health versus customer satisfaction.

The overall purpose of this scholarly project was to identify and explore provider's knowledge, attitudes, perceptions, and prescribing practices related to antibiotic use and resistance. Improving prescribing by understanding the underlying factors influencing prescribing behaviors is a central component necessary for identifying educational strategies and designing effective antimicrobial stewardship interventions (PEW Charitable Trust, 2017). Based on a comprehensive literature review and the results of this study, target educational strategies were identified. Educational stratagies focusing on public awareness and professional learning opportunities have been shown to enhance knowledge of appropriate antibiotic use (Lee et al, 2015). The clinical significance of the findings of this project have implications in APRN practice, health policy and education by enhancing the body knowledge of appropriate antibiotic use and resistance in the primary and secondary care setting. Identified educational strategies targeted at improving appropriate antibiotic use will be discussed in the following paragraphs.

Targeted Educational Strategies

Insufficiency of knowledge pertaining to the appropriate use of antibiotics is a major driver of antibiotic resistance (Lee et al., 2015). Targeted educational strategies aimed at both the prescribers and the public have been identified as an effective and important means for enhancing knowledge of prudent antibiotic use in both the primary and secondary care setting (Lee et al., 2015).

Acute upper respiratory tract infections are one for the most common reasons for which antibiotics are prescribed (CDC, 2013). In the outpatient setting, an estimated 40% to 50% of antibiotics prescribed for Acute URIs are unnecessary (Hart, 2007). Clinical practice guidelines (CPGs) have been developed to help aid in the proper diagnosis and treatment of acute URIs. Respondents of this project support the use of CPGs to help reduce inappropriate antibiotic prescriptions. One provider commented "better access and distribution of evidence-based medicine" would be beneficial. Another provider emphasized the importance to "practice evidence-based medicine". Furthermore, one provider stated the need for "consistency among providers" and emphasized the "use of the same up-to-date guidelines" should be incorporated and followed per local hospital policy. Current evidence-based recommendations and CPGs for the diagnosis and treatment of common acute URIs are found in the appendices of this project (Appendix D & Appendix E).

Useful educational resources, handouts, posters, and fact sheets have been developed by the CDC for the purpose of enhancing public awareness on the appropriate use of antibiotics and issues of resistance. These resources are provided free-of-charge on the CDCs website and are intended to be printed, distributed, and advertised in the primary and secondary care setting (CDC, 2020). Based on the findings of this project and suggestions made by the providers, the researcher identified CDC educational resources that can be used in the clinical setting for the purpose of enhancing patient and healthcare provider awareness of appropriate antibiotic use and resistance. These targeted educational resources are found in the appendices of this project (Appendix I-K). Appendix I includes targeted educational resources for patients. Appendix J includes educational resources and strategies that health care providers can utilize in the clinical setting to help curb inappropriate antibiotic use. These strategies include symptomatic relief, delayed prescribing, and watchful waiting. Lastly, Appendix K represents posters of targeted educational information intended to be advertised in both the inpatient and outpatient setting.

Based on qualitative data collected from respondent suggestions, key educational pearls and messages concerning antibiotic use and resistance were included. The following (Table 8) represents pertinent data compiled from the CDCs “Be Antibiotics Aware” toolkit (2020). As a compliment to the U.S. Antibiotic Awareness Week (USAAW) campaign, “Be Antibiotics Aware” is a year-round CDC educational effort intended to raise public awareness on the importance of appropriate antibiotic use and the current crisis of antimicrobial resistance. The CDC invites users to openly share key messages and resources from the toolkit to healthcare partners, organizations, and the general public.

Table 8. Key messages from the Centers for Disease Control & Prevention (CDC) “Be Antibiotics Aware” toolkit *	
Topic/Target Population	**Key Messages**
Antibiotic Resistance	• Antibiotics are live-saving medications but anytime antibiotics are used, they can cause adverse effects and can lead to antibiotic resistance • Antimicrobial resistance is one of the most urgent threats to the public’s health • In the U.S. alone, more than 2.8 million infections occur from antibiotic-resistant bacteria and more than 35,000 die every year as a result • Antibiotic resistance is the result of bacteria developing the ability to survive antibiotics mechanism of action • When bacteria become resistant, antibiotics lose their effectiveness, and the bacteria multiply • Resistant bacteria can be hard or even impossible to treat and can spread from person to person
Antibiotic Considerations	• Antibiotics save lives and are critical tools used to treat infections, but they can lead to adverse effects • 1 out of 5 medication-related visits to the emergency department (ED) are caused by reactions from antibiotics • Reaction from antibiotics are the most common cause of medication-related ED visits in children • Common side effects of antibiotics include rash, dizziness, nausea, diarrhea, and yeast infections • Improving the way providers prescribe antibiotics, and the way we take antibiotics, helps keep us healthy now, helps prevention antibiotic resistance, and ensures that the life-saving abilities of antibiotics will be available for future generations
Messages for Consumers	• Antibiotics save lives • Antibiotics are not always the answer • Antibiotics do not work on viruses • Thick, yellow, or green mucus alone does not indicate a bacterial infection • Antibiotics are only indicated to treat bacterial infections, but even some bacterial infections get better without antibiotics

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The majority of common upper respiratory infections do not require antibiotics
Antibiotics will not help or make you feel better if you have a virus, and the side effects could still cause harm
Taking antibiotics can lead to antibiotic resistance
If an antibiotic is needed, take exactly as prescribed
Development of severe diarrhea, while taking or shortly after taking antibiotics, could indicate C. difficile infection
Practice Prevention:

Frequent handwashing
Cover your mouth or nose when coughing or sneezing
Stay at home when sick
Stay up-to-date on recommended vaccinations

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<tr><td>Messages for Outpatient Healthcare Providers</td><td>

Follow clinical practice guidelines to determine:

Antibiotic indication
Selection of appropriate antibiotic class, dose, and duration

A key antibiotic stewardship strategy that should be employed in all healthcare settings= Shortening the duration of antibiotic therapy to the minimum effective duration
Protect your patients:

Only prescribe antibiotics when necessary
Harm can be caused by prescribing antibiotics when they are not needed

Viral Illnesses:

Educate your patients on why antibiotics are not indicated
Provide alternative symptomatic treatment
Educate on return precautions

Educate your patients about the possible harms from antibiotics, including adverse reactions, allergic reactions, C. difficile, and resistance
Perform hand hygiene and follow infection prevention measures with every patient encounter

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Messages for Inpatient Healthcare Providers	• Follow clinical practice guidelines • Review antibiotic therapy 48 to 72 hours after initiation based on the patient's condition and culture results, and stop or adjust antibiotic orders as needed • Educate about when antibiotics are not needed, and discuss possible harms of antibiotic therapy • Be aware and consider antibiotic resistance patterns in your facility and community (i.e. antibiogram) ○ Use this data to inform prescribing decisions • Perform hand hygiene and follow infection prevention measures with every patient encounter

The Antimicrobial Resistance (AMR) Challenge	• The AMR Challenge is a U.S. Government yearlong effort intended to accelerate the prevention of antibiotic resistance encompassing actions across multiple sections including governments, private industries, and civil societies.
	• The five commitment (or key actions) of the AMR Challenge include:
	    ○ Antibiotic use: Improve antibiotic use, ensure continued access
	    ○ Environment & sanitation: Decrease antibiotics and resistance in the environment
	    ○ Infection prevention and control: Prevention of infections and reduce the spread of resistant organisms
	    ○ Tracking and data: Share data and improve data collection
	    ○ Vaccines, therapeutics, and diagnostics: Invest in development and improved access

***Reference:** Centers for Disease Control and Prevention. (2020). Be antibiotics aware partner toolkit: Key messages. *Centers for Disease Control and Prevention (CDC)*. Retrieved from https://www.cdc.gov/antibiotic-use/week/toolkit.html#anchor_1538597291	

Practice & Health Policy Suggestions

In 2014, the CDC released a document titled "Core Elements for Hospital Antibiotic Stewardship" that called for the incorporation of antimicrobial stewardship programs in all major U.S. hospitals. At the time of its publication in 2014, only 41% of acute care hospitals reported having antimicrobial stewardship programs in place. In 2018, 85% of acute care hospitals in the U.S. reported having all seven core elements of the CDCs proposed antimicrobial stewardship program in place (CDC, 2020). The core elements proposed by the CDC later went on to form the foundation for antibiotic stewardship accreditation standards of the Joint Commission (CDC, 2020).

The Joint Commission (2019) identified antimicrobial stewardship as an organizational priority stating, "effective January 1, 2020, new antimicrobial stewardship requirements will be applicable to Joint Commission-Accredited Healthcare Organizations (JCAHO) that routinely prescribe antimicrobial medications" (p.1). As of 2019 under the conditions of participation (CoP) rule, all U.S. hospitals will now be required to have infection and prevention and stewardship programs in order to receive payments from Centers for Medicare and Medicaid services (CMS) (Dall, 2019). The JCAHO and CMS requirements are to be aligned and based on the recommendations developed by the CDCs "Core Elements of Antimicrobial Stewardship Programs" (CDC, 2019). Under the U.S. National Action Plan to combat antimicrobial resistance, the CDC set a goal for the implementation of antimicrobial stewardship core elements in all U.S. hospitals that receive federal funding (CDC, 2020).

In addition to policy initiatives structured to reduce antibiotic use in the hospital setting, the document published by the CDC titled "Core Elements of Outpatient

Antibiotic Stewardship" specifically addresses strategies to reduce inappropriate antibiotic prescribing in outpatient and ambulatory care settings (CDC, 2016). The four core elements of outpatient antibiotic stewardship include: 1) commitment, 2) action for policy and practice, 3) tracking and reporting, and 4) education and expertise (Appendix F). At least 30% and up to 50% of all antibiotics prescribed in the outpatient setting are unnecessary (CDC, 2018). As stated by the CDC (2018), "antibiotic prescribing nationally has improved, with a 5% decrease from 2011 to 2016, but more progress needs to be made" (p.5). In 2016, in response to the continued urgent need to combat antibiotic resistance, Congress appropriated financial resources for the CDC to implement the "Antibiotic Resistance (AR) Solutions Initiative".

The Antibiotic Resistance (AR) Solutions Initiative is a federally-funded program designed to improve the United States' capacity to: 1) detect, respond to, and contain emerging resistance, 2) prevent and stop the spread of resistant infections in healthcare and the community settings, and 3) improve the overall use of antibiotics (CDC, 2018). Through the AR Solutions Initiative, the CDC partners with various organizations throughout both healthcare and community settings to aggressively drive political action and empower the nation to comprehensively respond to the growing threats of resistance (CDC, 2020). An overview of the CDCs AR Solutions Initiative as well as information on the latest antibiotic resistance activities for the states of Missouri and Kansas can be found in the appendix of this project (Appendix L).

The CDC set a national standard goal to reduce inappropriate antibiotic prescribing practices by 50% in the outpatient setting and 20% in the hospital setting (CDC, 2020). Applicable to the overall purpose of this DNP project, the AR Solutions

Initiative describes the importance of monitoring and tracking data pertaining to antibiotic use and trends to better understand prescribing practices in both the hospital and outpatient setting (CDC, 2020). To accomplish this, the AR Solutions Initiative recommends expanding the use of the CDC's National Healthcare Safety Network (NHSN). The NHSN surveillance program can be used to develop strategies for improvement by collecting pertinent data that helps us better understand differences in prescribing patterns of inpatient and outpatient settings at both the state and national level (CDC, 2020).

The NHSN is a secure internet-based surveillance system developed and managed by the CDC's Division of Healthcare Quality Promotion (DHQP) that collects mandated and voluntary reported data on antimicrobial use and resistance (CDC, 2014). The program uses the Standardized Antimicrobial Administration Ratio (SAAR) metric as the means for analyzing and reporting antimicrobial use data (CDC, 2014). Nationally reported SAAR metric is used by institutions to track antimicrobial use, assess antimicrobial stewardship program effectiveness, and compare their findings with national SAAR benchmark data reported by other various programs participating in the program (Avedissian et al., 2019).

The CDC's NHSN surveillance program is an effective means of monitoring and tracking antibiotic use in the U.S. However, in its current state, the majority of participation is voluntary, with only a small fraction of healthcare settings required to make mandatory use of the program (PEW Charitable Trust, 2018). As stated by the PEW Charitable Trust (2018), "mandatory reporting would provide the data needed to establish a more accurate baseline of current use, identify where and what types of stewardship interventions would be most effective, and measure progress toward reducing inappropriate prescribing" (p.5). Future efforts should focus on establishing national policies that require major healthcare organizations to mandatorily report antibiotic use data to the NHSN surveillance program.

Conclusion

Antimicrobial resistance (AMR) is a major public health crisis that threatens the very integrity of our nation's healthcare system. AMR contributes significantly to increased healthcare costs, increased length of hospital stays, higher readmission rates, increased morbidity and mortality, and overall poorer patient outcomes. The single most important factor leading to resistance is the use of antibiotics (CDC, 2013). Current estimates suggest that at least 30% and up to 50% of all antibiotics prescribed are unnecessary (CDC, 2018). The outpatient and ambulatory setting accounts for the majority of antibiotic consumption in the U.S., with acute upper respiratory conditions being the most common reason for which antibiotics are prescribed. The majority of acute URIs are the manifestation of self-limited viral infections that rarely warrant an antibiotic prescription; however, antibiotics are prescribed 40% to 50% of the time for these conditions (Hart, 2007).

Countless clinical practice guidelines and evidence-based resources strongly recommend against the prescription of antibiotics for common acute upper respiratory indications (CDC, 2020). Despite surmounting evidence, antibiotics continue to be inappropriately prescribed for these conditions at alarmingly high rates across all healthcare settings (CDC, 2018). In an effort to describe this phenomena, major interest has been placed on exploring provider-related factors concerning antibiotic prescribing behaviors.

The overall purpose of this DNP scholarly project was to identify and explore healthcare provider's knowledge, attitudes, perceptions, and prescribing practices concerning antibiotic use and resistance. For this purpose, an adapted pre-validated survey developed by Rodrigues et al. (2016) was administered to 116 providers working in primary and secondary care settings in Southwest Missouri and Southeast Kansas. A total of 54 responses (46.6% response rate) were included in the final product of this project. Statistical analysis utilizing mean scores and univariate analysis of variance (ANOVA) found that the providers of this sample had a good overall understanding or antibiotic prescribing practices. Statistically significant differences in mean scores suggested the following: 1) compared to males, female providers had an overall greater understanding of appropriate antibiotic prescribing practices; 2) compared to primary care providers, providers in the hospital and emergency medicine setting are more likely to prescribe antibiotics in situations of doubt and questionable follow-up; and 3) providers with high-volume workloads were less likely to utilize clinical decision tools, rapid diagnostic techniques, had an overall poorer comprehension of major causes of antibiotic resistance, and were more likely to prescribe antibiotics in the face of clinical uncertainty.

Outcomes of this study suggest that barriers to appropriate antibiotic prescribing are related to time constraints, high-volume workload, clinical uncertainty, and lack of patient education. Previous studies provide evidence that patient pressures involving satisfaction and lack of knowledge are also a major factor involved in the inappropriate prescription of antibiotics (Dekker et al., 2015; PEW Charitable Trust, 2017) A consensus of current data show that providers understand the concept of appropriate antibiotic prescribing and are familiar with current practice guidelines, yet antibiotics continue to be prescribed inappropriately at exponentially high-rates in both the inpatient and outpatient setting. In addition to the findings of this project, the presentation of pertinent substantiated literature concerning current guidelines, educational resources, and national/political strategies combine to contribute and enhance the body knowledge of appropriate antibiotic use and resistance in the primary and secondary care setting.

Improving prescribing by understanding the underlying factors influencing prescribing behaviors is a central component necessary for identifying educational strategies and designing effective antimicrobial stewardship interventions (PEW Charitable Trust, 2017). Based on previous findings, findings of this project, and replies from the respondents, targeted educational resources and strategies were identified and supplied in the appendices. The targeted educational resources are intended to enhance both patients' and providers' awareness of antibiotic use and resistance while also providing the latest evidence-based recommendations and strategies to support the appropriate use of antibiotics in the clinical setting.

Antibiotics save lives and are one of the most widely used medications in modern medicine (CDC, 2013). However, antimicrobial resistance threatens the future usefulness of these life-saving medications. The unchecked inappropriate use of antibiotics that has plagued our healthcare system for centuries has resulted in the incidence of resistance to occur in nearly all antibiotics offered in medicine. Antibiotic misuse is not a phenomenon that occurs in a vacuum and blame can neither be placed fully on the patient nor the provider. Organizations, healthcare providers, and patients all must work together to promote the appropriate use of antibiotics. Enhancing the awareness of antimicrobial resistance, improving the way we as providers prescribe antibiotics, and educating and altering patient expectations, will help keep us healthy now, helps prevent the occurrence of resistance, and ensures that the life-saving abilities of antibiotics will be available for future generations (CDC, 2020).

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The data analysis for this paper was generated using Qualtrics Software, Version (Core XM January 2020) of the Qualtrics Research Suite. http://www.qualtrics.com

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APPENDIX

Appendix A

Literature Review

DESCRIPTIVE LITERATURE	
Title/Author/Date/Journal or Source	**Key Findings**
An evidenced-based approach to the diagnosis and management of acute respiratory infection. Hart. 2007. *Journal for Nurse Practitioners.*	-Acute respiratory infections (ARIs) are the most common reason for which antibiotics are prescribed. -ARIs include: common cold, acute rhinosinusitis, acute pharyngitis, and acute bronchitis. -Most ARIs are due to self-limited viral infections, however antibiotics are prescribed 40% to 50% of the time. -Two most common reasons clinicians prescribe antibiotics inappropriately: 1) patient satisfaction, and 2) misinformed about the nature and course of ARIs and often possess outdated information. -Common Cold: viral non-specific infection lasting 1-2 weeks. Less than 2% complicated by bacteria. Antibiotic do not shorten the course and are not recommended. Management: symptom relief (decongestant, anti-inflammatories).. -Acute Rhinosinusitis: inflammation of nasal mucosa and paranasal sinuses lasting less than 4 weeks. Less than 2% from bacterial origin. Consider bacterial origin only if moderate to severe symptoms (sinus pain, tooth pain, and nasal congestion) for greater than 7 days. Management: symptom relief (decongestants, anti-inflammatories, nasal steroids).

	-Acute Pharyngitis: mostly viral (adenovirus, rhinovirus, influenza). 5% to 15% due to Group A Beta-Hemolytic Strep (GABHS). Pharyngeal cultures or rapid antigen detection test (RADT) recommended testing in all patients with features of GABHS (sudden, fever, inflammation, N/V, hx of exposure, age 5-15yrs, etc.). Management: acetaminophen, NSAIDs, fluids, and consider short course of oral steroids. -Acute Bronchitis: cough as predominant symptom that is persistent for less than 3 weeks. Mostly viral. 5% to 10% bacterial. In the absence of B. Pertussis, antibiotics are not recommended. Management: reassurance of viral origin and spontaneous resolution usually in 2 weeks, Inhaled short-acting beta agonists and short trial of antitussives reasonable. - Purulent drainage, tonsillar exudate, and sputum color/consistency are poor diagnostic indicators for bacterial infection. -Withholding antibiotics for ARIs does not decrease patient satisfaction and symptomatic relief should be offered in place of antibiotics for most patients presenting with ARIs.
Antibiotic resistance threats in the United States, 2013. 2013. *Centers for Disease Control and Prevention.*	-The 1940's, often referred to as the "Golden Era of Antibiotics", marks the introduction of antibiotics for the purposes of treating serious infections. "Since then, antibiotic have saved millions of lives and transformed modern medicine (p.41)". • However, resistance to penicillin was noted shortly after its introduction in the 1940's. And just like the resistance developed against penicillin, over the past 70 years "bacteria shown the ability to become resistant to every antibiotic that has been developed (p.41)". • Antibiotics are a highly effective but limited resource. History shows us that the more antibiotics are used, the more

	quickly bacteria develop resistance, and the less likely antibiotics will remain effective in the future. -Antibiotic resistance, also commonly referred to as antimicrobial resistance (AMR), is a global threat. Strains of antibiotic resistance bacteria can be passed from person-to-person, cross international boundaries, and spread between continents with remarkable speed and ease. -Described as "nightmare bacteria" that "pose a catastrophic threat" to persons in every country of the world (CDC, 2013, p.11). -AMR is associated with considerable excess health care costs, extended hospital stays, increased surgical complications, increased morbidity and mortality, and poor patient outcomes. -As AMR continues, antibiotics used to treat infections do not work as well or at all. Many acute illness and exacerbations of chronic illnesses rely on the ability of antibiotics to fight infections. When the ability of antibiotics to effectively fight infections is lost, the ability to offer "many life-saving and life-improving modern medical advantages will be lost with it" (CDC, 2013, p.24). -An estimated $20 billion in excess of direct health care costs and $35 billion in indirect costs in the United States alone is attributed to AMR, although the actual number is likely much higher. -In the United States, 2 million illnesses & 23,000 deaths per year caused by antibiotic resistant infections. -*Clostridium Difficile*, although not significantly resistant to drugs, is directly related to antibiotic use and resistance. At least 250,000

	illnesses and 14,000 deaths due to *C. difficile* each year in the United States. -"The use of antibiotics is the single most important factor leading antibiotic resistance (p.11)." -Antibiotics are the most common medications prescribed in modern medicine. However, an estimated 50% of all antibiotic prescribed are unnecessary. -Improving the use of antibiotics is a priority identified by the CDC, describing it as a necessary core action to combat AMR. -Urgent Threats (require urgent public health attention): *C. difficile*, carbapenem-resistant enterobacteriaceae (CRE), and drug-resistant *Neisseria gonorrhoeae.* -Serious Threats (declining availability of therapeutic agents, require ongoing health monitoring to prevent from becoming urgent): Drug-resistant *Acinetobacter*, *Campylobacter*, *Pseudomonas aeruginosa*, *Salmonella*, *Shigella*, *Streptococcus pneumoniae*, *Tuberculosis*, -Threats resistant to specific antibiotics: carbapenem-resistant enterobacteriaceae (CRE) an urgent threat, serious threats such as extended spectrum beta-lactamase producing enterobacteriaceae (ESBL), vancomycin-resistant *Enterococcus* (VRE), methicillin-resistant *Staphylococcus aureus* (MRSA), and concerning threats (many therapeutic agents exist, require monitoring) including vancomycin-resistant *Staphylococcus aureus* (VRSA), erythromycin-resistant Group A *Streptococcus*, and clindamycin-resistant Group B *Streptococcus*.

