Quality Improvement of Antibiotic Stewardship in the Treatment of Respiratory Infections

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Abstract

Antibiotic resistance rates continue to rise, in part due to the inappropriate prescription of antibiotics for the treatment of acute upper respiratory infections. This quality improvement project focused on increasing antibiotic stewardship in the treatment of acute respiratory tract infections in an urgent care clinic in eastern North Carolina through implementation of a provider behavioral change strategy. The behavioral change strategy, which was implemented over a twelve-week period and consisted of a provider educational session and public commitment, produced a clinically significant decrease in inappropriate antibiotic prescriptions for acute respiratory tract infections