	-Gram negative pathogens (enterobacteriaceae, *Pseudomonas aeruginosa*, *Acinetobacter*), are the most worrisome because they are becoming resistant to nearly all drugs used in their treatment. -In addition to causing increased resistance, the inappropriate use of antibiotics is associated with adverse drug events including allergic reactions (most common reason for emergency care visits due to an allergic reaction), *C. difficile*, drug interactions, and side effects (nausea, diarrhea, stomach pain, etc.). -Identified Gaps in Knowledge of Antibiotic Resistant: 1)Limited capacity at the national, state and federal level to detect and respond to urgent and emerging AMR threats. 2)No systematic international surveillance of AMR threats currently exists. 3)Lack of systematic collection of data on human and agricultural antibiotic use. 4)Programs to improve antibiotic prescribing (antimicrobial stewardship) are not widely used in the United States. -Inappropriate antibiotic use drivers: • Healthcare providers: 1) prescribing antibiotics when not needed, 2) prescribing the wrong antibiotic or the wrong dose, 3) not following guideline directed diagnostics before initiating treatment with an antibiotic, 4) falling into patient pressures to satisfy a patient's expectation of an antibiotic. • Patients: 1) lack of awareness and consequences of inappropriate antibiotic use and AMR, 2) demands for treatments to conditions that do not require an antibiotic (viral illness). • Food Industry: Use of antibiotics in animal food products (chicken, pork, beef, etc.) to promote growth. Results in

	resistant bacteria to contaminate food and serve as a carrier that can be passed on to people who consume these foods. -Improving antibiotic prescribing and stewardship: • Is the single most important action needed to slow the development and spread of AMR. This can be accomplished by changing the way antibiotics are used. Antimicrobial stewardship is a “commitment to always used antibiotics appropriately and safely—only when they are needed to treat disease, and to choose the right antibiotics and to administer them in the right way in every case (p.31).” -Antimicrobial Stewardship: • Increases patient outcomes • Decreases antibiotic resistance • Decreases *C. Difficile* infections • Decreases healthcare costs • Shortens length of hospital stays • Improves the morbidity and mortality rates of the nation
Otitis media: Diagnosis and treatment. Harmes, Blackwood, Burrows, Cooke, Van Harrison, and Passamani. 2013. *American Academy of Family Physicians.*	-Acute Otitis Media (AOM) infection or inflammation of middle ear and structures. Otitis media with effusion (OME) is middle ear effusion without acute symptoms/signs of infection. • 80% of children will have at least one episode of AOM • 80-90% will have at least one episode of OME -AOM is the most common infection for which antibiotics are prescribed for in children. -Often a complication of Eustachian tube dysfunction following an acute viral upper respiratory tract infection, AOM is the most common bacterial respiratory tract infection in children. • Predominantly affects children age 6 months to two years

	• Most common causes: *Streptococcus pneumoniae, Haemophilus influenzae,* and *Moraxella catarrhalis*. -AOM is a clinical diagnosis that requires stringent otoscopic criteria to make an accurate diagnosis. AOM diagnosis requires: • Moderate-to-severe bulging of TM • New-onset of otorrhea • *OR* • Mild TM bulging with new-onset (<48hrs) of otalgia or erythema -AOM should not be diagnosed in the absence of middle ear effusion (MEE). -Inaccurate diagnosis leads to inappropriate use of antibiotics and contributes to the development of AMR. -OME is often mistaken for AOM and is a major contributor to inappropriate use of antibiotics. • Antibiotics do not hasten the clearance of middle ear fluid and is not recommended. -AOM antibiotic Indications: • Children 6 months or older with severe signs or symptoms (moderate to severe ear pain, ear pain for at least 48hrs, temperature 102.2 or higher, or toxic appearing). • Children 2 years or younger with bilateral AOM. -Due to the major concern of resistance, deferring antibiotic treatment in children who are least likely to benefit has become a priority and major strategy for improving AOM management. • Even in the presence of MEE, antibiotic therapy can be deferred in children two years or older with mild symptoms.

	• Observation can be considered in the presence of AOM symptoms. • Study found that two of three children will recover without the use of antibiotics. • Do NOT prescribe antibiotics to children two to 12 years of age with non-severe symptoms. • Avoid the use of amoxicillin alone in children who have been exposed to this antibiotic in the past 30 days. • If observation strategy chosen: either provide parent with delayed prescription or schedule follow-up visit within 48-72hrs to evaluate for symptom persistence.
The antibiotic resistance crisis, part 1: Causes and threats. Ventola. 2015. *Pharmacy and Therapeutics.*	**-History of ABX & Resistance:** • 1928—Discovery of Penicillin by Sir Alexander Fleming • 1940's—Penicillin (PCN) introduced into medicine, known as the "Golden Era of Antibiotics" • 1950's—Substantial development of PCN resistance and subsequent development of new beta-lactam antibiotics • 1962—first case of methicillin-resistant *Staphylococcus aureus* (MRSA) identified • 1972—Vancomycin introduced to treat MRSA infections • 1979—Vancomycin resistance identified • 1960's-1980's—surge of antibiotic research and development by pharmaceutical companies to address the resistance problem • Today—Major lack of research and development of antibiotics by pharmaceutical companies. Resistance identified in nearly all antibiotics currently available on the market. -**Benefits & Impact of ABX:** • Prevent & treatment of infections in: ○ Cancer patients receiving chemotherapy

	- Patients with chronic diseases (DM, RA, ESRD) who are immunocompromised - Complex surgeries requiring prophylaxis (organ transplants, joint replacements, cardiac surgeries) - Food-borne and poverty-related infections in developing countries with poor sanitation - Epidemiological Shift: 1920's—average life expectancy was 56.4yrs with major morbidity and mortality attributed to infectious diseases - Today—average life expectancy is 80yrs with major morbidity and mortality attributed to chronic diseases - ABX have played a pivotal role in major achievements of modern medicine. - ABX save lives and have been attributed as a vital component to the major decrease in morbidity and mortality and increased life-expectancy that has occurred over the last century -**Causes of Antibiotic Resistance:** - Overuse: - As early as 1945 Sir Alexander Fleming himself recognized the threat of resistance stat the "public will demand antibiotics… then will begin an era… of abuses" (p.2) - Epidemiological studies show a direct relationship between antibiotic consumption and development of resistant strains of bacteria. - Bacteria can develop resistance spontaneously through mutations in genes. - Genes can be transferred to other bacteria causing them to become resistant.

	○ U.S. antibiotic consumption estimate—22.0 units (1 unit = one pill, or ampule) per person in the U.S. population was prescribed in 2010 ○ In some states, the number of prescribed antibiotics per year exceeded the entire population of that state ○ In many other countries, antibiotic use is unregulated and can be purchased over the counter without a prescription ○ ABX can be purchased online in countries where ABX are regulated • Inappropriate Prescribing: ○ Up to 50% of all antibiotics prescribed in the U.S. are unnecessary. ○ In a U.S. study of 17,435 patients hospitalized for community-acquired pneumonia, only 7.6% of the patients had an identified pathogen. • Extensive Agricultural Use: ○ An 80% of antibiotics sold in the U.S. are used for growth promotion in livestock. ○ Antibiotic resistance that develops in livestock can be transferred to humans via the consumption of meat products. • Availability of Few New ABX: ○ Beginning after the late 1980's a major decline in research and development (R&D) of new antibiotics has occurred. ○ Of the 18 major pharmaceutical companies, 15 have abandoned the antibiotic R&D field. ○ Pharmaceutical companies choose to invest in profitable medications used for the treatment of chronic diseases.

	- o Antibiotics are used for acute illnesses and are only required for a short period of time making them much less profitable than medications that are taken on a daily basis. - Regulatory Barriers: - o Regulatory barriers posed by the FDA - o Challenges of the clinical trial design provide a major obstacle in gaining new antibiotic approval - o Further potentiates pharmaceutical companies lack of interest in developing nee antibiotics. **-ABX Resistance Threats:** - At the global level, gram-positive resistant pathogens pose the greatest threat. These include MRSA and VRE. - MRSA kills more U.S. citizens each year than HIV/AIDS, Parkinson's disease, emphysema, and homicide combined. - Global spread of common respiratory pathogens *Streptococcus pneumoniae* and *Mycobacterium tuberculosis* has become an epidemic. - Gram-negative multi-drug resistant pathogens (*Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Acinetobacter*, *E. Coli*, and *Neisseria gonorrhoeae*) are becoming increasing prevalent in the community as well. **-ABX Resistance Burden:** - Increased morbidity and mortality. - Over 2 million deaths per year in the U.S. are attributed to resistance infections. - Considerably longer hospital stays. - Limits the usefulness of first and second-line therapies resulting in the use of alternative agents that are more expensive and toxic to the patient. - Higher incidence of long-term disability and reduced patient outcomes.

	• Economic burden of $20 billion in health care costs and $35 billion a year in lost productivity in the U.S. alone.

Current concepts in adult acute rhinosinusitis. Aring, and Chan. 2016. *American Academy of Family Physicians*	-**Acute Rhinosinusitis (ARS):** inflammation of the mucosal lining of the paranasal sinuses and nasal cavity.
	• AKA "Sinusitis"
	• One of the most common conditions treated in the ambulatory care setting.
	• One in seven adults affected yearly
	• Fifth most common diagnosis for which antibiotics are prescribed in the U.S.
	• Categorized as acute viral rhinosinusitis (AVRS) and acute bacterial rhinosinusitis (ARBS).
	• Most cases are the result of a viral etiology (rhinovirus, adenovirus, influenza virus, and parainfluenza virus).
	
	-**Four Signs & Symptoms:** that significantly increase the likelihood of a bacterial etiology. Combination of at least 3 of the following 4 signs and symptoms has a specificity of 81% and sensitivity of 66% for ARBS.
	• **Double-Sickening**—Initial improvement with worsening of symptoms between days 5 and 10)
	• **Purulent Rhinorrhea & Sinus pain**— predominantly unilateral local sinus pain/tenderness coupled with purulent rhinorrhea 85% reliability for diagnosing ARBS.
	• **ESR greater than 10mm/hr**
	• **Purulent secretions in the nasal cavity**
	• **Note:**
	  ◦ Providers should not rely solely on colored nasal drainage as an indication for antibiotic therapy.
	  ◦ 60% probability of ARBS with persistence of signs and symptoms without evidence of improvement for at least 10 days beyond onset

	• Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are somewhat useful tests for confirming ARBS. **-Clinical Recommendations:** • Watchful waiting with or without symptomatic relief (intranasal steroids, analgesics, saline irrigation) is recommended for the treatment of uncomplicated ARS for the first 7-10 days after symptoms appear. • Mild rhinosinusitis with symptoms lasting fewer than 10 days can be managed with supportive care (analgesics, intranasal steroids, saline irrigation) • Antibiotic therapy is recommended if symptoms persist $\geq$ 7 days with no evidence of improvement or is symptoms worsen after initial improvement (double sickening) • First-line antibiotic therapy: Amoxicillin or Augmentin. • For PCN allergy: doxycycline or a fluoroquinolone ABX can be used. • Diagnostic imaging is not recommended unless a complication or an alternative diagnosis is suspected.
Acute bronchitis. Kinkade, and Long. 2016. *American Academy of Family Physicians.*	-**Acute Bronchitis:** clinical diagnosis with predominant symptoms of cough lasting two to three weeks that is due to inflammation of trachea and large airways in the absence of pneumonia. -**Etiology:** 90% due to a viral infection. • Study showed bacteria etiology of only 1% to 10% of acute bronchitis cases. -**Treatment & Management:** • Acute bronchitis is a self-limited disease and should be treated in a similar fashion to the common cold. • Symptomatic relief is the cornerstone of therapy

- Dextromethorphan, guaifenesin, and/or honey as well as increased fluid intake should be used for acute bronchitis symptom management.
- Bronchodilators can be used if wheezing is present.

-**Antibiotics:**

- “The strongest predictor of an antibiotic prescription is the clinician’s preception of patient desire for antibiotics” (p.5).
- All major guidelines on acute bronchitis do not recommend the use of antibiotics for uncomplicated acute bronchitis.
- Antibiotics should only be considered if there is high suspicion of pneumonia (high-grade fever, dyspnea, tachycardia, tachypnea, bloody sputum, focal lung consolidation), pertussis (confirmed via testing, persistent cough accompanied by paroxysmal cough, whooping cough, post-tussive emesis, or recent pertussis exposure), or older frail adults with multiple co-morbidities (esp. COPD).

-**Strategies to Reduce ABX:**

- Purulent sputum (green or yellow) is a poor indicator for bacterial etiology and should not indicate the need for an antibiotic.
- Use of delayed prescribing
- Address patient concerns with providing symptomatic relief.
- Refer to acute bronchitis as a “chest cold”.
- Educate patient on the course of illness and cough duration of two to three weeks. One study found that the average duration of cough in acute bronchitis was 18 days.
- Explain that antibiotics do not shorten the course of illness, do not provide any therapeutic benefit and can result in adverse effects and development of resistance.

What drives inappropriate antibiotic use in outpatient care?. 2017. *PEW Charitable Trust.*	**-Overuse of Antibiotics:**
	• In the U.S. 1 in 3 antibiotics prescribed in the outpatient setting is inappropriate, equally 47 million prescriptions per year.
	-Factors Influencing Prescribing Decisions:
	• **Patient Satisfaction and pressure**:
	    ○ Cited as the main driver for the antibiotic prescribing.
	    ○ Patients wrongfully believe that they would benefit from receiving an antibiotic based on previous experiences when an antibiotic provided relief (fever).
	    ○ Study found clinicians are much more likely to prescribe antibiotics for pediatric patients based on perceived belief that child's parents expected them.
	    ○ Poor balance of patient health versus customer satisfaction. Fear of losing patients to competitors if antibiotic is not given.
	    ○ Believe prescribing an antibiotic will increase patient satisfaction.
	• **Time Constraints:**
	    ○ Feeling of being ill-equipped in terms of resources and time
	    ○ Study found that clinicians with higher patient workloads prescribed antibiotics at higher rates when compared with their less busy colleagues.
	    ○ Save time by avoiding lengthening conversations with patients of why antibiotics are not needed.
	    ○ Study found "decision fatigue" that occurs as a typical workday wore on leading to providers prescribing antibiotics for ARI at a much higher rate.

	• **Diagnostic Uncertainty:**
	  ○ Viral and bacterial ARIs have similar presentation (congestion, cough, sore throat)
	  ○ Limited diagnostics availability in the office-setting for rapid differentiation between etiologies.
	  ○ Prescription of antibiotics seen as a safe choice due to fear of worsening or progression, uncertain follow-up, or fear of legal ramifications.
	• **Externalized Responsibility:**
	  ○ Displacing blame
	  ○ Studies interviewing clinicians found that all participants agreed that antibiotic resistance and overprescribing was a problem but attributed the cause of inappropriate use to other clinicians.
	-Improving Prescribing by Understanding Behavior:
	• "Central to designing effective antimicrobial stewardship interventions is understanding the underlying factors that influence prescribing behaviors" (p.4).
	• This knowledge provides stakeholders with needed information and provides new insight into antibiotic stewardship strategies
	• By determining clinician's antibiotic prescribing behavior interventions can be developed to target providers' underlying social motivation in order to influence decision-making.
	• **Educational Strategies:**
	  ○ Public awareness campaigns and professional learning opportunities.
	• **Communication Training:**
	  ○ Improve provider-to-patient communication by understanding patient concerns and agreeing on a treatment plan.

	○ Suggesting treatment alternative with non-antibiotic OTC and home remedies for symptomatic relief. • **Audit & Feedback Strategies:** ○ Aimed to increase clinician's awareness of their own prescribing behaviors. ○ Review and relay individuals prescribing behaviors ○ Benchmarked against colleagues or expected prescribing rates ○ Studies show audit and feedback to be effective but benefits last only as long as audit and feedback in place • **Clinical Decision Support Systems:** ○ Consistent with current clinical practice guidelines, CDS systems help guide the process of evaluation and treatment ○ Studies show effectiveness of CDS at increasing appropriate antibiotic prescribing • **Delayed Prescriptions:** ○ Help clinicians in managing diagnostic uncertainty. ○ AKA "Watchful Waiting" in which an antibiotic prescription is written but patient is advised to only fill if symptoms persist or worsen. ○ Studies show this an effective strategy to reducing inappropriate antibiotic use. • **Commitment Pledging:** ○ Study involving clinicians' signing a letter pledging their commitment to prescribe antibiotics according to current practice guidelines. Letters were enlarged to create commitment posters that were publicly placed in doctors' offices. The study found that providers participating in the poster intervention inappropriately prescribed antibiotics at a rate 20% lower than those who did not participate.

	• **Merit-Based Strategies:**
	  ○ In another study, participating providers were required to justify prescriptions of antibiotics in the patient chart which was visible to other clinicians. Results found this behavioral intervention led to significant reductions in inappropriate prescribing.
	  ○ Another study ranked providers by their level of inappropriate prescribing. Providers that inappropriately prescribed the least were termed "Top Performers" while their peers who wrote more prescriptions were not. Results led to significant decreases in inappropriate prescribing.

Unleashing the power of diagnostic tests in the fight against antibiotic resistance. 2017. *Antibiotic Resistance Action Center, Milken Institute of Public Health, George Washington University.*	**-Discovery of Antibiotics:** one of the greatest medical discoveries in modern history and became the cornerstone of modern medicine. However, due to the overuse of antibiotics the development of resistance is causing antibiotics to lose their effectiveness. **-AMR a Global Crisis:** • Up 50% of all antibiotics prescribed today are unnecessary. • The overuse of antibiotics has led to a sharp increase in drug-resistance infections that effects nearly every aspect of healthcare. **-If Antibiotic Resistance is Allowed to Continue at its Current Rate:** • "Without urgent coordinated action by many stakeholders the world is headed for a post-antibiotic era, in which common infection and minor injuries, which have been treatable for decades can once again kill" (p.1). • "It is estimated that by 2050, 10 million people a year will die from drug-resistant infections and $100 trillion in global economic productivity will have been lost over that time period" (p.1).

Measuring outpatient antibiotic prescribing: Key U.S. statistics. 2018. *Centers for Disease Control and Prevention.*	**-Current Key U.S. Statistics on Antibiotic Use in Outpatient Setting:**
	• At least 30% and up to 50% of all antibiotics prescribed are unnecessary.
	• In 2016, 270.2 million courses of antibiotics were dispensed to outpatient pharmacies (equivalent to 836 prescriptions per every 1,000 persons in the U.S.).
	• Antibiotic prescribing in the outpatient setting varies by state. Local outpatient prescribing practices contributes significantly to local resistance patterns.
	• Prescribing is greatest in the winter months.
	• Antibiotic consumption is highest in the South-Central region of the U.S. and decreases as you move towards the Western region of the U.S.
	• **Acute respiratory indications are the most common reason for which antibiotics are prescribed, including:**
	  o Acute Rhinosinusitis
	  o Acute Bronchitis
	  o Common cold or non-specific upper respiratory tract infection (URI)
	  o Pharyngitis
	  o Acute Otitis Media (AOM)
	• 80-90% of antibiotic consumption by volume occurs in the outpatient setting.
	• Azithromycin and amoxicillin are the most common antibiotics prescribed in the outpatient setting.

Antibiotic resistance 101: An Overview. 2018. *Antibiotic Resistance Action Center, Milken Institute of Public Health, George Washington University.*	-Antibiotic resistance is one of the greatest public health threats of our time. **-How Does Antibiotic Resistance Occur?** Bacteria develop the ability to mutate, survive the killing effects of antibiotics, and therefore become resistant to the effects of antibiotics.

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-Today: antibiotic resistant infections kill tens of thousands of people every year in the United States.
-If Antibiotic Resistance is Allowed to Continue at its Current Rate:

AMR is a natural and expected consequence that occurs in every antibiotic after a period of continued use.
As bacteria become increasingly resistant to antibiotics, common bacteria that once caused easily treatable infections (UTI, AOM, etc.) will become resistant to treatment, rendering first-line therapies ineffective, and possibly even become life-threatening.
The Antibiotic Resistance Action Center (ARAC) at the Milken Institute of Public Health (2018) stated: “in the next 30 years, antibiotic resistant infections are expected to overtake cancer as the leading cause of death worldwide, and experts predict that based on current estimates, could kill one person every three seconds” (p.1).
As pre-surgery antibiotics become less effective, surgeries and routine procedures will be threatened by higher risks of antibiotic resistant infections resulting in poor outcomes.
Dramatic impact on women’s health as childbirth and gynecologic surgeries become less safe due to AMR.

-Major Contributors to AMR:

Widespread and inappropriate use of antibiotics in modern medicine and livestock production.
Antibiotics sold without a prescription in developing countries.
Lack of research and development of new antibiotics as pharmaceutical companies development of more lucrative drugs.

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CRITICAL APPRAISAL OF PREVIOUS STUDIES

Title/Author/Date/Journal	Theoretical/ Conceptual Framework	Research Question(s)/ Hypotheses	Methodology	Analysis & Results	Conclusions
Effects of knowledge, attitudes, and practices of primary care providers on antibiotic selection, United States. Sanchez, Roberts, Albert, Johnson, and Hicks. 2014. *Emerging Infectious Diseases.*	Not explicitly identified	"Does provider knowledge, attitudes, and self-reported practices effect the appropriate selection of antibiotic drugs?"	Qualitative open-ended interviews with 36 primary care providers in the United States. -Included physicians (n=27), nurse practitioners (n=5), and physician assistants (n=4). -Interviews consisted of digitally recorded telephone calls transcribed into text. Conducted in May of 2013 by a professional moderator. -Screening questionnaire used to recruit. -Inclusion criteria: ≥50% of practice time in primary care setting, ≥30 years of age, and fluent in English. -Exclusion criteria: immediate family member working in an area of conflict of interest, board certified in an area other	-Participant interviews were reviewed and transcribed into text by project staff. -To identify frequency of responses, excerpts from the interviews were compiled and coded into themes via inductive and deductive methods. - In-depth analysis of themes was performed by coding responses using Nvivo 9. -Study was reviewed and approved by the CDC. -Results of the interview analyses were identified in the form of a table.	-The study was conducted to explore provider's knowledge, attitudes, and practices (KAPs) in regard to antibiotic prescribing, selection, and resistance. -Participants were familiar with CPGs but admitted to intermittent non-compliance. -Concerns for patient satisfaction and pressures was the most common perceived reason for inappropriate antibiotic prescribing. -Inconsistencies and non-compliance of other providers negatively impacts patient expectations. -Fear of complications and low-confidence in prescribing abilities often leads to the prescription of broad-spectrum antibiotics. -Knowledge gap identified as inconsistent definitions of

			than primary care, and practiced medicine >30 years. -Sponsoring organization: Centers for Disease Control and Prevention (CDC). -Interview questions addressed: practice setting, patient population served, self-reported antibiotic prescribing practices, perception of peers prescribing practices, attitudes towards clinical practice guidelines (CPGs) for common infections, assessed knowledge of narrow and broad-spectrum antibiotics, preferred resources used for antibiotic treatment and education, and attitudes towards antibiotic resistance. -Participants were asked to rank 12 factors that influence their prescription of antibiotics. -Clinical scenario questions were asked to assess compliance with	-Results were categorized into 5 major themes: 1) Antibiotic selection 2) Broad VS. Narrow-spectrum 3) Education and resources 4) Changing prescribing habits 5) Antibiotic resistance	broad and narrow-spectrum antibiotics. -Consensus agreement that antibiotic resistance is a major health care issue; however, resistance is not commonly considered when selecting therapy. -Consensus agreement that the best way to change prescribing behavior is to alter the expectations of patients so to reduce the pressure to prescribe antibiotics. **Strengths:** 1) Inappropriate antibiotic selection is not caused by lack of knowledge of CPGs. 2) Inappropriate prescribing is the result of complex interactions between both the patient and provider. 3) Inappropriate antibiotic use is strongly linked to patient satisfaction and pressures, and fear of repercussions and/or patient illness if an antibiotic is not prescribed. **Limitations:** 1) Qualitative designs making it difficult to generalize findings.

			clinical practice guidelines. -Each participant received a cash incentive for participation.		2) Biased opinions of providers cannot be excluded **Relevance to current practice:** Greater comprehension of "Why" providers prescribe antibiotics including barrier and facilitators to appropriate antibiotic utilization. **Recommendations for future research:** 1) Incentives for appropriate antibiotic prescribing practices 2) Develop standardized methods to encourage first-line agents 3) Identify interventions that improve antibiotic selection 4) Education both patients and providers on promoting appropriate antibiotic use.
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Inappropriate antibiotic prescription for respiratory tract indications: Most prominent in adult patients. Dekker, Verheij, and Van Der Velden. 2015. *Family Practice.*	Not explicitly stated	Approximately one-half of all antibiotics are inappropriately prescribed for respiratory tract indications and is greatly related to	**-Design:** Mixed methods research/observational study using both quantitative and qualitative measures.	-Baseline characteristics of 2724 consultations were calculated according to percentages, means, and SDs.	**-Goal:** increase awareness of indications of factors related to antibiotic overprescribing to facilitate development of targeted strategies to enhance GP's prescribing behaviors for RTIs.

		provider prescribing practices and patient pressures.	-**Problem:** Inappropriate antibiotic use in RTIs of primary care settings leading to increased rates of resistance. -**Aim:** to quantify and qualify inappropriate antibiotic prescriptions for respiratory tract indications (RTIs) among general practitioners (GPs) caring for adults in the primary care setting. -**Data/Location/Time:** data obtained from 2739 RTI consultations by GPs from 48 Dutch primary care practices during the winter seasons of 2008 to 2010. **Data Collection:** -all patients with an acute RTI that have specific evidenced-based guidelines: acute otitis media,	- Recommendations from national guideline were used as the benchmark to classify GP's prescribing decisions as correct or incorrect. 1) Prescribing when indicated (correct) 2) Non-prescribing when not indicated (correct) 3) Prescribing when not indicated (over prescription) 4) Non-prescribing when treatment was indicated (under prescription) -Prescribing rates and overprescribing rates were calculated according to:	-Nearly half of all antibiotics prescribed for RTIs were not indicated in accordance with guideline recommendations -Overprescribing was highest in adults (18 to 65 yrs) & lowest in children -Less than 4% of antibiotics were under-prescribed -Relative over-prescribing was highest in throat indications & absolute over-prescribing was highest in lower respiratory RTIs -GPs perceived that over-prescribing of antibiotics was most effected by patient expectations & fever with symptoms lasting ≥7day. **Strengths:** -Large sample size (n=2724)

			rhinosinusitis, acute sore throat, and acute cough. -Guidelines used to benchmark data are based on combinations of signs and symptoms, patient characteristics, and disease severity. -**GPs Registered the Following:** 1) Patient characteristics 2) Medical history 3) Patient's specific signs and symptoms 4) Findings of physical examination 5) Patient or parent expectation of antibiotic 6) Diagnosis recorded according to IPC code 7) if prescribed, an antibiotic was recorded by its Anatomical Therapeutically Chemical Code 8) Additional management (reassurance, advice,	1)Age (children, adult, elderly) 2) Indication (ear, throat, nose/sinuses, lower respiratory tract) 3) IPC code (primary care diagnosis) **Analysis: (SPSS)** **-Factors associated with over-prescription:** Multivariable logic regression analysis, P-value <0.2, Chi-square test, stratified regression of age and RTI type, odds ratios, 95% confidence intervals. **Results:** -Illness severity rated high in elderly -Patient expectations of	- Comprehensive documentation inputted into a registry that considered multiple variables including a complete range of RTIs. -Specific comparisons of cases to guideline recommendations -Provides insight into the quality of community antibiotic use for RTIs -Registry forms were provided in a simplistic format that could be completed in a timely fashion during everyday routine. **Limitations:** **-**GPs subjective interpretation of illness of severity as a possible bias -Possibility of GPs overestimating illness severity in order to justify their prescription -Registry form did not provide an open-ended discussion section allowing GPs to justify their treatment decisions.

			referral or secondary testing) if indicated -Of the 2739 RTI consultations recorded, 15 were excluded for missing data (n=2724) -**Calculations:** 1) Percentages 2) Means 3) SDs	antibiotic highest in adults -38% overall prescribing rates and increased with age -Amoxicillin most prescribed in children -Doxycycline most prescribed in adults and elderly -Reassurance/ advice given in 80% - 46% of all antibiotics were not indicated (over-prescription) -36% were indicated (appropriate prescribing) - <4% were indicated but not prescribed (under-prescription) -Over-prescribing highest in adults (18 to 65 years) and was directly related to patient expectations of an	**Application to Practice:** -Most antibiotics are prescribed in the primary care setting and the most common reason for antibiotic prescriptions are for respiratory tract indications (RTIs). -This study provides insight into appropriateness of antibiotic prescriptions based on age, indication/chief complaint while also identifying areas in need of improvement to reduce inappropriate antibiotic use. -Based on this data, target strategies/interventions can be developed and evaluated according to a broad range of respiratory complaints and benchmarked against national guideline recommendations in an effort to enhance antibiotic appropriateness and reduce rates of resistance.

				antibiotic and fever with complaints >1week. -Relative over-prescribing highest in throat indications (tonsillitis) (58%) - Lowest in ear indications (AOM) (4%) -Absolute over-prescriptions highest in lower RTIs (bronchitis)	-Additionally, this study shows that patient pressures from expectations of receiving an antibiotic is a strong determining factor in the inappropriate prescription of antibiotics. **Recommendations for Future:** -Future research should focus on exploring patient concerns and expectations to provide reassurance and education as well as alternative treatment modalities when an antibiotic is indeed not indicated.
Title/Author/Date/Journal	**Theoretical/ Conceptual Framework**	**Research Question(s)/ Hypotheses**	**Methodology**	**Analysis & Results**	**Conclusions**
Physicians' attitudes and knowledge concerning antibiotic prescription and resistance: Questionnaire development and reliability. Teixeira Rodrigues, Ferreira, Roque, Falcao, Ramalheira,	Not explicitly stated	Development of a questionnaire tested for validity and reliability will lead to an enhanced appreciation of physicians' ABX	**-Aim:** to develop a reliable and valid questionnaire instrument to assess the attitudes and knowledge underlying physician antibiotic prescribing behaviors in both primary and	**-Primary Care Response Rates:** 1) Pretest: 64% (n=39) 2) Retest: 49% (n=30)	**-Main Study Objective:** develop a measurement tool to identify underlying factors regarding antibiotic prescriptions and resistance.

Figueiras, and Herdeiro. 2016. *BioMed Central Infectious Diseases*		prescribing behaviors?	hospital-based care settings. -Conducted in September of 2013. -Convenience sample of 61 primary care physicians and 50 hospital physicians (N=111) in Portuguese. -Development and validation process divided into two major steps: 1) Content & face validation 2) Reliability analysis -**Content Validity:** 1) **Development stage:** literature review, and previous qualitative studies published 2) **Judgmental stage:** panel of experts (n=10) -**Face Validity:** panel of experts including clinical psychologists	-**Hospital Care Response Rates:** 1) Pretest: 66% (n=33) 2) Retest: 60% (n=30) -Content Validity resulted in 9 changes to the professional concepts of the questionnaire -Face Validity resulted in 19 changes to the linguistic and interpretive terms of the questionnaire. -Reliability Analysis results: 1) Internal validity via Cronbach alpha value (α >0.70) considered satisfactory. 2) ICC values indicated fair to good	-Many questionnaires have historically been used to assess physician attitudes and knowledge regarding antibiotic use and resistance but most lack full validation. -Analysis of the questionnaire revealed that content and face validity was reliable in terms of internal consistency and reproducibility. -**Strengths:** 1) Questionnaire structured to be utilized in both primary and hospital-care settings. 2) Allows for comparisons of demographic, knowledge and prescribing practices of primary and hospital-care groups 3) use of a non-numerical VAS allows for the assessment of minute differences among respondents.

			and Portuguese linguists -**Reliability Analysis:** 1) **Pilot study**: primary care physicians (n=61) and hospital care physicians (n=50). Internal consistency using Cronbach's alpha analysis. 2) **Re-test study:** primary care (n=30) & hospital care (n=30). Reproducibility assessed with intraclass correlation coefficient (ICC). - interval of 2-4 weeks between pre-test and post-tests	reproducibility (ICC >0.4). -The final questionnaire included the following five sections: **Section 1:** instructions for completion of questionnaire **Section 2:** 17 statements on agreement via visual analog scale (VAS) regarding attitudes and knowledge of antibiotic prescribing, use and resistance **Section 3:** 9 statements regarding importance of various sources of knowledge. **Section 4:** Demographic and	-**Limitations:** 1) Small sample size inadequate to confirm construct validity 2) Convenience sampling process -**Relevance to Current Practice:** 1) Questionnaire useful for better understanding physicians' attitudes, knowledge and antibiotic prescribing behaviors considered to be important factors contributing to resistance. 2) Questionnaire pre-test/re-test format proves useful for evaluating antimicrobial stewardship intervention and effectiveness. -**Recommendations for the Future:** 1) use of the questionnaire in different countries/settings to ascertain and compare geographical differences among prescribing practices

				professional information **Section 5:** blank section allowing participants to express ideas and views on antibiotic use and resistance	2) Conduct future studies using this questionnaire with a larger sample size to evaluate construct validity
Title/Author/Date/Journal	**Theoretical/ Conceptual Framework**	**Research Question(s)/ Hypotheses**	**Methodology**	**Analysis & Results**	**Conclusions**
Prevalence of inappropriate antibiotic prescriptions among US ambulatory care visits, 2010-2011. Fleming-Dutra, Hersh, and Hicks. 2016. *JAMA*.	Not explicitly stated	To what extent is outpatient antibiotic use inappropriate in US ambulatory care settings?	**Design:** Quantitative observational study of population-adjusted antibiotic (ABX) prescription rates. **Objective:** To estimate rates of total oral antibiotic prescriptions by age and diagnosis & estimate the proportions of inappropriate antibiotic use in adults and children in US ambulatory care. **Methods of Measurement:** 1)2010-2011 National Ambulatory Medical	**Analysis:** Using national guidelines and regional variations in prescribing the following was determined: 1)Diagnosis-specific prevalence and rates of total antibiotic prescriptions 2)Diagnosis-specific prevalence and rates of appropriate antibiotic prescriptions -Total & appropriate antibiotic	**Conclusions:** In 2010 to 2011 -50% of all ABX prescriptions for acute respiratory conditions were inappropriate. -Sinusitis was the most diagnosis for which antibiotics are prescribed. -31% of all ABX prescribed for all ages and diagnoses were inappropriate. -Such estimates provide evidence supporting the urgency of ABX misuse in the US and the need for establishment of out-patient antibiotic stewardship programs.

			Care Survey (NAMCS) 2)2010-2011 National Hospital Ambulatory Medical Care Surveys (NHAMCS) **Methods of Estimation:** 1)Annual Numbers 2)Population-adjusted rates with 95% confidence intervals of ambulatory visits with oral antibiotic prescriptions by age, geographical region, and diagnosis. **Determination of Appropriateness:** -National guidelines and regional variations in prescribing. **Sample Size:** -184,032 visits	prescription rates were combined to determine: an estimate of annual rates of appropriate antibiotic prescriptions per 1000 population. **Results:** -Sample size 184,032 visits -12.6% of all visits resulted in an ABX prescription -Sinusitis diagnosis had the most ABX prescriptions per 1000 population, followed by otitis media and pharyngitis. -Acute respiratory conditions had the highest absolute ABX prescriptions -221 ABX prescriptions were given annually for acute respiratory disorders, but only	**Strengths:** -Study supports the notion that most inappropriate antibiotic use occurs in acute respiratory conditions. -Capture an estimation of antibiotic use in the US that can be compared to ABX use of various regions, both nationally and internationally -The study used national surveys and evidenced-based guidelines approved by the CDC -Provides national representativeness and inclusion of both diagnosis and therapy. **Limitations of NAMCS/NHAMCS:** -Relies on clinicians diagnosis. -Only limited variables adjusted for non-response increasing the chance of non-response bias -represents overall visits and not episodes of illness increasing the chance of overestimation

				111 were estimated to be appropriate (50%). -Combing all ages and conditions in 2010-2011, an estimated 506 ABX prescriptions were given annually and only 353 were considered to be appropriate (69%)	-Time delays limitations and use of dated data (2010-2011) -Urgent care, retail clinics, hospital discharges, telemedicine, and long-term care settings not included in estimates -No method of differentiating standard from delayed prescriptions **Relevance to Practice:** -Annual data and estimations of antibiotic use and appropriateness by disease, age, and geographical area allows for targeted interventions and identification of high need areas of antimicrobial stewardship implementation. **Recommendations for the Future:** **-**Conduct a separate study on appropriate selection of antibiotics to provide opportunities to improve

					selection and decrease resistance.
Title/Author/Date/Journal	**Theoretical/ Conceptual Framework**	**Research Question(s)/ Hypotheses**	**Methodology**	**Analysis & Results**	**Conclusions**
Outpatient antibiotic prescribing among United States nurse practitioners and physician assistants. Sanchez, Hersh, Shapiro, Cawley, and Hicks. 2016. *Infectious Diseases Society of America*.	Not explicitly stated	What are antibiotic prescribing rates of Nurse Practitioners (NPs) and Physician Assistants (PAs) in the U.S. ambulatory care setting? And, how do these differ from Physician antibiotic prescribing rates?	**Design:** Quantitative study analyzing antibiotic prescribing rates in U.S. ambulatory care setting among provider type (PA, NP, and Physician). **Data Sources**: Two national surveys including the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS) collected data from 1998 to 2011 to assess trends in ambulatory visits by provider type. Data collected of visits from 2006-2011 was used to assess both the proportions of overall antibiotic prescribing	**Statistical Analysis:** Logistic regression using the time period as the predictor variable and multi-variable logistic regression model using antibiotic prescribing as the outcome variable to determine rates of NP and PA visits resulting in ABX prescription compared to physician-only visits. -Bivariate analysis using the X^2 test was used to assess independent variables. **Results:** of the 1,301,474 sampled visits:	-Few previous studies have focused on antibiotic prescribing according to provider type. This study provides insight into antibiotic prescribing rates according to provider type and compares these rates "in order to guide public health initiatives and better understand antibiotic prescribing practices across all provider types" (p.1). -A substantial increase in the proportion of NP/PA ambulatory care visits was observed during the study period. Higher frequencies of ambulatory visits resulting in an antibiotic prescription was observed when a non-physician provider was involved.

			for ambulatory care visits as well as proportions ABX prescribing in visits involving acute respiratory tract infections (ARTIs) -Data collected was categorized according to provider type, diagnoses, and antibiotic class. -Used in previous studies, the NAMCS and NHAMCS provide a nationally representative sample of ambulatory care visits in the U.S. **Sample Size:** NAMCS/NHAMCS survey data from a total of 1,301,474 U.S. ambulatory visits was included in this study. -Based on estimates of this data, an average of 1.13 billion ambulatory visits take	-6.3% involved NPs or PAs. -Over the study period, the proportion of NP or PA visits more than doubled across ambulatory care visits, and more than tripled in ED visits. A testament to the rapid expansion and increase of non-physician providers entering the U.S. medical system. -From 2006-2011, the proportion of antibiotics prescribed by physicians was 12% for all ambulatory visits and 54% for ARTI visits. -In comparison, NP and/or PAs prescribed antibiotics in 17%	-When compared to physicians, NPs and PAs are more likely to prescribe antibiotics in all ambulatory care visits (17% for NP/PA vs 12% for physicians) and are more likely to prescribe antibiotics in ARTI visits (61% for NP/PA vs 54% for physicians). -"Elements of antibiotic stewardship are often included in NP, PA, and physician education curricula, suggesting that potential differences in antibiotic prescribing are more likely due to practice environment, learned clinical behaviors, or differences in patient communication rather than medical education" (p.2).

			place in the U.S. per year.	of all ambulatory visits and in 61% of ARTI visits. -Visits that involved NPs or PAs had independently higher odds of prescribing antibiotics (odd ratio=1.13) even after controlling patient and practice-level variables.	

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Not a magic pill: a qualitative exploration of provider perspectives on antibiotic prescribing in the outpatient setting. Yates, Davis, Taylor, Davidson, Connor, Buehler, and Spencer. 2018. *BMC Family Practice*.	Not explicitly stated	What barriers posed in outpatient clinical settings challenge the success of appropriate antibiotic use? And, how can we address these barriers?	**Design:** Qualitative study with a phenomenological perspective design using semi-structured interview with key informants **Sample/Setting:** 17 out-patient providers (10 physicians and 7 advanced care practitioners) covering a large health-care	**Analysis:** **-**From analysis of the interviews, 3 major themes were identified: 1)Current ABX prescribing practices 2)Providers perceptions of patient knowledge and awareness 3) Recommendations	**Conclusion:** A myriad of factors are involved in influencing providers to prescribe antibiotics. In regard to inappropriate antibiotic prescribing among the most influential factors include patient satisfactions, pressures, and expectations. Education targeting both patients and providers are considered key elements

			system in North Carolina. **Objectives:** 1)Investigate the elements involved in influencing providers antibiotic prescription decisions 2)Identify possible interventions from provider recommendations to address inappropriate antibiotic use 3)Inform clinical management of patients with infections that do not warrant antibiotics in an outpatient setting **Method:** -Emails sent out to various providers in out-patient settings responded to emails electing to partake in the study -Semi-structured interviews of 17 providers who agreed to the studies terms and conditions	for education, training, and reporting -Inductive process going from thematic analysis, to descriptive interpretation, to more abstracted categories. -First and second level coding classifications to reflect emerging patterns / relationships among data -NVivo version 10 used to assist in management and analysis of data -Analysis of data completed by the same qualitative researcher who conducted the interview -Consultation with a transcriptionist, members of the project, and project stakeholders reviewed the data	to any antimicrobial stewardship program. **Strengths:** -Incorporates the perspectives, of not only physicians but also of advanced care practitioners, involving the ‘how’ and ‘why’ providers prescribe antibiotics. -Pressures and challenges related to antibiotic prescribing found in this study are aligned with the findings of prior studies from other settings. -Setting included both primary and urgent cares, areas considered to be highest in antibiotic use. **Limitations:** -No exclusion or inclusion criteria of sample selection explicitly stated. -Only one researcher coded the data.

			-All interviews conducted over the phone in the months of November-December 2016 by the same qualitative researcher -Each interview was recorded and later transcribed for analysis -Interview guide focusing on questions developed by project stakeholders that specifically addressed the objectives of the study: 1)key factors involved in ABX prescribing, 2)communication with patients about ABX, 3)attending to patient satisfaction and 'want' to get better, 4)perceptions of patient knowledge and experience, 5)the problem of ABX resistance, 6)barriers and facilitators to appropriate antibiotic prescribing	**Results:** **-Key factors in ABX decision making:** acute clinical presentation, best practices, patient factors (age), and workflow. **-Communicating with patients:** viral versus bacterial, disease course, symptomatic relief, signs to watch for, and follow-up **-Assisting patients to feel better:** OTC medications, personal care, and rest. **-Perceptions of patient knowledge / experience:** expectations are high, and desire to	-All participants were from the same health care system (limits generalizability). -Small convivence sample (limits generalizability). -Individuals volunteered to participate (self-selection bias). **Relevance to Practice:** -Study's findings were aligned with the findings of previous studies. -Emphasized importance of educational materials disseminated in waiting rooms, doctor lounges etc. -Findings promote that institutional monthly or quarterly publication of ABX use results and recommendations to improve prescribing practices would be well received.

			-Data was collected until saturation was achieved beyond the original goal of 15 key informants	feel better now with a quick fix. **-Perceptions of the problem of ABX resistance:** public largely unaware, often disassociate, and varies based on demographics. **-Barriers to appropriate ABX prescribing:** patient education and expectations, system-level concerns, and time-constraints. **-Education and training for providers:** system-wide evidenced-based guidelines, & decision support tools, **-Reporting ABX use to providers:** multiple forms of delivery (in	-Insights derived from the study can be used in the development of patient education materials, provider scripting, and reporting dashboards. **Recommendations for the Future:** **-**Study indicated that patient expectations for antibiotics strongly influence providers decisions to overprescribe. -Additionally, institutional constraints that promote unrealistic attainment of patient satisfaction often lead to false expectations of patients and pressures providers to inappropriately prescribe antibiotics. -In considering these factors, education of patients, providers and

				person, electronic), and aligned with current reporting practices.	the governing institution needs to be implemented in order to successfully implement an effective antimicrobial stewardship program. -Future studies should focus on increasing the awareness of the effect of patient pressures and institutional constraints have on providers inappropriately prescribing ABX and ways to address and reduce these barriers.
Title/Author/Date/Journal	**Theoretical/ Conceptual Framework**	**Research Question(s)/ Hypotheses**	**Methodology**	**Analysis & Results**	**Conclusions**
Clinicians' beliefs, knowledge, attitudes, and planned behaviors on antibiotic prescribing in acute respiratory infections. Hruza, Velasquez, Madaras-Kelly, Fleming-Dutra, Samore, & Butler. 2018. *Open Forum Infectious Diseases*.	Theory of Planned Behavior (TPB)	What provider perceptions contribute to appropriate antibiotic prescribing and how can knowledge of these prescribing behaviors be used to improve the use of antibiotic in the	**Design:** Qualitative study design using one-on-one interviews with providers (n=20) working in emergency departments, primary care, and community-based clinical settings of five VA Medical centers in the U.S. conducted May-July 2017.	**Beliefs & Attitudes: -** Providers positively perceived ASP efforts and believed strategies such as audit-feedback and tools to improve antibiotic prescribing	The study found that providers often intend on prescribing antibiotics appropriately. However, patient gaps in knowledge and perceived patient demands were identified as significant barriers that influence appropriate antibiotic prescribing practices, especially in the treatment of ARIs. ASP

		treatment of acute respiratory infections (ARIs)?	**Objective:** 1) To examine provider perceptions regarding appropriate antibiotic use 2) Identify provider acceptability of proposed ASP interventions to improve antibiotic use in the treatment of ARIs in the outpatient setting. **Methods:** The semi-structured interview questions were developed using the Theory of Planned Behavior (TPB) to assess providers beliefs and attitudes, behavior control, perceptions of societal norms, and planned future behaviors for managing ARIs.	practices would be well received. -Perceived barriers to appropriate antibiotic prescribing included patient demand, time constraints, and resource limitation. **Behavioral Control:** -Providers felt they have full control in regard to prescribing or withholding antibiotics. **Social Norms:** -Providers perceived that poor peer practices and lack of patient education play a role in driving patient demands for antibiotics. **Planned Future Behaviors:**	efforts should utilize audit-feedback and shared decision-making communication strategies specifically tailored to consider time constraints, available resources, and perceived patient demands.

				-Provider's perceived that patient demands play the largest role in inappropriate antibiotic prescribing. -Viable solutions to address the issue of perceived patient demand included the use of audit-feedback and communication strategies.	
Title/Author/Date/Journal	**Theoretical/ Conceptual Framework**	**Research Question(s)/ Hypotheses**	**Methodology**	**Analysis & Results**	**Conclusions**
Variability of antibiotic prescribing in a large healthcare network despite adjusting for patient-mix: Reconsidering targets for improved prescribing. Jung, Sexton, Owens, Spell, & Fridkin**.** 2019. *Infectious Diseases Society of America*.	Not explicitly stated	What patient-specific and provider-specific factors contribute to inappropriate antibiotic prescribing in the outpatient setting?	**Objective:** identify predictors of inappropriate antibiotic (ABX) prescribing for acute respiratory infections (ARIs) in the outpatient setting. **Design:** cross-sectional study of patient encounters presenting with diagnoses of ARIs in	-Of the 9600 patient encounters, more than half (53.4%) resulted in an ABX prescription. -When prescribing rates were modified to include only ARI antibiotic-inappropriate categories, median	**-**Significant predictors of antibiotic prescribing included: Caucasian race, older age, and presence of co-morbid conditions. -More than 50% of patients with a diagnosis of an ARI received an antibiotic during the two-year study period. Based on a an ARI target prescribing rate of 20% or less, the data suggests

			15 primary care clinics between 2015 to 2017. **Variables:** -ARI diagnoses by ICD-10 code. To evaluate ABX appropriateness, antibiotic-appropriate ICD codes were excluded including sinusitis, pharyngitis, and tonsillitis) -Patient-Level Variables: categorized by race, age, and presence of comorbid conditions. -Provider-Level Variables: categorized by professional training including physicians, NPs, PAs, and resident physicians. **Methods:** - Proportions & adjusted odds ratios (aOR) to determine antibiotic prescribing rates.	provider prescribing rate remained high at 43%. -Antibiotic prescribing rates were higher in white patients (aOR= 1.59), patients 51 years or older (aOR=1.32), and patients with comorbid conditions (aOR=1.19) -According to provider-type, antibiotic prescribing rates were lowest in resident physician providers, and no difference was found to exist between NP/PA and physicians. -Significant differences in antibiotic	that $\geq$30% of the patients unnecessarily received an antibiotic. -Resident physicians had the lowest prescribing rates out of all provider types. All residents within these 15 clinics are required to rotate with infectious disease during their training. Provider knowledge, beliefs and attitudes (KAP) may play a role in prescribing rates. -The major clinic-specific differences noted merits further investigation into prescribing behaviors.

			-Multivariable logistic regression analysis used to identify predictive characteristics of antibiotic prescribing. **Sample Size:** -A total of 9600 (N=9600) of the 10,362 visits met inclusion criteria. -After excluding providers with less than 10 encounters, these patients were seen by 109 providers	prescribing rates were found to exist between clinics.	

Appendix B

Healthcare Provider Questionnaire

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QUESTIONNAIRE Nº:______

FILLING INSTRUTIONS	totally disagree — totally agree
In the left column are questions that will be the subject of your evaluation and in the right column there is a **gradual scale** where you should mark with a cross the place where, accordingly to your opinion represents your agreement with the text comment. If you are totally in disagreement, you should place a cross at the left end, and as your agreement increases you should move the cross to the right.	0 |X———————————————————| 100% |——————————X——————————| |———————————————————X|

ABOUT ANTIBIOTICS AND RESISTANCES

	Totally disagree — totally agree
1. Antibiotic resistance is an important Public Health problem in our setting.	|————————————————|
2. In a primary-care context, one should wait for the microbiology results before treating an infectious disease.	|————————————————|
3. Rapid and effective diagnostic techniques are required for diagnosis of infectious diseases.	|————————————————|
4. The prescription of an antibiotic to a patient does not influence the possible appearance of resistance.	|————————————————|
5. I am convinced that new antibiotics will be developed to solve the problem of resistance.	|————————————————|
6. The use of antibiotics on animals is an important cause of the appearance of new resistance to pathogenic agents in humans.	|————————————————|
7. In case of doubt, it is preferable to use a wide-spectrum antibiotic to ensure that the patient is cured of an infection.	|————————————————|
8. I frequently prescribe an antibiotic in situations in which it is impossible for me to conduct a systematic follow-up of the patient.	|————————————————|
9. In situations of doubt as to whether a disease might be of bacterial aetiology, it is preferable to prescribe an antibiotic.	|————————————————|
10. I frequently prescribe antibiotics because patients insist on it.	|————————————————|
11. I sometimes prescribe antibiotics so that patients continue to trust me.	|————————————————|
12. I sometimes prescribe antibiotics, even when I know that they are not indicated because I do not have the time to explain to the patient the reason why they are not called for.	|————————————————|
13. If a patient feels that he/she needs antibiotics, he/she will manage to obtain them at the pharmacy without a prescription, even when they have not been prescribed.	|————————————————|
14. Two of the main causes of the appearance of antibiotic resistance are patient self-medication and antibiotic misuse.	|————————————————|
15. Dispensing antibiotics without a prescription should be more closely controlled.	|————————————————|
16. In a primary-care context, amoxicillin is useful for treating most respiratory infections.	|————————————————|
17. The phenomenon of resistance to antibiotics is mainly a problem in hospital settings.	|————————————————|

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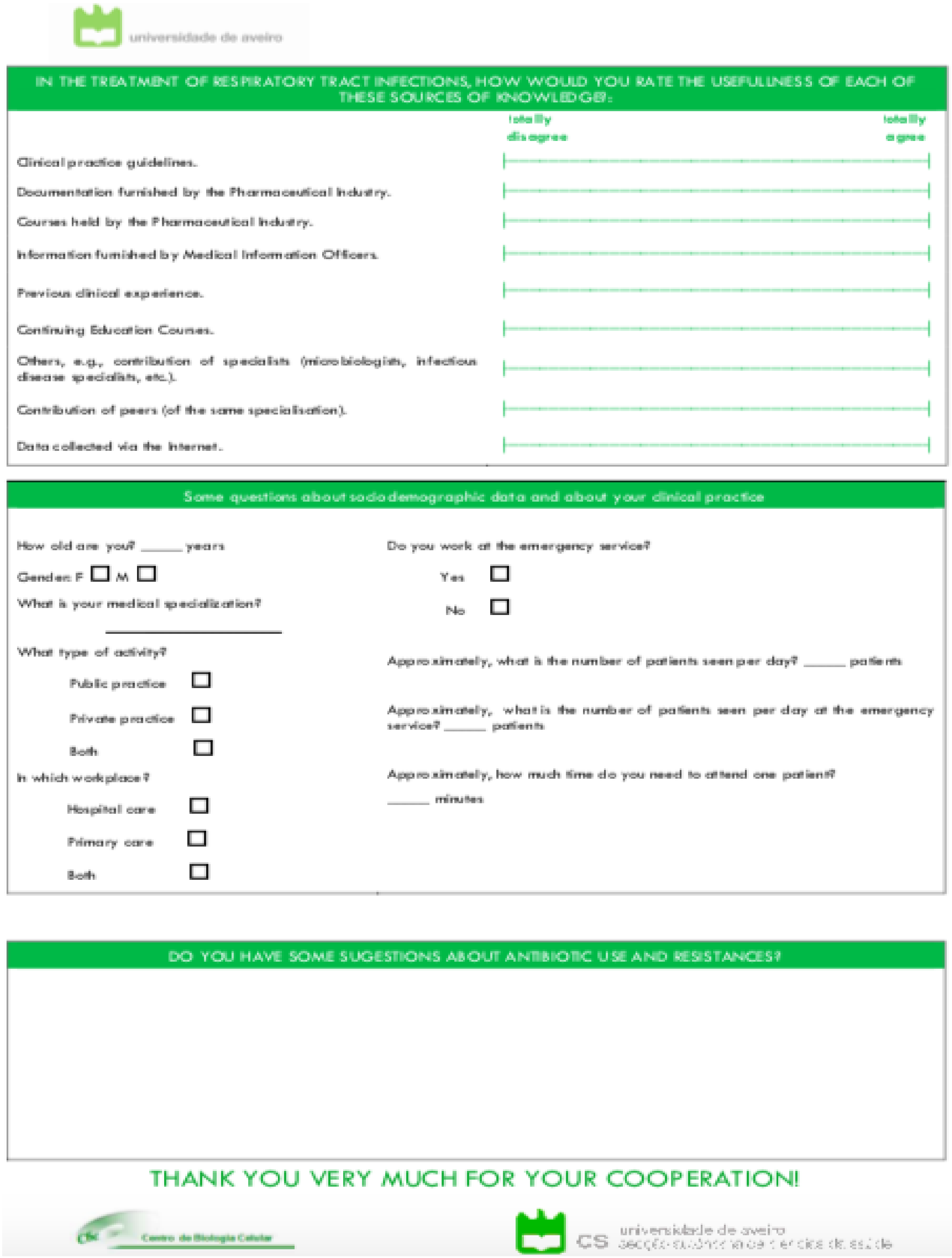
Figure B1. Provider questionnaire, page 1 of 2. Developed by Teixeira Rodrigues et al., 2016, https://bmcinfectdis.biomedcentral.com/track/pdf/10.1186/s12879-015-1332-y

Appendix B

Healthcare Provider Questionnaire



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IN THE TREATMENT OF RESPIRATORY TRACT INFECTIONS, HOW WOULD YOU RATE THE USEFULNESS OF EACH OF THESE SOURCES OF KNOWLEDGE?

	totally disagree — totally agree
Clinical practice guidelines.	
Documentation furnished by the Pharmaceutical Industry.	
Courses held by the Pharmaceutical Industry.	
Information furnished by Medical Information Officers.	
Previous clinical experience.	
Continuing Education Courses.	
Others, e.g., contribution of specialists (microbiologists, infectious disease specialists, etc.).	
Contribution of peers (of the same specialisation).	
Data collected via the Internet.	

Some questions about sociodemographic data and about your clinical practice

How old are you? _____ years

Gender: F ☐ M ☐

What is your medical specialization?

____

What type of activity?

- Public practice ☐
- Private practice ☐
- Both ☐

In which workplace?

- Hospital care ☐
- Primary care ☐
- Both ☐

Do you work at the emergency service?

- Yes ☐
- No ☐

Approximately, what is the number of patients seen per day? _____ patients

Approximately, what is the number of patients seen per day at the emergency service? _____ patients

Approximately, how much time do you need to attend one patient?

_____ minutes

DO YOU HAVE SOME SUGESTIONS ABOUT ANTIBIOTIC USE AND RESISTANCES?

THANK YOU VERY MUCH FOR YOUR COOPERATION!

Centro de Biologia Celular

universidade de aveiro

Figure B2. Provider questionnaire, page 2 of 2. Developed by Teixeira Rodrigues et al., 2016, https://bmcinfectdis.biomedcentral.com/track/pdf/10.1186/s12879-015-1332-y

Appendix C

Adapted Healthcare Provider Questionnaire

EXPLANATION
This survey has been adapted from a pre-validated questionnaire developed by Teixeira-Rodrigues et al. (2016). The questionnaire is intended to collect data on health care provider's knowledge, attitudes, perceptions, and prescribing behaviors involved in the use of antibiotics and resistance in the clinical setting. The survey and question responses will be used as part of the completion of a Doctor of Nursing Practice Scholarly Project, a requirement of the Pittsburg State University Graduate Nursing program. Participation is completely voluntary. No identifying information will be obtained or used in the final publication. All responses are anonymous. Thank you for taking the time to complete this survey, your responses are greatly valued!

FILLING INSTRUCTIONS
In the left column are the questions that will be the subject of your evaluation. To the right of each question there is a continuous scale where you will use the slider to mark the place where, according to your opinion represents your agreement with the text comment. If you are totally in disagreement, you should place the slider at the left end, and as your agreement increases you should move the slider to the right.

ABOUT ANTIBIOTICS AND RESISTANCES: Use the slider to select your level of agreement with each statement below, from zero (totally disagree) to 100 (totally agree).

	Totally Disagree	Totally Agree
1. Antibiotic resistance is an important Public Health problem in our setting.		
2. In a primary-care context, one should wait for the microbiology results before treating an infectious disease.		
3. Rapid and effective diagnostic techniques are required for diagnosis of infectious diseases.		
4. The prescription of an antibiotic to a patient does not influence the possible appearance of resistance.		

5. I am convinced that new antibiotics will be developed to solve the problem of resistance.

6. The use of antibiotics on animals is an important cause of appearance of new resistance to pathogenic agents in humans.

7. In case of doubt, it is preferable to use a wide-spectrum antibiotic to ensure that the patient is cured of an infection.

8. I frequently prescribe an antibiotic in situations in which it is impossible for me to conduct a systematic follow-up of the patient.

9. In situations of doubt as to whether a disease might be of bacterial etiology, it is preferable to prescribe an antibiotic.

10. I frequently prescribe antibiotics because patients insist on it.

11. I sometimes prescribe antibiotics so that patients continue to trust me.

12. I sometimes prescribe antibiotics, even when I know that they are not indicated because I do not have the time to explain to the patient the reason why they are not called for.

13. If a patient feels that he/she needs antibiotics, he/she will manage to obtain them without a prescription, even when they have not been prescribed.

14. Two of the main causes of the appearance of antibiotic resistance are patient self-medication and antibiotic misuse.	
15. Dispensing antibiotics without a prescription should be more closely monitored.	
16. In a primary-care context, amoxicillin is useful for treating most respiratory infections.	
17. The phenomenon of resistance to antibiotics is mainly a problem in hospital settings.	

IN THE TREATMENT OF RESPIRATORY TRACT INFECTIONS, HOW WOULD YOU RATE THE USEFULLNESS OF EACH OF THESE RESOURCES OF KNOWLEDGE?:	
	Totally Disagree Totally Agree
18. Clinical practice guidelines.	
19. Documentation furnished by the Pharmaceutical Industry.	
20. Courses held by the Pharmaceutical Industry.	
21. Information furnished by Medical Information Officers.	
22. Previous Clinical Experience.	

23. Continuing Education Courses.	
24. Others, e.g., contribution of specialists (microbiologists, infectious disease specialists, etc.).	
25. Contribution of peers (of the same specialization).	
26. Data collected via the internet.	

SOME QUESTIONS ABOUT SOCIODEMOGRAPHIC DATA AND ABOUT YOUR CLINICAL PRACTICE

27. How old are you? _____years

28. Gender:

1 Female

2 Male

29. What type of activity?

1 Public Practice

2 Private Practice

3 Both

30. In which workplace?

1 Hospital Care

2 Primary Care

3 Both

31. Do you work at the emergency service?

1 Yes

2 No

32. Approximately, what is the number of patients seen per day? _______patients

33.Approximatley, how much time do you need to attend to one patient? _____minutes

DO YOU HAVE SOME SUGGESTIONS ABOUT ANTIBIOTIC USE AND RESISTANCES?

Figure C1. Adapted healthcare provider questionnaire. Adapted from Teixeira Rodrigues et al., 2016, https://bmcinfectdis.biomedcentral.com/track/pdf/10.1186/s12879-015-1332-y

Appendix D

Summary of Appropriate Antibiotic Use Recommendations for ARTIs in Adults

ACP

American College of Physicians

Leading Internal Medicine, Improving Lives

SUMMARY OF THE AMERICAN COLLEGE OF PHYSICIANS AND CENTERS FOR DISEASE CONTROL AND PREVENTION ADVICE FOR HIGH-VALUE CARE ON APPROPRIATE ANTIBIOTIC USE FOR ACUTE RESPIRATORY TRACT INFECTION IN ADULTS

Disease/Condition	Acute respiratory tract infection (ARTI)
Target Audience	Primary care providers, emergency medicine providers
Target Patient Population	Healthy adults
Intervention	Reduction in antibiotic prescriptions
Evidence That Using Antibiotics in Patients With ARTI Does Not Improve Outcomes	Multiple randomized clinical trials have shown that antibiotics are ineffective for most ARTIs. There is no benefit for patients with the common cold or acute uncomplicated bronchitis and limited benefit for patients diagnosed with bacterial rhinosinusitis.
Harms of Using Antibiotics	Annual direct costs are $6.5 billion and annual indirect costs are >$30 billion in the United States. Antibiotics are responsible for 1 of every 5 emergency department visits for drug-related complications. Complications occur in 5% to 25% of patients who use antibiotics. Antibiotic-associated diarrhea caused by *Clostridium difficile* is the most common serious complication, responsible for 29300 deaths in the United States per year.
Approaches to Overcome Barriers to Evidence-Based Practice	Multidimensional approaches involving active clinician education work best to reduce antibiotic prescriptions, including physician and patient education, physician audit and feedback, delayed antibiotic prescriptions, health information technology, and financial or regulatory incentives.
Talking Points for Clinicians When Discussing the Use of Antibiotics in Patients With ARTI	The average adult has 2 to 3 episodes of ARTI per year. Symptoms usually resolve in 1 to 2 weeks, but cough can last up to 6 weeks. Symptomatic treatment tailored to patient preferences may provide relief. Antibiotics do not cure most ARTIs or reduce time to resolution of symptoms. Antibiotics cause many serious adverse effects and should be reserved for patients with confirmed group A streptococcal pharyngitis.
High-Value Care Advice	High-Value Care Advice 1: *Clinicians should not perform testing or initiate antibiotic therapy in patients with bronchitis unless pneumonia is suspected.* High-Value Care Advice 2: *Clinicians should test patients with symptoms suggestive of group A streptococcal pharyngitis (for example, persistent fevers, anterior cervical adenitis, and tonsillopharyngeal exudates or other appropriate combination of symptoms) by rapid antigen detection test and/or culture for group A* Streptococcus. *Clinicians should treat patients with antibiotics only if they have confirmed streptococcal pharyngitis.* High-Value Care Advice 3: *Clinicians should reserve antibiotic treatment for acute rhinosinusitis for patients with persistent symptoms for more than 10 days, onset of severe symptoms or signs of high fever (>39 °C) and purulent nasal discharge or facial pain lasting for at least 3 consecutive days, or onset of worsening symptoms following a typical viral illness that lasted 5 days that was initially improving (double sickening).* High-Value Care Advice 4: *Clinicians should not prescribe antibiotics for patients with the common cold.*

Figure D1. The american academy of physicians and centers for disease control and prevention advice for high-value care on appropriate use to antibiotics for acute respiratory tract infections in adults, page 1 of 1. Developed by Harris, Hicks, and Qaseem, 2016, http://www.ashnha.com/wp-content/uploads/2015/05/ACP-URI-guidelines-1.pdf

Appendix E

Diagnosis and Treatment of Respiratory Illness in Children and Adults Algorithms

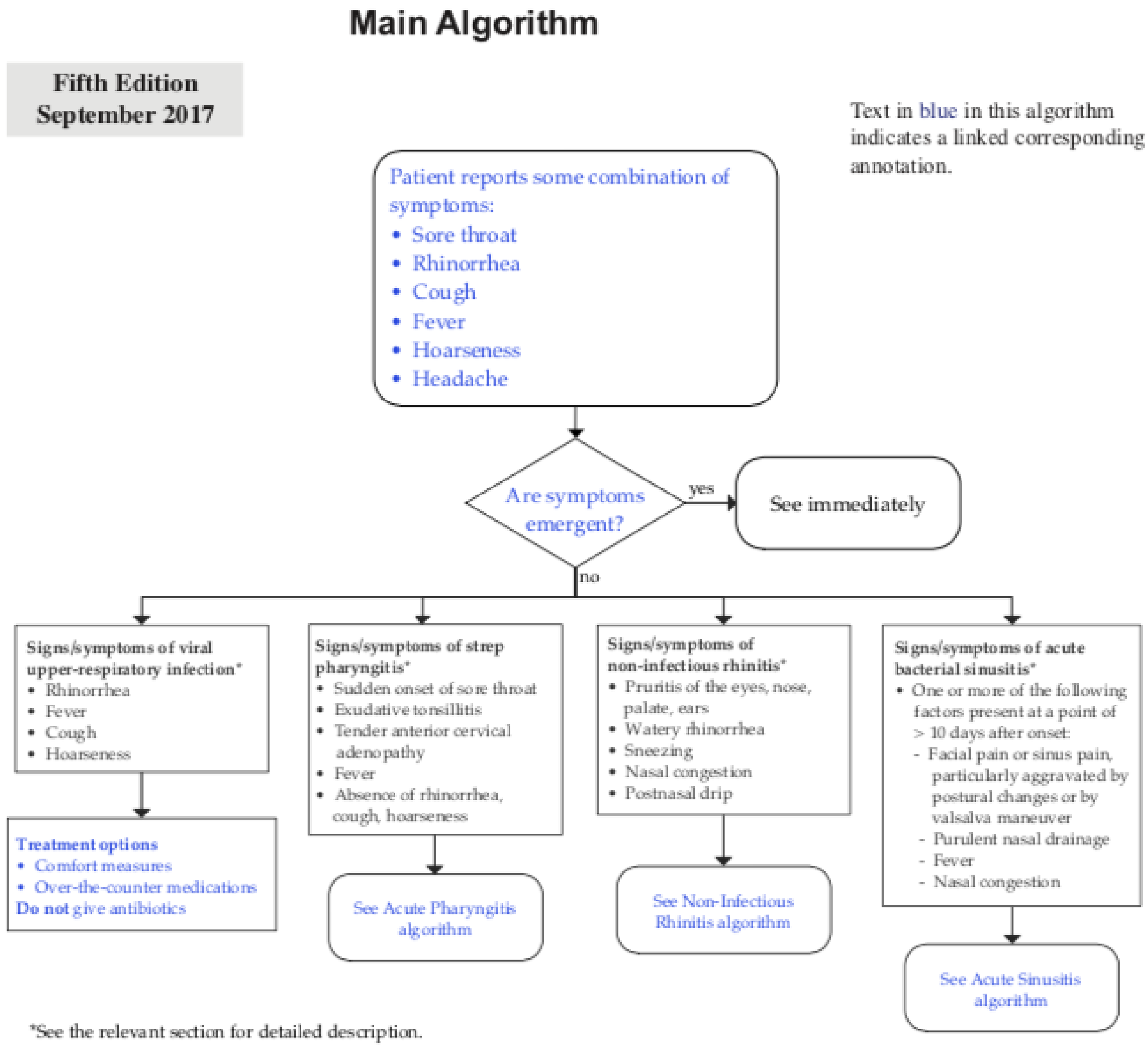


Figure E1. Institute for Clinical Systems Improvement (ICSI): Diagnosis and treatment of respiratory illness main algorithm, page 1 of 4. Developed by Short et al., 2017, https://www.icsi.org/_asset/pwyrky/RespIllness.pdf

Appendix E

Diagnosis and Treatment of Respiratory Illness in Children and Adults Algorithms

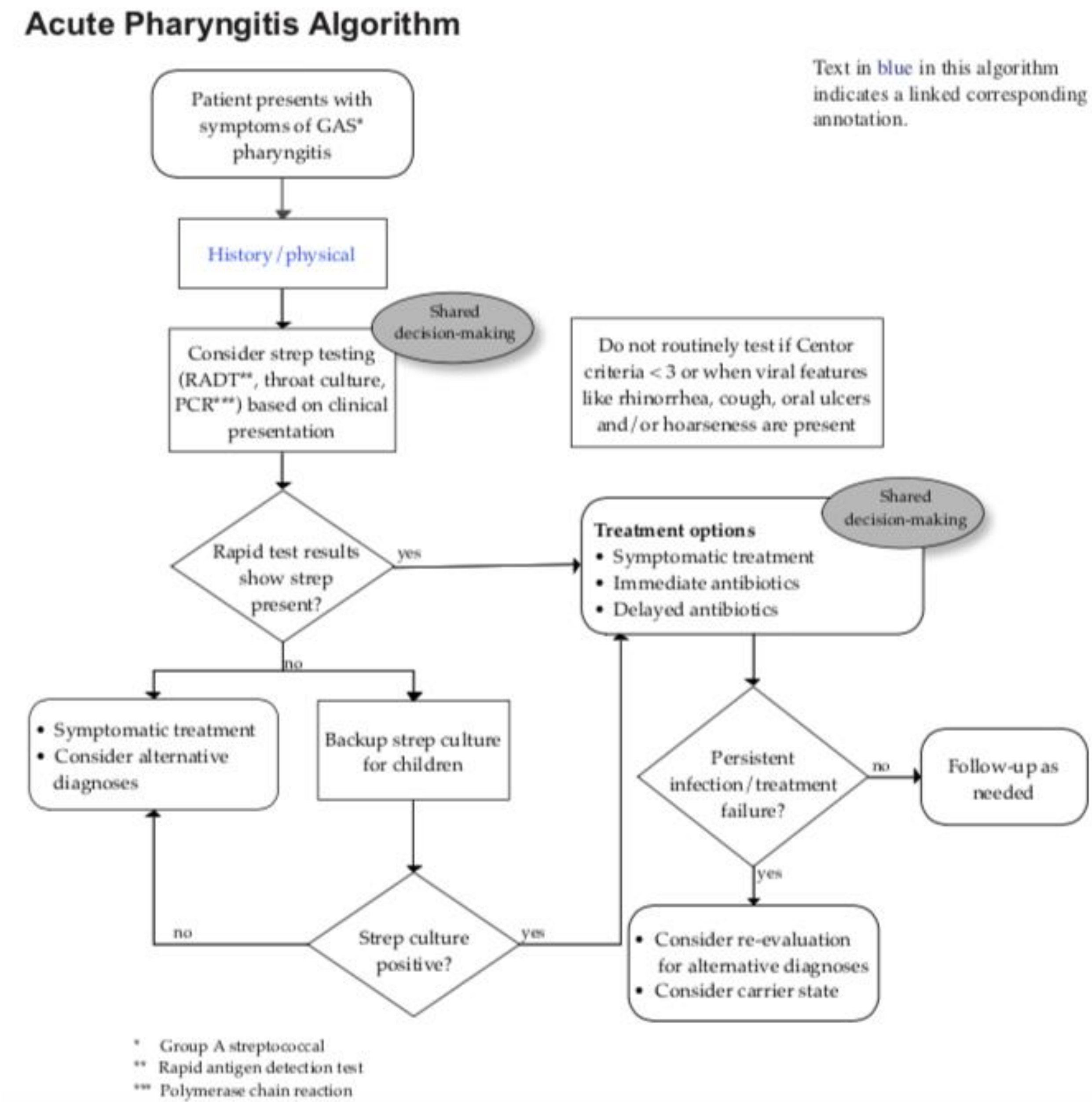


Figure E2. Institute for Clinical Systems Improvement (ICSI): Diagnosis and treatment of respiratory illness acute pharyngitis algorithm, page 2 of 4. Developed by Short et al., 2017, https://www.icsi.org/_asset/pwyrky/RespIllness.pdf

Appendix E

Diagnosis and Treatment of Respiratory Illness in Children and Adults Algorithms

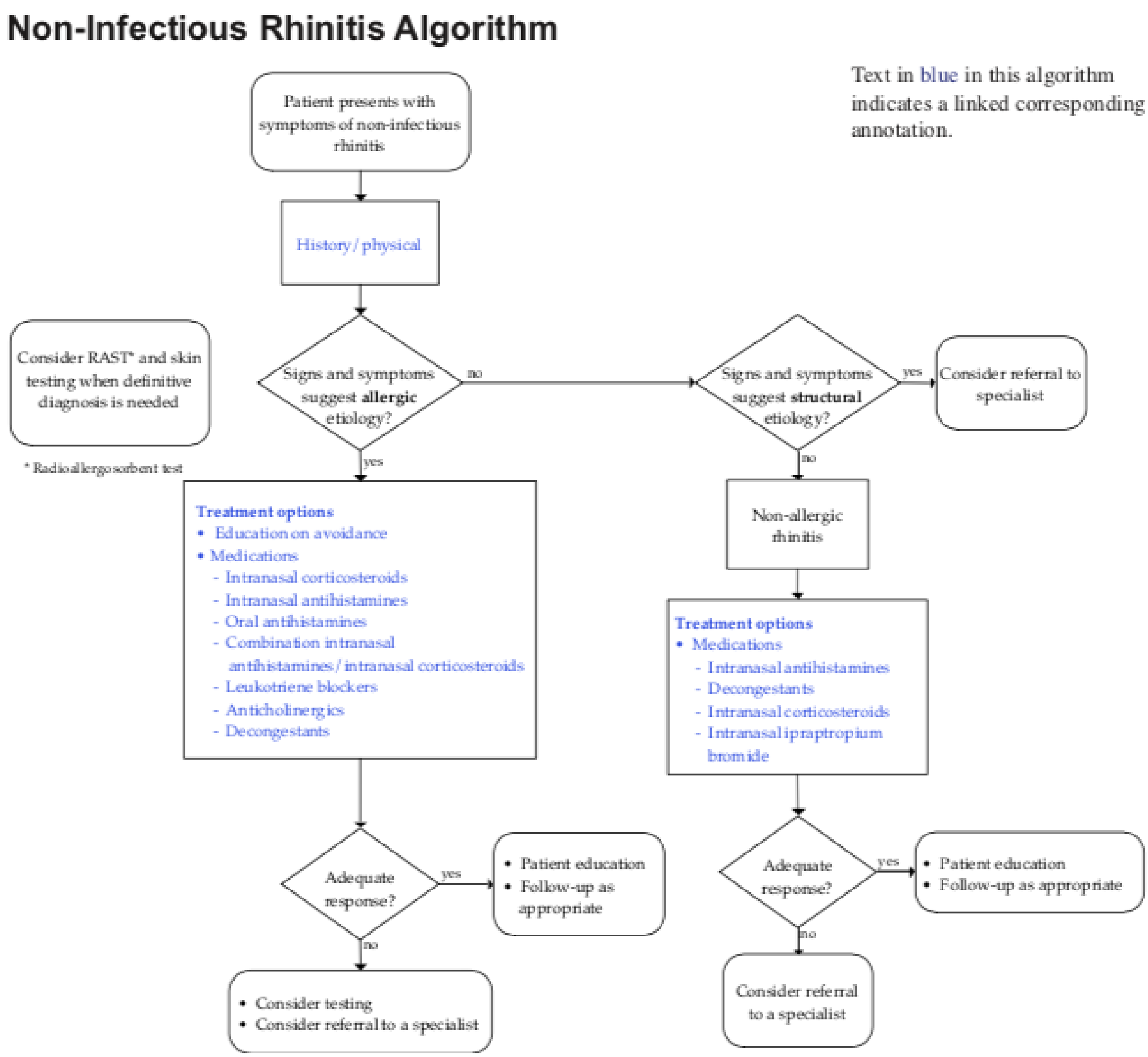


Figure E3. Institute for Clinical Systems Improvement (ICSI): Diagnosis and treatment of respiratory illness non-infectious rhinitis algorithm, page 3 of 4. Developed by Short et al., 2017, https://www.icsi.org/_asset/pwyrky/RespIllness.pdf

Appendix E

Diagnosis and Treatment of Respiratory Illness in Children and Adults Algorithms

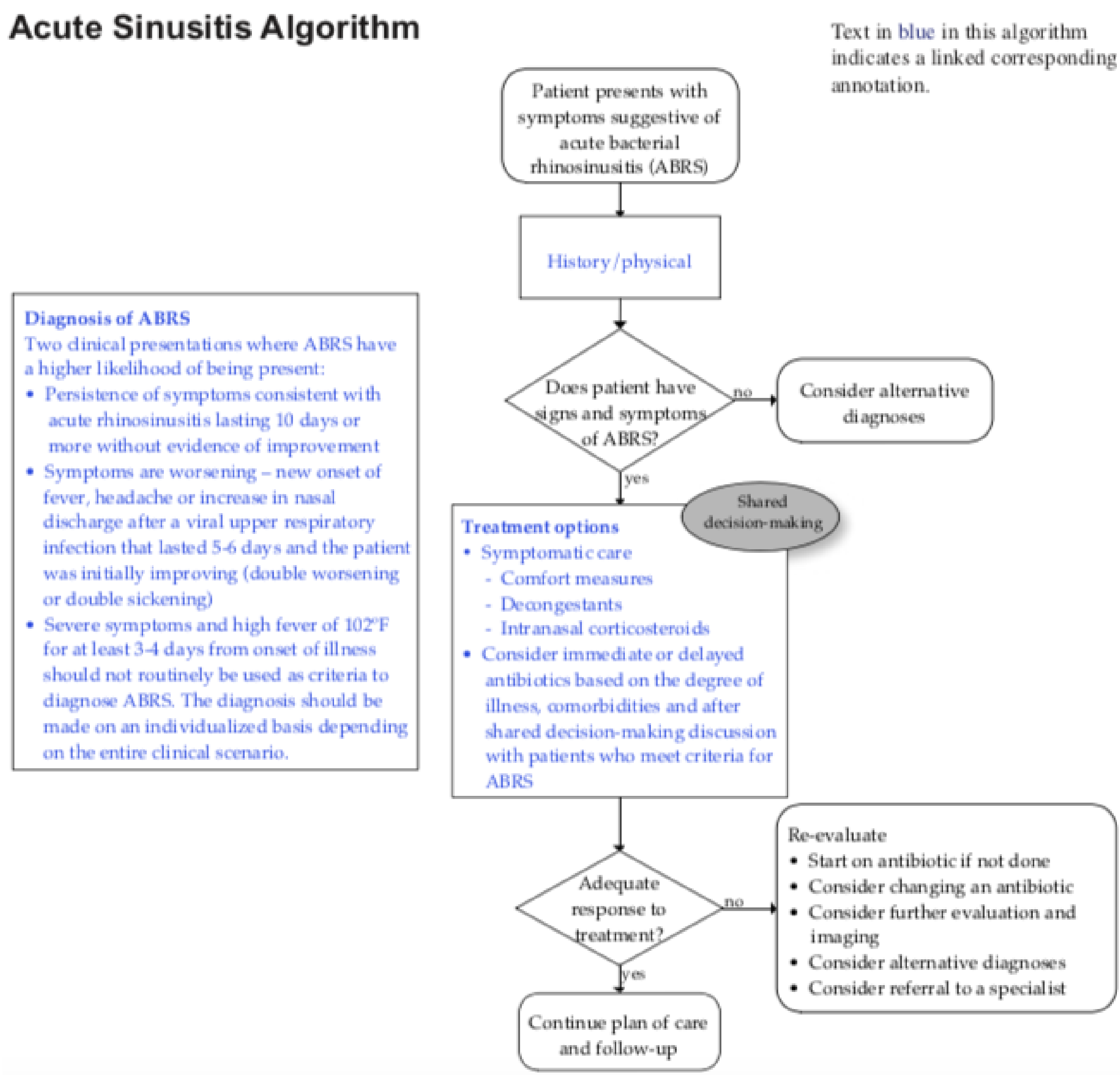


Figure E4. Institute for Clinical Systems Improvement (ICSI): Diagnosis and treatment of respiratory illness acute sinusitis algorithm, page 4 of 4. Developed by Short et al., 2017, https://www.icsi.org/_asset/pwyrky/RespIllness.pdf

Appendix F

Four Core Elements of Outpatient Antibiotic Stewardship

Figure F1. The centers for disease control and prevention four core elements of outpatient antibiotic stewardship, page 1 of 1. Developed by Sanchez et al., 2016, https://www.cdc.gov/antibiotic-use/community/pdfs/16_268900-A_CoreElementsOutpatient_508.pdf

Appendix G

IRB Approval

about:blank

Pittsburg State University
Application for Approval of Investigations
Involving the Use of Human Subjects

This application must be completed by the Investigator and sent to the Office of Graduate and Continuing Studies by the first Tuesday of the month during the fall and spring academic semesters to be considered for full review on the second Tuesday of the month.

Expedited and exempt reviews can be turned in any time. For questions about the review process contact Brian Peery in Russ Hall, #112, Ext. 4175.

1. Investigator(s) Name(s): Brice Saunders

2. Department: Irene Ransom Bradley School of Nursing

3. Local Address: 1220 Garden Grove Road, Joplin MO

4. Phone: 417-434-0837

5. E-mail Address: bsaunders@gus.pittstate.edu

6. Project Title: Inappropriate Antibiotic Use: A Survey of Provider Prescribing Behaviors

7. Expected Completion Date: May, 2020

8. Expected Starting Date November, 2019

9. Is this project (check all that apply): Use review criteria in Form CR-1 to determine which category of review applies.

- [ ] Application for Full Review
- [ ] Protocol Change
- [x] Thesis/Special Investigation
- [ ] Being submitted for external support
- [ ] Continued Review
- [ ] Application for Expedited Review
- [ ] Being conducted in a foreign country
- [ ] Faculty Research
- [x] Application for Exempt Review
- [ ] Publishable research
- [x] A Class Project

10. If notification of human subject approval is required give date required: N/A

Name of agency:

11. If you are a student, complete the following:

Faculty Sponsor: Amanda Alonzo

Department: Nursing

Phone: 620-231-7000

**** If submitted externally, a complete copy of the proposal must be submitted to the IRB.****

1 of 22 12/3/2019, 4:34 PM

Figure G1. Pittsburg state university IRB approval, page 1 of 2.

Appendix G

IRB Approval

CERTIFICATION AND APPROVAL

Certification by Investigator: I certify that (a) the information presented in this application is accurate, (b)only the procedures approved by the IRB will be used in this project, (c)modifications to this project will be submitted for approval prior to use, and that all guidelines outlined in the PSU Policy and Assurance Handbook for the Protection of Human Research Subjects will be followed as well as all applicable federal, state and local laws regarding the protection of human subjects in research as outlined in Form VA-1.

Signature of Investigator — Date: 10/22/2019

Faculty Sponsor: If the Investigator is a student, his/her Faculty Sponsor must approve this application. I certify that this project is under my direct supervision and that I accept the responsibility for ensuring that all provisions of approval are met by the investigator.

Signature of Faculty Sponsor — Date: 10/22/19

Department Review Committee Chair: I acknowledge that this research is in keeping with the standards set by our department, university, state and federal agencies and I assure that the student principal investigator has met all departmental requirements for review and approval of this research.

Signature of Department Review committee Chairperson — Date: 11/20/19

CPHRS Chairperson — Date: 12/3/19

I. Description of the Subjects (If advertising for subjects, include a copy of the proposed advertisement.)

A. How many subjects will be involved? Approx. 80 participants

B. Subject Population (check all that apply) Survey of Health Care Providers

- [x] Adults
- [ ] Prisoners
- [ ] Minors
- [ ] Intellectual Disability
- [ ] Physically Ill
- [ ] Disabled
- [ ] Special Education
- [ ] Other

C. For projects conducted in schools or school settings:
(Written approval from the Building Administrator must be obtained)

What grade are the students in? ______

Approximate Age of Students? ______

How many classes involved? ______

Figure G2. Pittsburg state university IRB approval, page 2 of 2.

Appendix H

Site Approval Letters

Irene Ransom Bradley School of Nursing
Pittsburg State University
1701 S. Broadway St.
Pittsburg, KS 66762

Subject: Site Approval Letter

To whom it may concern:

This letter acknowledges that I have received and reviewed a request by Brice Saunders, DNP Student at Pittsburg State University, to conduct a research project entitled *"Inappropriate Antibiotic Use: A Survey of Provider Prescribing Behaviors"* at [redacted] and I approve of this research to be conducted at our facility during December 2019 to May 2020.

Sincerely,

[redacted]
(Signature)

12/6/2019
(Date)

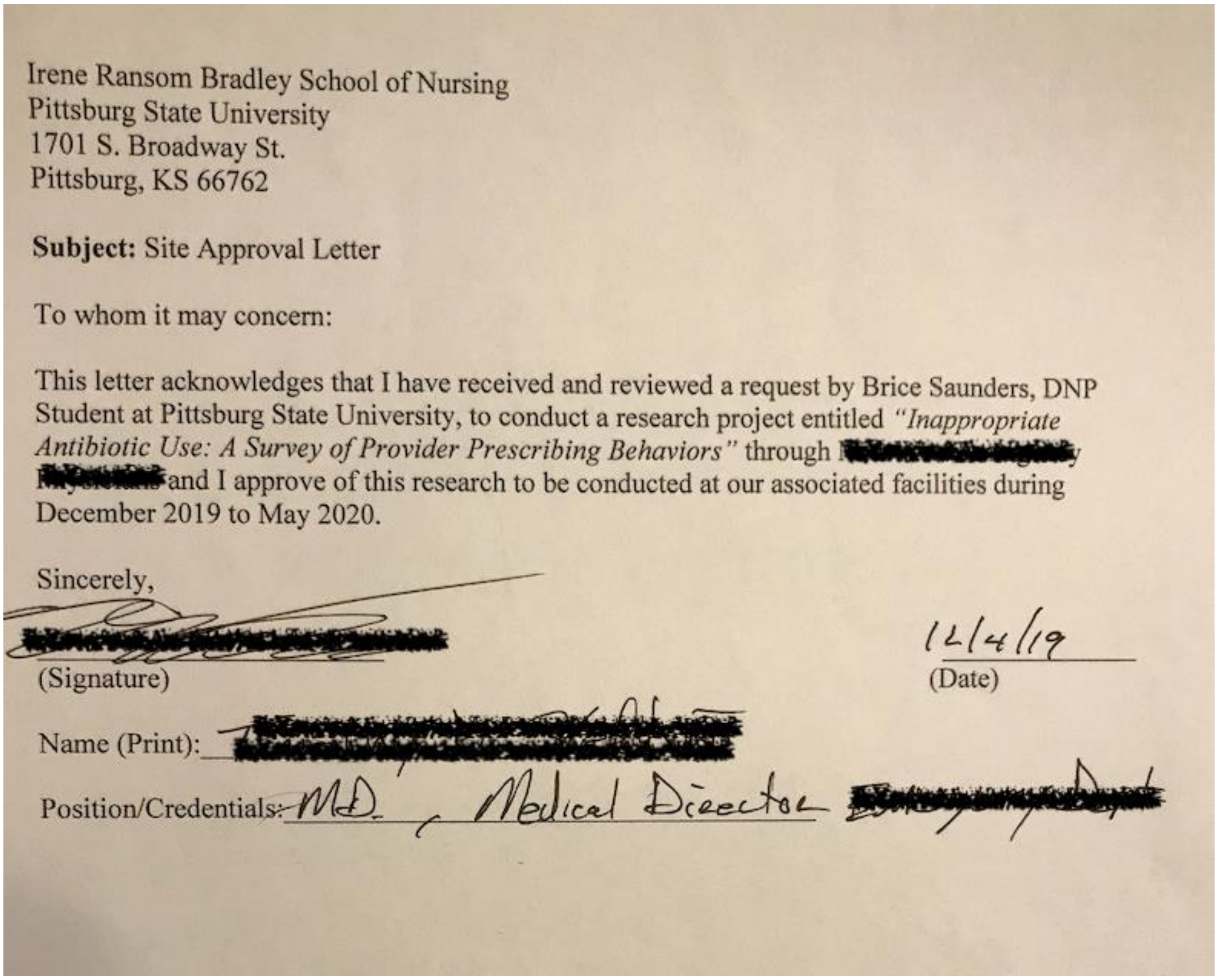
Name: [redacted]

Position/Credentials: VP of Clinical Education

Figure H1. Site approval letter, page 1 of 3.

Appendix H

Site Approval Letters



Irene Ransom Bradley School of Nursing
Pittsburg State University
1701 S. Broadway St.
Pittsburg, KS 66762

Subject: Site Approval Letter

To whom it may concern:

This letter acknowledges that I have received and reviewed a request by Brice Saunders, DNP Student at Pittsburg State University, to conduct a research project entitled *"Inappropriate Antibiotic Use: A Survey of Provider Prescribing Behaviors"* through [redacted] and I approve of this research to be conducted at our associated facilities during December 2019 to May 2020.

Sincerely,

[redacted] 12/4/19
(Signature) (Date)

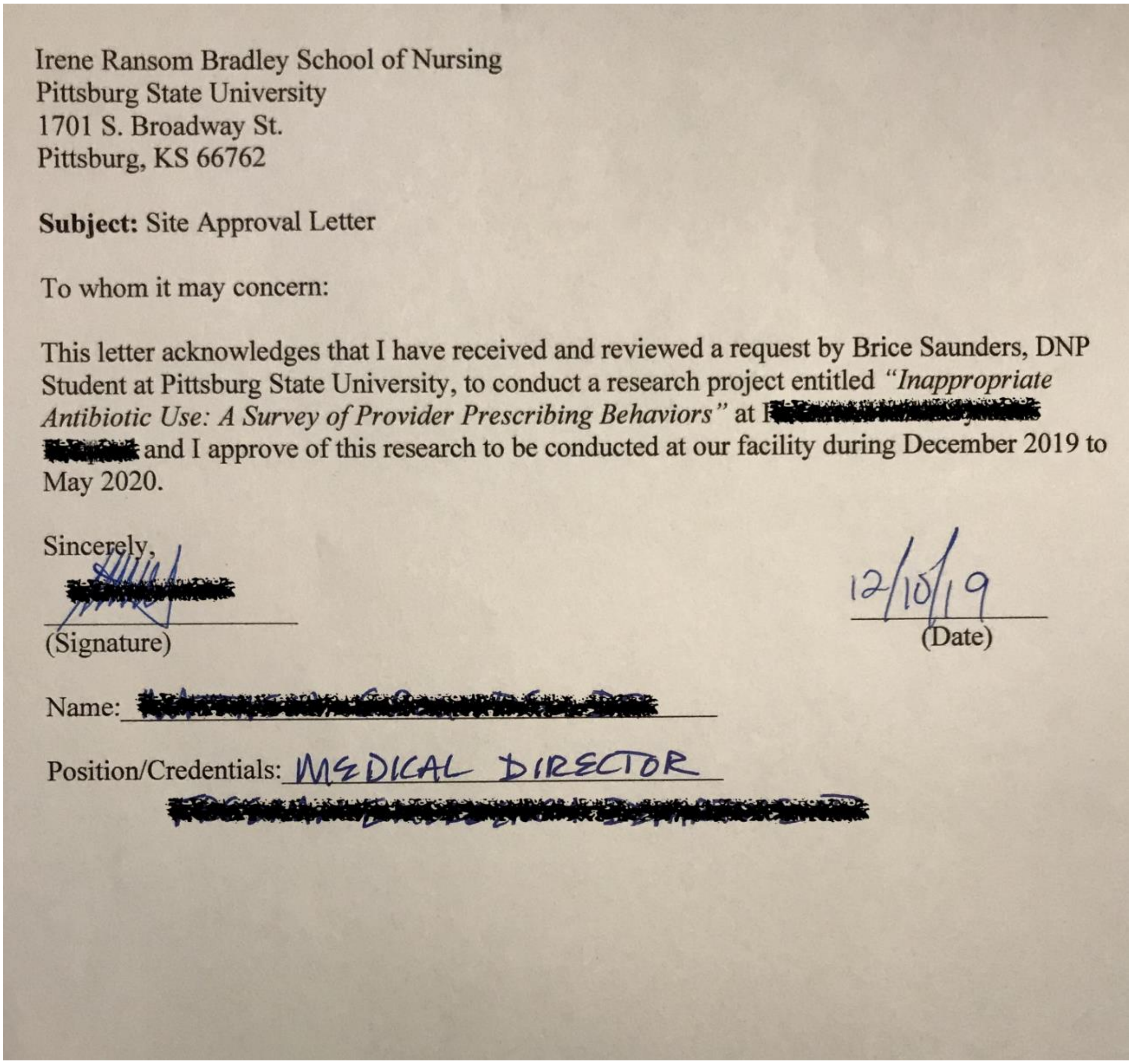
Name (Print): [redacted]

Position/Credentials: MD, Medical Director [redacted]

Figure H2. Site approval letter, page 2 of 3.

Appendix H

Site Approval Letters



Irene Ransom Bradley School of Nursing
Pittsburg State University
1701 S. Broadway St.
Pittsburg, KS 66762

Subject: Site Approval Letter

To whom it may concern:

This letter acknowledges that I have received and reviewed a request by Brice Saunders, DNP Student at Pittsburg State University, to conduct a research project entitled *"Inappropriate Antibiotic Use: A Survey of Provider Prescribing Behaviors"* at [redacted] and I approve of this research to be conducted at our facility during December 2019 to May 2020.

Sincerely,

[redacted]
(Signature)

12/10/19
(Date)

Name: [redacted]

Position/Credentials: MEDICAL DIRECTOR
[redacted]

Figure H3. Site approval letter, page 3 of 3.

Appendix I

Targeted Education Resources for Patients

A Commitment to Our Patients About Antibiotics

Antibiotics only fight infections caused by bacteria. Like all drugs, they can be harmful and should only be used when necessary. Taking antibiotics when you have a virus can do more harm than good: you will still feel sick and the antibiotic could give you a skin rash, diarrhea, a yeast infection, or worse.

Antibiotics also give bacteria a chance to become more resistant to them. This can make future infections harder to treat. It means that antibiotics might not work when you really do need them. Because of this, it is important that you only use an antibiotic when it is necessary to treat your illness.

How can you help? When you have a cough, sore throat, or other illness, tell your doctor you only want an antibiotic if it is really necessary. If you are not prescribed an antibiotic, ask what you can do to feel better and get relief from your symptoms.

Your health is important to us. As your healthcare providers, we promise to provide the best possible treatment for your condition. If an antibiotic is not needed, we will explain this to you and will offer a treatment plan that will help. We are **dedicated** to prescribing antibiotics **only** when they are needed, and we will avoid giving you antibiotics when they might do more harm than good.

If you have any questions, please feel free to ask us.

Sincerely,

To learn more about antibiotic prescribing and use, visit www.cdc.gov/antibiotic-use.

BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

Figure I1. Examination room written public commitment to patients concerning the use of antibiotics, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/week/pdfs/Commitment-Poster-english-11x17.pdf

Appendix I

Targeted Education Resources for Patients

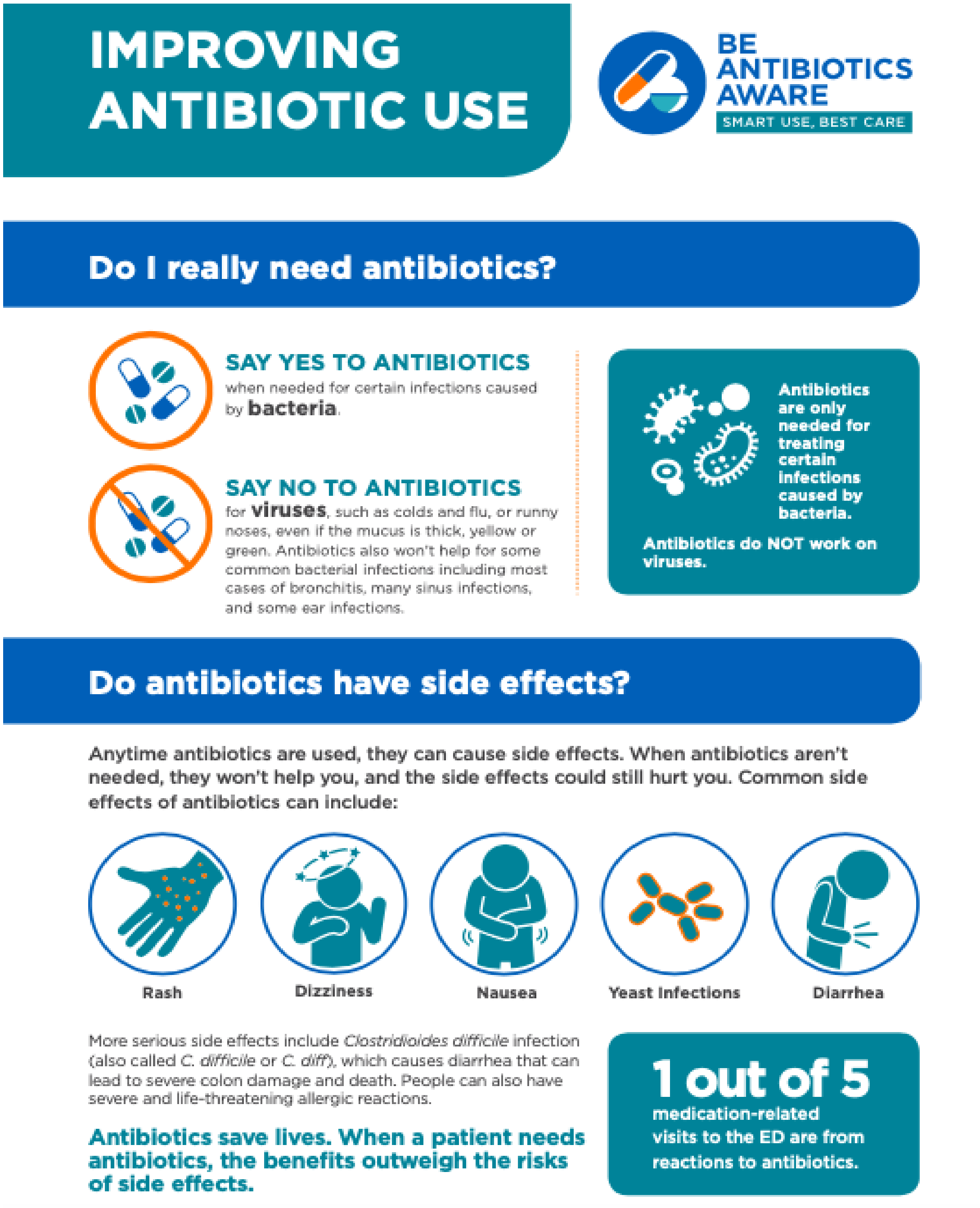


Figure I2. Improving antibiotic use, page 1 of 2. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/pdfs/aaw/au_improving-antibiotics-infographic_8_5x11_508.pdf

Appendix I

Targeted Education Resources for Patients

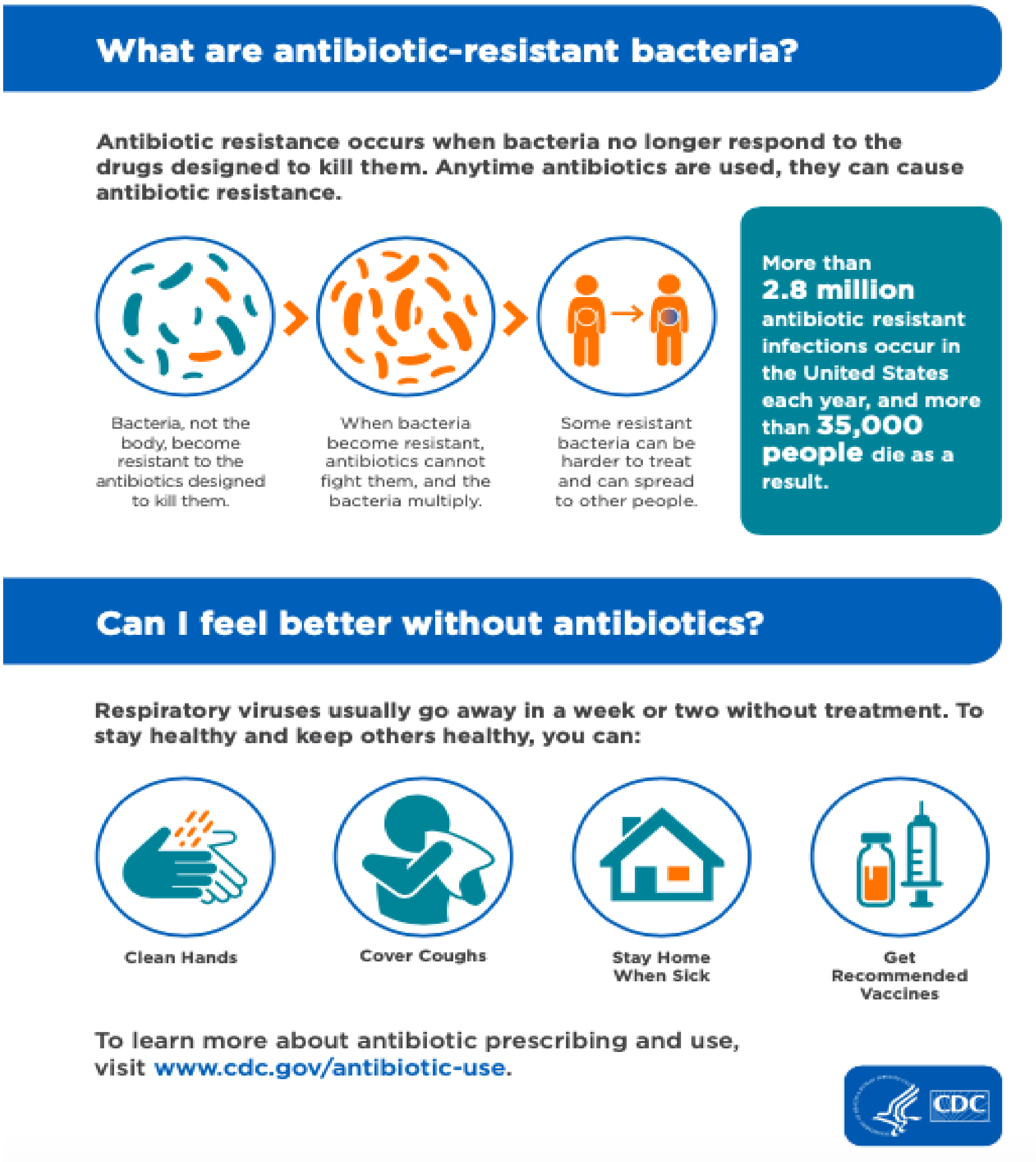


Figure I2. Improving antibiotic use, page 2 of 2. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/pdfs/aaw/au_improving-antibiotics-infographic_8_5x11_508.pdf

Appendix I

Targeted Education Resources for Patients

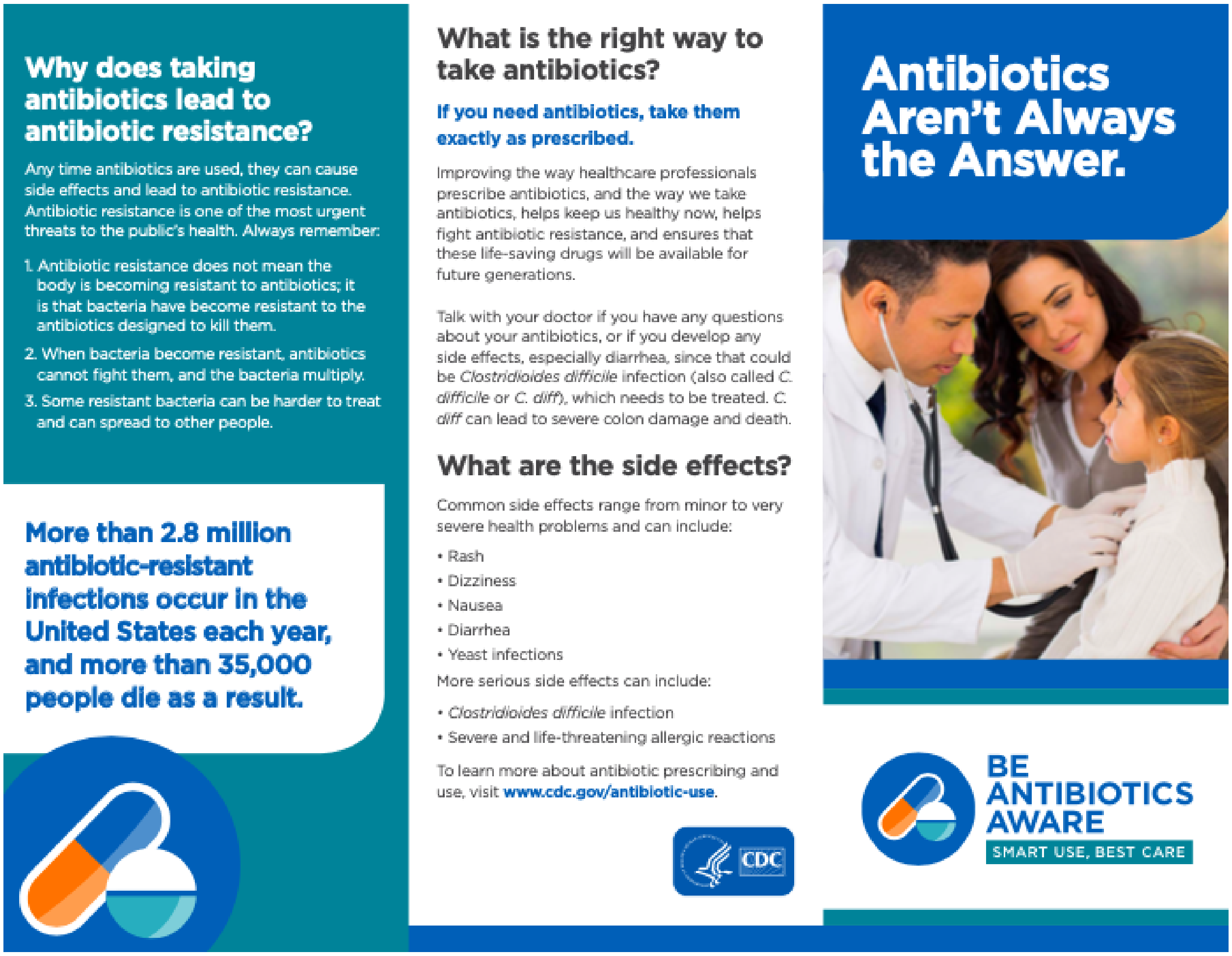
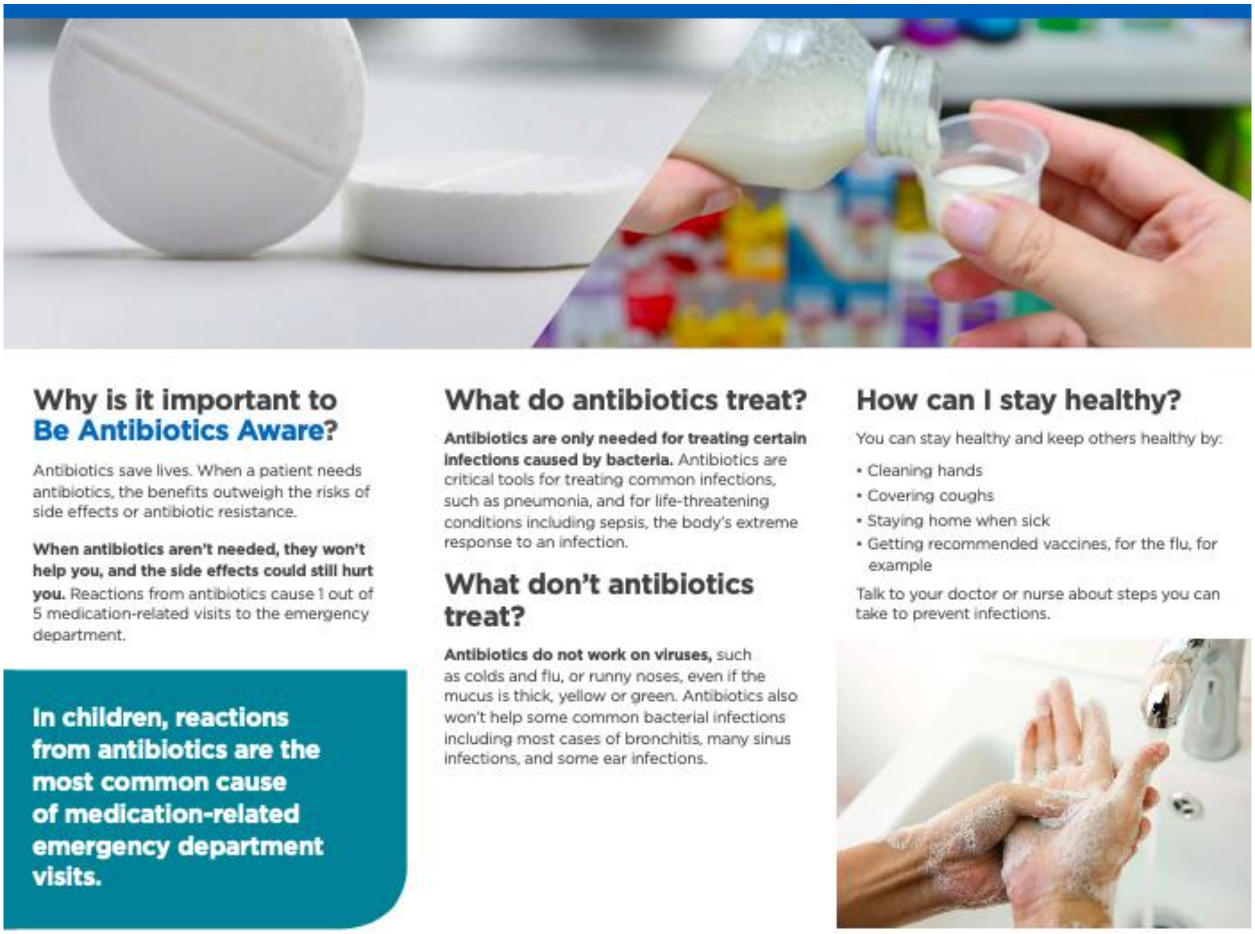


Figure I3. Antibiotics are not always the answer brochure, page 1 of 2. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/pdfs/aaw/AU_trifold_8_5x11_508.pdf

Appendix I

Targeted Education Resources for Patients



Why is it important to Be Antibiotics Aware?

Antibiotics save lives. When a patient needs antibiotics, the benefits outweigh the risks of side effects or antibiotic resistance.

When antibiotics aren't needed, they won't help you, and the side effects could still hurt you. Reactions from antibiotics cause 1 out of 5 medication-related visits to the emergency department.

In children, reactions from antibiotics are the most common cause of medication-related emergency department visits.

What do antibiotics treat?

Antibiotics are only needed for treating certain infections caused by bacteria. Antibiotics are critical tools for treating common infections, such as pneumonia, and for life-threatening conditions including sepsis, the body's extreme response to an infection.

What don't antibiotics treat?

Antibiotics do not work on viruses, such as colds and flu, or runny noses, even if the mucus is thick, yellow or green. Antibiotics also won't help some common bacterial infections including most cases of bronchitis, many sinus infections, and some ear infections.

How can I stay healthy?

You can stay healthy and keep others healthy by:

- Cleaning hands
- Covering coughs
- Staying home when sick
- Getting recommended vaccines, for the flu, for example

Talk to your doctor or nurse about steps you can take to prevent infections.

Figure I3. Antibiotics are not always the answer brochure, page 2 of 2. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/pdfs/aaw/AU_trifold_8_5x11_508.pdf

Appendix I

Targeted Education Resources for Patients

Viruses or Bacteria
What's got you sick?

Antibiotics are only needed for treating certain infections caused by bacteria. Viral illnesses cannot be treated with antibiotics. When an antibiotic is not prescribed, ask your healthcare professional for tips on how to relieve symptoms and feel better.

Common Condition	Common Cause			Are Antibiotics Needed?
	Bacteria	Bacteria or Virus	Virus	
Strep throat	✓			Yes
Whooping cough	✓			Yes
Urinary tract infection	✓			Yes
Sinus infection		✓		Maybe
Middle ear infection		✓		Maybe
Bronchitis/chest cold (in otherwise healthy children and adults)*		✓		No*
Common cold/runny nose			✓	No
Sore throat (except strep)			✓	No
Flu			✓	No

* Studies show that in otherwise healthy children and adults, antibiotics for bronchitis won't help you feel better.

BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

To learn more about antibiotic prescribing and use, visit www.cdc.gov/antibiotic-use.

CDC

Figure I4. Acute upper respiratory etiology and antibiotic indications, page 1 of 1.

Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/pdfs/aaw/AU_viruses-or-bacteria-Chart_508.pdf

Appendix I

Targeted Education Resources for Patients

Preventing and Treating Bronchitis

Cough keeping you up at night? Soreness in your chest and feeling tired? You could have acute bronchitis, but be aware: **an antibiotic will not help you get better.**

What is Acute Bronchitis?

Bronchitis occurs when the airways of the lungs swell and produce mucus. That's what makes you cough. Acute bronchitis, often called a "chest cold," is the most common type of bronchitis. The symptoms last less than 3 weeks. If you're a healthy person without underlying heart or lung problems or a weakened immune system, this information is for you.

Symptoms

- Coughing with or without mucus production
- Soreness in the chest
- Fatigue (feeling tired)
- Mild headache
- Mild body aches
- Watery eyes
- Sore throat

Causes

- Acute bronchitis is usually caused by a virus and often occurs after an upper respiratory infection.
- Bacteria can sometimes cause acute bronchitis, but even in these cases antibiotics are NOT recommended and will not help you get better.

When to Seek Medical Care

See a healthcare professional if you or your child have any of the following:

- Temperature of 100.4°F or higher
- Cough with bloody mucus
- Shortness of breath or trouble breathing
- Symptoms that last more than 3 weeks
- Repeated episodes of bronchitis

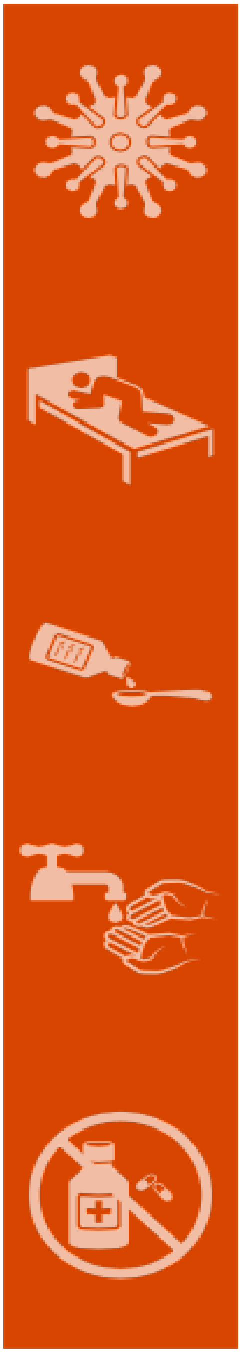
www.cdc.gov/antibiotic-use

CDC
Centers for Disease Control and Prevention
National Center for Emerging and Zoonotic Infectious Diseases

Figure I5. Prevention and treatment of acute bronchitis, page 1 of 2. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/downloads/Preventing-Treating-Bronchitis-p.pdf

Appendix I

Targeted Education Resources for Patients



Treatment

Acute bronchitis usually gets better on its own—without antibiotics. **Antibiotics won't help you get better if you have acute bronchitis.**

When antibiotics aren't needed, they won't help you, and the side effects could still cause harm. Side effects can range from minor issues, like a rash, to very serious health problems, such as antibiotic-resistant infections and *C. diff* infection, which causes diarrhea that can lead to severe colon damage and death.

If you have whooping cough (pertussis) or pneumonia, which can have similar symptoms to acute bronchitis, your doctor will most likely prescribe antibiotics.

How to Feel Better

- Get plenty of rest.
- Drink plenty of fluids.
- Use a clean humidifier, cool mist vaporizer, or saline nose drops to relieve a stuffy nose.
  - For young children, use a rubber suction bulb to clear mucus.
- Breathe in steam from a bowl of hot water or shower.
- Suck on lozenges. Do not give lozenges to children younger than 4 years old.
- Use honey to relieve cough for persons at least 1 year old.
- Ask your doctor or pharmacist about over-the-counter medicines that can help you feel better. Always use over-the-counter medicines as directed. Remember, over-the-counter medicines may provide temporary relief of symptoms, but they will not cure your illness.

Remember, always use over-the-counter medicines as directed. **Be careful about giving over-the-counter medicines to children. Not all over-the-counter medicines are recommended for children of certain ages.**

- Pain relievers:
  - Babies 6 months or younger: only give acetaminophen.
  - Children 6 months or older: it is OK to give acetaminophen or ibuprofen.
  - Never give aspirin to children because it can cause Reye's syndrome, a rare but very serious illness that harms the liver and brain.
- Cough and cold medicines:
  - Children younger than 4 years old: do not use unless a doctor specifically tells you to. Misuse of over-the-counter cough and cold medicines in young children can result in serious and potentially life-threatening side effects.
  - Children older than 4 years old: discuss with your child's doctor if over-the-counter cough and cold medicines are safe to give to your child for temporary symptom relief.

Prevention

- Practice good hand hygiene.
- Make sure you and your child are up-to-date with all recommended vaccines.
- Don't smoke and avoid secondhand smoke, chemicals, dust, or air pollution.
- Always cover your mouth and nose when coughing or sneezing.
- Keep your distance from others when you are sick, if possible.

Antibiotics will not treat acute bronchitis. Using antibiotics when not needed could do more harm than good.

Figure I5. Prevention and treatment of acute bronchitis, page 2 of 2. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/downloads/Preventing-Treating-Bronchitis-p.pdf

Appendix I

Targeted Education Resources for Patients

Preventing and Treating Ear Infections

Is your child's ear hurting? It could be an ear infection. Children are more likely than adults to get ear infections. Talk to your child's doctor about the best treatment.

Some ear infections, such as middle ear infections, need antibiotic treatment, but many can get better on their own without antibiotics.

What is an ear infection?

There are different types of ear infections. **Middle ear infection** (acute otitis media) is an infection in the middle ear.

Another condition that affects the middle ear is called **otitis media with effusion.** It occurs when fluid builds up in the middle ear without being infected and without causing fever, ear pain, or pus buildup in the middle ear.

When the outer ear canal is infected, the condition is called "swimmer's ear," which is different from a middle ear infection.

Causes

Middle ear infections can be caused by:

- Bacteria, like *Streptococcus pneumoniae* and Haemophilus influenzae (nontypeable) —the two most commonbacterial causes
- Viruses, like those that cause colds or flu

Symptoms

Common symptoms of middle ear infection in children can include:

- Ear pain
- Fever
- Fussiness or irritability
- Rubbing or tugging at an ear
- Difficulty sleeping

When to Seek Medical Care

See a doctor if your child has:

- A fever of 102.2°F (39°C) or higher
- Pus, discharge, or fluid coming from the ear
- Worsening symptoms
- Symptoms of a middle ear infection that last for more than 2–3 days
- Hearing loss

See a doctor right away if your child is younger than 3 months old and has a fever greater than 100.4 °F (38 °C).

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

CS309672 Aug 07, 2019

Figure I6. Prevention and treatment of ear infection, page 1 of 2. Developed by CDC, 2019, https://www.cdc.gov/antibiotic-use/community/downloads/preventing-and-treating-ear-infections-h.pdf

Appendix I

Targeted Education Resources for Patients

Preventing and Treating Ear Infections

Treatment

A doctor will determine what type of illness your child has by asking about symptoms and doing a physical examination. Your doctor can make the diagnosis of a middle ear infection by looking inside your child's ear to examine the eardrum and see if there is pus in the middle ear.

Antibiotics are often not needed for middle ear infections because the body's immune system can fight off the infection on its own. But sometimes antibiotics, such as amoxicillin, are needed to treat severe cases right away or cases that last longer than 2–3 days.

For mild cases of middle ear infection, your doctor might recommend **watchful waiting** or **delayed antibiotic prescribing**.

- **Watchful waiting:** Your child's doctor may suggest watching and waiting to see if your child needs antibiotics. This gives the immune system time to fight off the infection. If your child doesn't feel better after 2–3 days of rest, extra fluids, and pain relievers, the doctor will write a prescription for an antibiotic.
- **Delayed prescribing:** Your child's doctor may give an antibiotic prescription but will suggest that you wait 2–3 days to see if your child is still sick before filling it.

How to Feel Better

Some ways to feel better—whether or not antibiotics are needed for an ear infection:

- Rest.
- Drink extra water or other fluids.
- Take acetaminophen or ibuprofen to relieve pain or fever. Ask your doctor or pharmacist what medications are safe for your child to take and what dose to give your child.

Over-the-Counter Medicine and Children

Be careful about giving over-the-counter medicines to children. **Not all over-the-counter medicines are recommended for children of certain ages.**

- Pain relievers:
  - Babies younger than 6 months: only give acetaminophen.
  - Children 6 months or older: acetaminophen or ibuprofen can be given.
  - Never give aspirin to children because it can cause Reye's syndrome, a rare but very serious illness that harms the liver and brain.

Be sure to ask your doctor or pharmacist about the right dosage of over-the-counter medicines for your child's age and size. Also, tell your child's doctor and pharmacist about all the prescription and over-the-counter medicines they are taking.

Prevention

You can help prevent ear infections by doing your best to stay healthy and keep others healthy.

- Make sure your child is up to date on vaccinations and gets a flu vaccine every year. The pneumococcal vaccine protects against *Streptococcus pneumoniae*, a common cause of middle ear infections.
- Clean your hands.
- Breastfeed exclusively until your baby is 6 months old and continue to breastfeed for at least 12 months.
- Don't smoke and avoid exposure to secondhand smoke.

Learn more about antibiotic prescribing and use at https://www.cdc.gov/antibiotic-use/

Figure I6. Prevention and treatment of ear infection, page 2 of 2. Developed by CDC, 2019, https://www.cdc.gov/antibiotic-use/community/downloads/preventing-and-treating-ear-infections-h.pdf

Appendix I

Targeted Education Resources for Patients

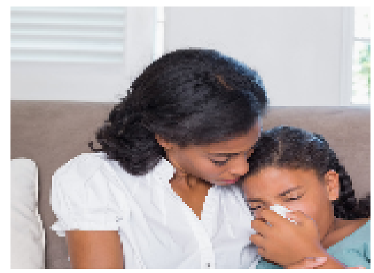
Runny Nose from a Cold & Antibiotics: Q & A Guide for Parents

Are antibiotics needed for a runny nose?

No. Antibiotics do not work on viruses that cause colds or runny noses, even if the mucus is thick, yellow, or green.

A runny nose is a normal part of a cold. Your child's doctor or nurse may prescribe other medicine or give you tips to help with symptoms like fever and cough.

What causes a runny nose during a cold?



When the viruses that cause colds first infect the nose and sinuses, the nose makes clear mucus. This helps wash the virus from the nose and sinuses. After two or three days, the body's immune system fights back, changing the mucus to a white or yellow color. When bacteria that normally live in the nose grow back during the recovery phase, they then change the mucus to a greenish color. This is all normal and does not mean your child needs antibiotics.

Why not just try antibiotics?

When antibiotics aren't needed, they won't help and could even cause harm. Taking antibiotics creates resistant bacteria. Antibiotic resistance occurs when bacteria develop the ability to defeat the drugs designed to kill them. Any time antibiotics are used, they can cause side effects and can lead to antibiotic resistance. Side effects of antibiotics can include rash, dizziness, stomach problems, and yeast infections.

How can I help my child feel better?

- Make sure they rest and drink plenty of fluids.
- Use a clean humidifier or cool mist vaporizer.
- Use saline nasal spray or drops.
- For young children, use a rubber suction bulb to clear mucus.
- Older children can breathe in steam from a bowl of hot water or shower.
- Use honey to relieve cough (if your child is at least 1 year old).

Improving the way we take antibiotics can help fight antibiotic resistance and ensure that lifesaving antibiotics will be available for future generations. To learn more about appropriate antibiotic prescribing and use, visit: **www.cdc.gov/antibiotic-use.**

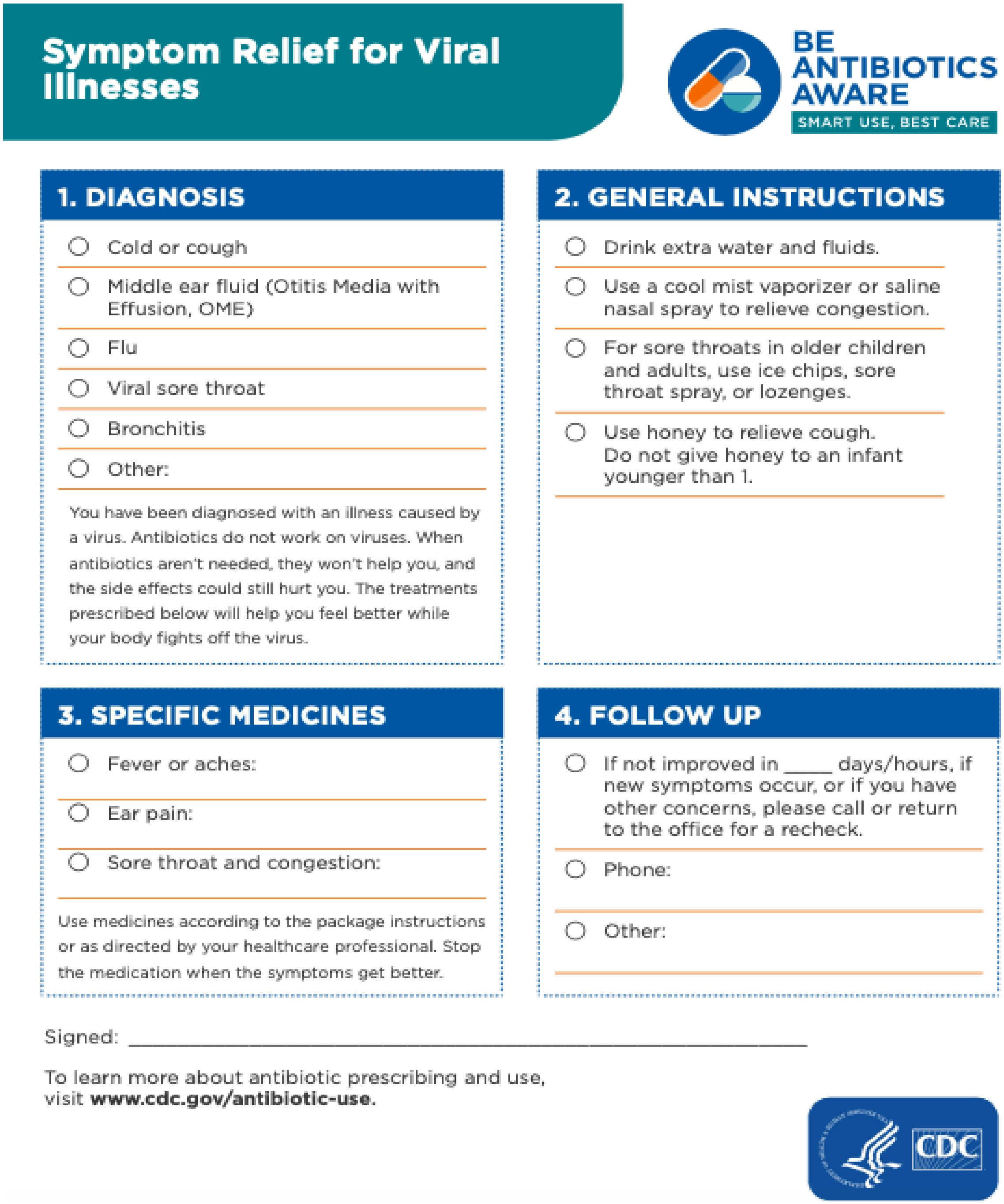
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

CS - 310899 Oct 09, 2019

Figure I7. Q & A for parents for child with runny nose and cold, page 1 of 1. Developed by CDC, 2019, https://www.cdc.gov/antibiotic-use/community/pdfs/runny-nose-bw-faqs.pdf

Appendix J

Targeted Education Resources for Providers



Symptom Relief for Viral Illnesses

BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

1. DIAGNOSIS

- ◯ Cold or cough
- ◯ Middle ear fluid (Otitis Media with Effusion, OME)
- ◯ Flu
- ◯ Viral sore throat
- ◯ Bronchitis
- ◯ Other:

You have been diagnosed with an illness caused by a virus. Antibiotics do not work on viruses. When antibiotics aren't needed, they won't help you, and the side effects could still hurt you. The treatments prescribed below will help you feel better while your body fights off the virus.

2. GENERAL INSTRUCTIONS

- ◯ Drink extra water and fluids.
- ◯ Use a cool mist vaporizer or saline nasal spray to relieve congestion.
- ◯ For sore throats in older children and adults, use ice chips, sore throat spray, or lozenges.
- ◯ Use honey to relieve cough. Do not give honey to an infant younger than 1.

3. SPECIFIC MEDICINES

- ◯ Fever or aches:
- ◯ Ear pain:
- ◯ Sore throat and congestion:

Use medicines according to the package instructions or as directed by your healthcare professional. Stop the medication when the symptoms get better.

4. FOLLOW UP

- ◯ If not improved in ____ days/hours, if new symptoms occur, or if you have other concerns, please call or return to the office for a recheck.
- ◯ Phone:
- ◯ Other:

Signed: ____

To learn more about antibiotic prescribing and use, visit **www.cdc.gov/antibiotic-use.**

CDC

Figure J1. Instructions for symptomatic relief of viral illness, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/pdfs/aaw/CDC-AU_RCx_Relief_for_Viral_Illness_sm_v8_508.pdf

Appendix J

Targeted Education Resources for Providers

What Is Watchful Waiting?

BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

WAIT. DO NOT FILL YOUR PRESCRIPTION JUST YET.

Your healthcare professional believes your illness may go away on its own.

You should watch and wait for _____ **days/hours** before deciding whether to take an antibiotic.

In the meantime, follow your healthcare professional's recommendations to help you feel better and continue to **monitor your own symptoms** over the next few days.

- ◯ Rest.
- ◯ Drink extra water and fluids.
- ◯ Use a cool mist vaporizer or saline nasal spray to relieve congestion.
- ◯ For sore throats in adults and older children, try ice chips, sore throat spray, or lozenges.
- ◯ Use honey to relieve cough. Do not give honey to an infant younger than 1.

If you **feel better, no further action is necessary. You don't need antibiotics.**

If you **do not** feel better, experience **new symptoms,** or have **other concerns**, call your healthcare professional ____________________. **Discuss whether you need a recheck or antibiotics.**

It may not be convenient to visit your healthcare professional multiple times, but it is critical to take antibiotics only when needed. When antibiotics aren't needed, they won't help you and the side effects could still hurt you. Common side effects of antibiotics can include rash, dizziness, nausea, diarrhea, and yeast infections.

Antibiotics save lives, and when a patient needs antibiotics, the benefits outweigh the risks of side effects. You can protect yourself and others by learning when antibiotics are and are not needed.

To learn more about antibiotic prescribing and use, visit **www.cdc.gov/antibiotic-use.**

CDC

Figure J2. Instructions for watchful waiting, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/pdfs/aaw/Watchful-Waiting-Prescription-Pads_small-P.pdf

Appendix J

Targeted Education Resources for Providers

What Is Delayed Prescribing?

BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

WAIT. DO NOT FILL YOUR PRESCRIPTION JUST YET.

Your healthcare professional believes your illness may resolve on its own.

First, follow your healthcare professional's recommendations to help you feel better without antibiotics. Continue to monitor your own symptoms over the next few days.

- ◯ Rest.
- ◯ Drink extra water and fluids.
- ◯ Use a cool mist vaporizer or saline nasal spray to relieve congestion.
- ◯ For sore throats in adults and older children, try ice chips, sore throat spray, or lozenges.
- ◯ Use honey to relieve cough. Do not give honey to an infant younger than 1.

If you **do not feel better in _____ days/hours or feel worse,** go ahead and fill your prescription.

If you **feel better, you do not need the antibiotic,** and do not have to risk the side effects.

Waiting to see if you really need an antibiotic can help you take antibiotics only when needed. When antibiotics aren't needed, they won't help you, and the side effects could still hurt you. Common side effects of antibiotics can include rash, dizziness, nausea, diarrhea, and yeast infections.

Antibiotics save lives, and when a patient needs antibiotics, the benefits outweigh the risks of side effects. You can protect yourself and others by learning when antibiotics are and are not needed.

To learn more about antibiotic prescribing and use, visit **www.cdc.gov/antibiotic-use.**

CDC

Figure J3. Instructions for delayed prescription, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/pdfs/aaw/CDC-AU_RCx_Delayed_Prescribing_sm_v9_508.pdf

Appendix J

Targeted Education Resources for Providers

Taking Your Antibiotics

BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

You have just filled a prescription for antibiotics.

READ THIS IMPORTANT INFORMATION.

- ○ Take it exactly as your healthcare professional tells you.
- ○ Do not skip doses.
- ○ Do not share it with others.
- ○ Do not save it for later. Talk to your pharmacist about safely discarding leftover medicines.

WHY IS THIS CHECKLIST SO IMPORTANT?

All medicines can have side effects. Antibiotics save lives, and when a patient needs antibiotics, the benefits outweigh the risks of side effects. You can protect yourself and others by learning when antibiotics are and are not needed.

If you have questions about your antibiotics, talk with your healthcare professional.

To learn more about antibiotic prescribing and use, visit **www.cdc.gov/antibiotic-use.**

CDC

Figure J4. Instruction for taking antibiotics, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/pdfs/aaw/CDC-AU_RCx_Taking_Your_Antibiotics_sm_v8_508.pdf

Appendix K

Antibiotic Use and Resistance Awareness Posters

Figure K1. Eight key ways to be antibiotics aware poster, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/materials-references/print-materials/index.html

Appendix K

Antibiotic Use and Resistance Awareness Posters

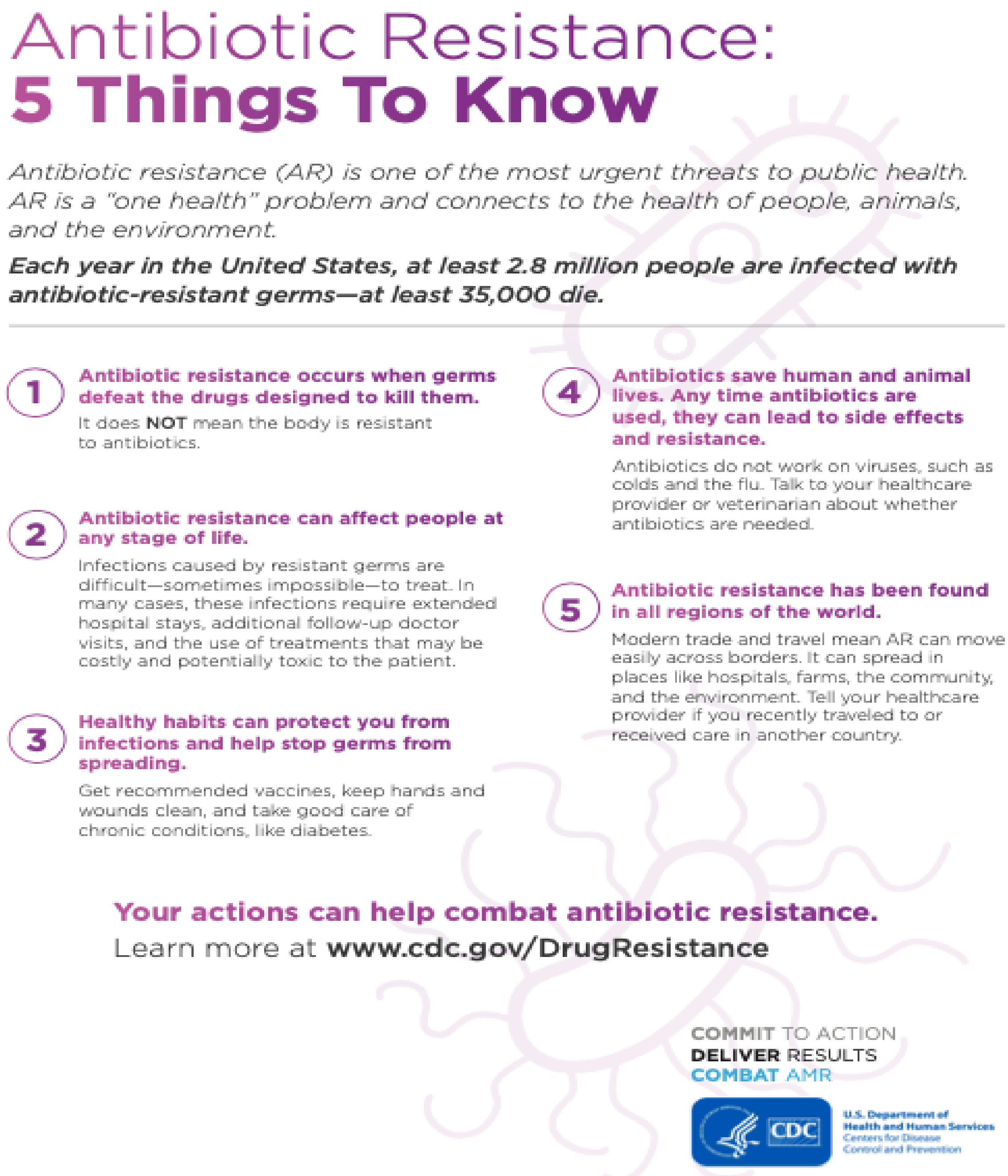


Figure K2. Five important facts about antibiotic resistance poster, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/drugresistance/resources/digital_materials.html

Appendix K

Antibiotic Use and Resistance Awareness Posters

Figure K3. Antibiotics are not indicated for the treatment of viral illness poster, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/community/materials-references/print-materials/index.html

Appendix K

Antibiotic Use and Resistance Awareness Posters

Figure K4. Antibiotic resistance global threat awareness poster, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/drugresistance/resources/digital_materials.html

Appendix K

Antibiotic Use and Resistance Awareness Posters

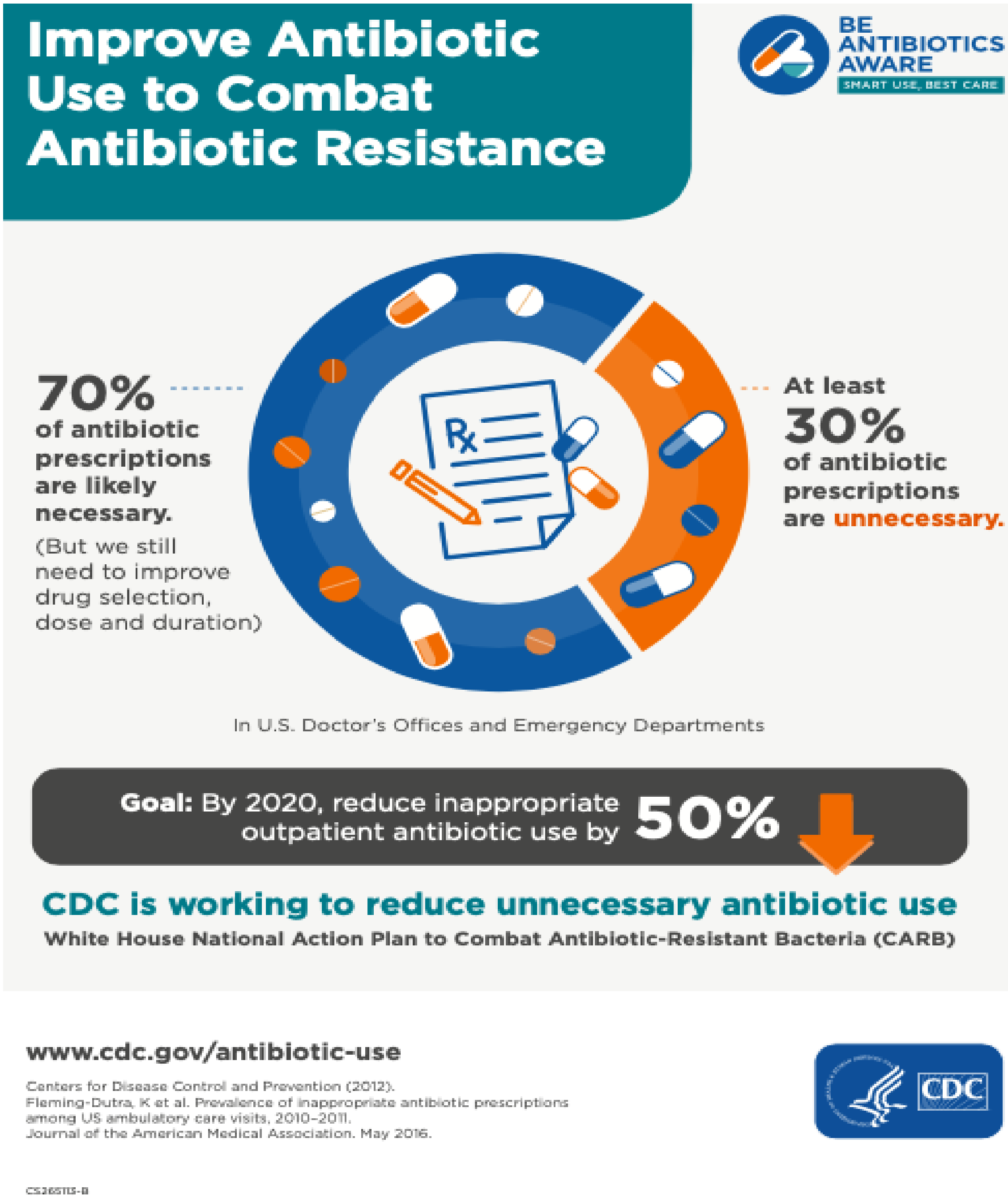


Figure K5. Improve antibiotic use awareness poster, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/antibiotic-use/week/toolkit.html#anchor_1538597291

Appendix L

Antibiotic Resistance (AR) Solutions Initiative

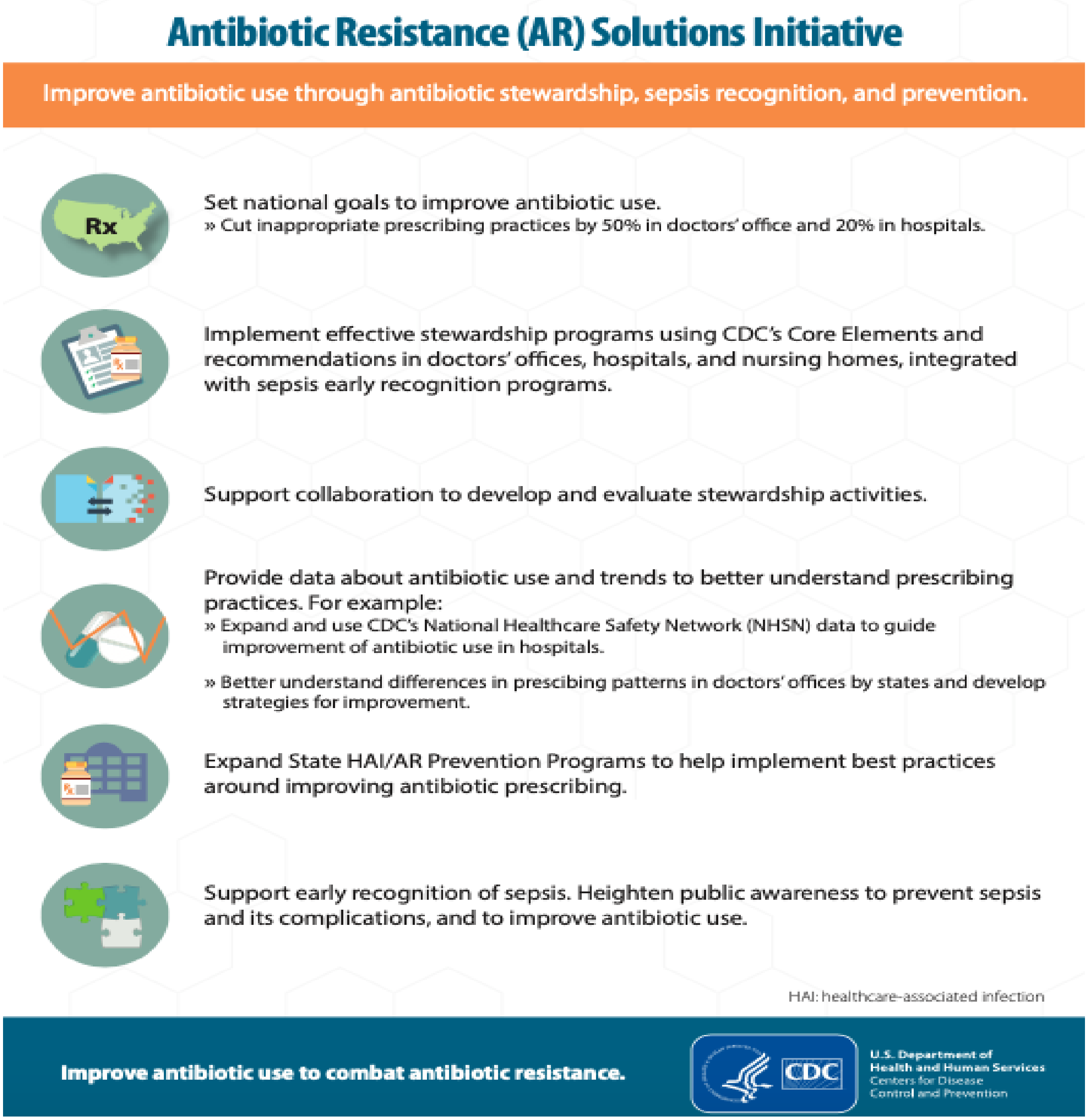


Figure L1. Overview of the CDCs antibiotic resistance (AR) solutions initiative in healthcare settings, page 1 of 1. Developed by CDC, 2020, https://www.cdc.gov/drugresistance/pdf/cdc-antibiotic-stewardship.pdf

Appendix L

Antibiotic Resistance (AR) Solutions Initiative

AR Solutions *In Action*

CDC's Investments to Combat Antibiotic Resistance Threats

FISCAL YEAR 2019

Investing to Protect the United States and World against Antibiotic Resistance

Antibiotic resistance (AR), when germs do not respond to the drugs designed to kill them, threatens to return us to the time when simple infections were often fatal. CDC is committed to protecting people and the future of the healthcare, veterinary, and agriculture industries from the threat of antibiotic resistance.

The AR Investment Map showcases CDC's critical investments in the United States and abroad to combat antibiotic resistance by increasing support for laboratory and epidemiological expertise and public health innovation.

CDC supports most of these activities through its AR Solutions Initiative, while also leveraging investments from successful programs across the agency for maximum efficiency.

DETECTION, RESPONSE & CONTAINMENT

- **Laboratory & Diagnostics:** Gold-standard lab capacity offered to all U.S. state and regional labs through CDC's AR Laboratory Network, and on-the-ground lab expertise and assistance in some countries abroad
- **Epidemiology Capacity for Response:** Increased capacity in state and local health departments and some countries for rapid detection and faster response to outbreaks and emerging resistance related to healthcare-associated infections, foodborne bacteria, and gonorrhea—to contain and control spread

PREVENTION

- **Surveillance & Science:** More effective tracking and prevention of healthcare-associated infections, foodborne illness, and gonorrhea
- **Improved Antibiotic Use:** Improving antibiotic use to ensure antibiotics are available and work to protect people from life-threatening infections or sepsis

HIGHLIGHTS

Since 2016, CDC's AR Solutions Initiative has supported comprehensive AR work in the U.S. and leveraged lessons learned for local solutions abroad.

- U.S. and 19+ countries abroad
- $300 million to 59 state and local health departments
- 500+ local AR experts
- AR Lab Network detects a resistant germ that requires investigation every 4 hours (as of 2018)
- Whole genome sequencing on 116,000+ germ samples

INNOVATION

- **Insights for Practice:** Innovations and collaborations with academic and healthcare partners to identify and implement new ways to prevent antibiotic-resistant infections and their spread in the United States and abroad
- **Research and Development:** Sharing isolates that inform development of new drugs and diagnostics, and making public CDC's sequencing data from AR pathogens to spur innovation in industry

These investments work toward meeting national goals to prevent drug-resistant infections as outlined in the *National Action Plan for Combating Antibiotic-Resistant Bacteria.*

See CDC's AR investments by state at www.cdc.gov/ARinvestments.

This map represents CDC's largest funding categories for antibiotic resistance.
It shows extramural funding that supports AR activities from multiple funding lines.

CDC provides critical support in the U.S. and abroad to protect people from antibiotic resistance.

www.cdc.gov/ARinvestments

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Figure L2. Overview of the CDC's antibiotic resistance (AR) initiative national investment factsheet, page 1 of 1. Developed by CDC, 2019, https://wwwn.cdc.gov/ARInvestments/PDFDocs/Strategy.pdf

Appendix L

Antibiotic Resistance (AR) Solutions Initiative

AR Solutions In Action

CDC's Investments to Combat Antibiotic Resistance Threats

FISCAL YEAR 2019

MISSOURI

$2,606,033

Funding for AR Activities Fiscal Year 2019

FUNDING TO STATE HEALTH DEPARTMENTS

$270,664

RAPID DETECTION & RESPONSE: State, territory, and local public health partners fight antibiotic resistance in healthcare, the community, and food. Programs use the AR Lab Network to rapidly detect threats and implement prevention, response, and antibiotic stewardship to stop the spread of resistant germs.

With 2018 funding, Missouri established the Missouri antibiotic Stewardship Educational Collaborative (MASEC), which provided 11 educational webinars and interactive case studies, reference materials, and an email hotline to 80 pharmacists and stewardship practitioners. MASEC surveyed 51 hospitals' stewardship programs, consulted on appropriate clinical treatments, and provided guidance on effective communication strategies with primary providers.

$151,056

FOOD SAFETY projects protect communities by rapidly identifying drug-resistant foodborne bacteria to stop and solve outbreaks and improve prevention.

Missouri uses whole genome sequencing to track and monitor local outbreaks of *Listeria*, *Salmonella*, *Campylobacter*, and *E. coli* and uploads sequence data into PulseNet for nationwide monitoring of outbreaks and trends. In Fiscal Year 2020, Missouri will continue monitoring these isolates for resistance genes. When outbreaks are detected, local CDC-supported epidemiologists investigate the cases to stop spread.

$14,932

GONORRHEA RAPID DETECTION & RESPONSE works with state and local epidemiology and laboratory partners to test for and quickly respond to resistant gonorrhea to stop its spread in high-risk communities. Only one treatment option remains for gonorrhea and resistance continues to grow.

To help inform national treatment guidelines for gonorrhea, Missouri participates in the Gonococcal Isolate Surveillance Project (GISP), testing how well antibiotics work on laboratory samples from sentinel STD clinics, which are often the first to detect the threat.

FUNDING TO UNIVERSITIES & HEALTHCARE PARTNERS

$500,000

WASHINGTON UNIVERSITY: CDC Prevention Epicenter

CDC collaborates with medical academic investigators to conduct innovative infection control and prevention research in healthcare settings. One of the projects in Missouri will determine whether intervention on the microbiome (germs in and on our bodies) can reduce drug-resistant urinary-tract infections. Another study is examining opportunities to improve antibiotic use in surgical patients to improve patient outcomes. Learn more: www.cdc.gov/hai/epicenters

Page 1 of 2 This data represents CDC's largest funding categories for AR. It shows extramural funding that supports AR activities from multiple funding lines. AR: antibiotic resistance HAI: healthcare-associated infection

CDC provides critical support in the U.S. and abroad to protect people from antibiotic resistance.

www.cdc.gov/ARinvestments

U.S. Department of Health and Human Services Centers for Disease Control and Prevention

Figure L3. Antibiotic resistance (AR) solutions initiative investments state of Missouri factsheet, page 1 of 2. Developed by CDC, 2019, https://wwwn.cdc.gov/ARInvestments/PDFDocs/Missouri-CDC-AR-Investments.pdf

Appendix L

Antibiotic Resistance (AR) Solutions Initiative


AR Solutions In Action

CDC's Investments to Combat Antibiotic Resistance Threats

FISCAL YEAR 2019

MISSOURI AR Investments (cont.)

$500,668 — **WASHINGTON UNIVERSITY, ST. LOUIS: Discovering & Implementing What Works**
Investigators will evaluate hospital-onset bacteremia in healthcare facilities in India as a feasible, useful, and acceptable metric for HAI surveillance in low- and middle-income countries.

$536,153 — **WASHINGTON UNIVERSITY, ST. LOUIS: Microbiome Assessment & Intervention**
Researchers at Washington University in St. Louis will be using a small laboratory system that resembles the human gut microbiome to look for markers of microbiome disruption from antibiotics. Using this information, they will develop and test a panel of markers that may be able to help clinicians understand their patients' risk for infection, and may support development of new therapies and microbiome disruption diagnostics.

$632,560 — **WASHINGTON UNIVERSITY, ST. LOUIS: Discovering & Implementing What Works**
The Leadership in Epidemiology, Antibiotic Stewardship, and Public Health (LEAP) Fellowship is a joint program of the Infectious Diseases Society of America (IDSA), Society for Healthcare Epidemiology of America (SHEA) and Pediatric Infectious Diseases Society (PIDS). It is designed to provide select Fellows at ID training programs across the nation an opportunity for immersive experiences in healthcare leadership, antibiotic stewardship and infection prevention, and the inner workings of public health departments.

Page 2 of 2 This data represents CDC's largest funding categories for AR. It shows extramural funding that supports AR activities from multiple funding lines. AR: antibiotic resistance HAI: healthcare-associated infection

CDC provides critical support in the U.S. and abroad to protect people from antibiotic resistance.

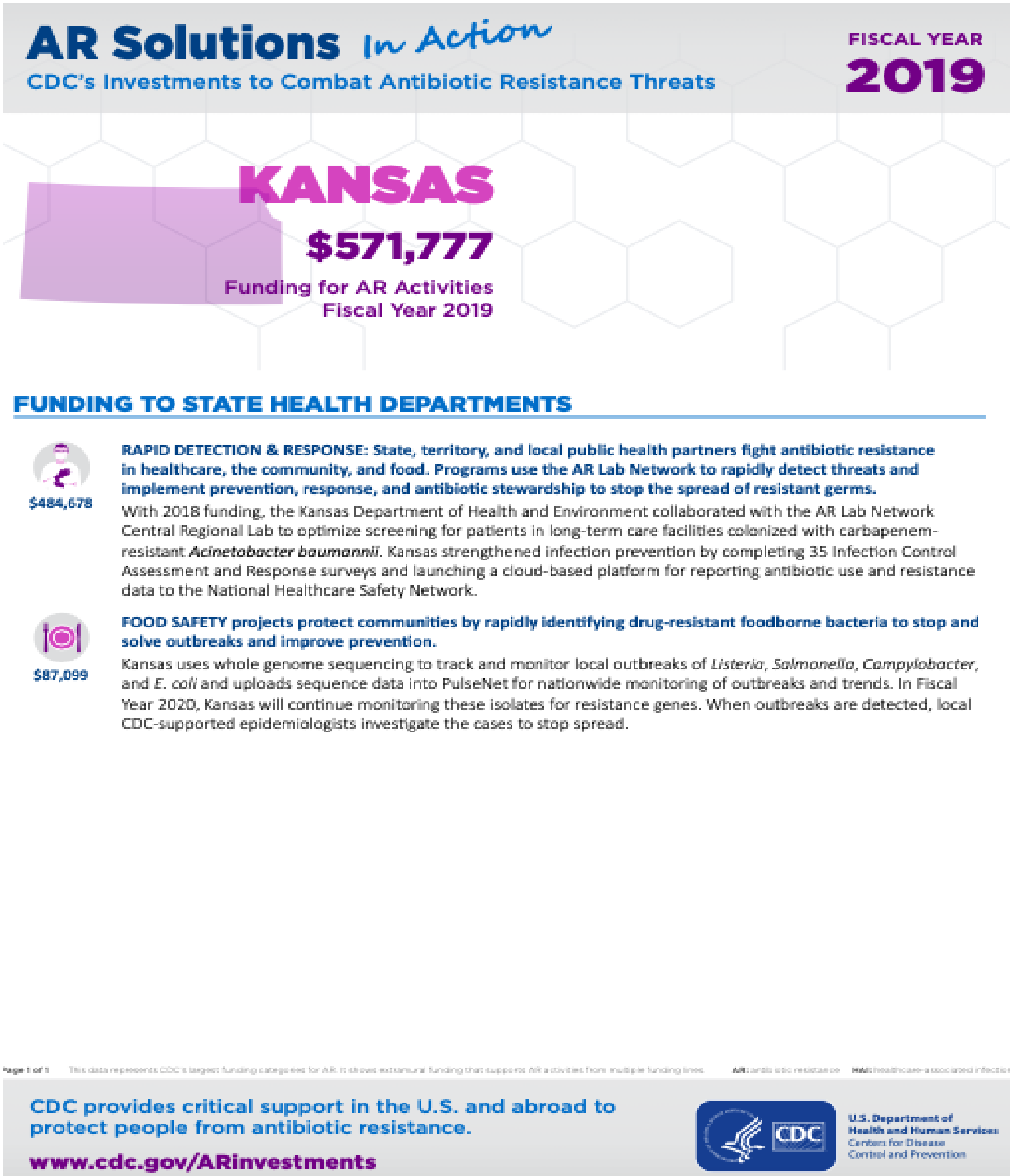
www.cdc.gov/ARinvestments

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Figure L3. Antibiotic resistance (AR) solutions initiative investments state of Missouri factsheet, page 2 of 2. Developed by CDC, 2019, https://wwwn.cdc.gov/ARInvestments/PDFDocs/Missouri-CDC-AR-Investments.pdf

Appendix L

Antibiotic Resistance (AR) Solutions Initiative



AR Solutions *In Action*

CDC's Investments to Combat Antibiotic Resistance Threats

FISCAL YEAR **2019**

KANSAS

$571,777

Funding for AR Activities
Fiscal Year 2019

FUNDING TO STATE HEALTH DEPARTMENTS

$484,678

RAPID DETECTION & RESPONSE: State, territory, and local public health partners fight antibiotic resistance in healthcare, the community, and food. Programs use the AR Lab Network to rapidly detect threats and implement prevention, response, and antibiotic stewardship to stop the spread of resistant germs.

With 2018 funding, the Kansas Department of Health and Environment collaborated with the AR Lab Network Central Regional Lab to optimize screening for patients in long-term care facilities colonized with carbapenem-resistant *Acinetobacter baumannii*. Kansas strengthened infection prevention by completing 35 Infection Control Assessment and Response surveys and launching a cloud-based platform for reporting antibiotic use and resistance data to the National Healthcare Safety Network.

$87,099

FOOD SAFETY projects protect communities by rapidly identifying drug-resistant foodborne bacteria to stop and solve outbreaks and improve prevention.

Kansas uses whole genome sequencing to track and monitor local outbreaks of *Listeria*, *Salmonella*, *Campylobacter*, and *E. coli* and uploads sequence data into PulseNet for nationwide monitoring of outbreaks and trends. In Fiscal Year 2020, Kansas will continue monitoring these isolates for resistance genes. When outbreaks are detected, local CDC-supported epidemiologists investigate the cases to stop spread.

Page 1 of 1 This data represents CDC's largest funding categories for AR. It shows extramural funding that supports AR activities from multiple funding lines. **AR:** antibiotic resistance **HAI:** healthcare-associated infection

CDC provides critical support in the U.S. and abroad to protect people from antibiotic resistance.

www.cdc.gov/ARinvestments

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Figure L4. Antibiotic resistance (AR) solutions initiative investments state of Kansas factsheet, page 1 of 1. Developed by CDC, 2019, https://wwwn.cdc.gov/ARInvestments/PDFDocs/Kansas-CDC-AR-Investments.pdf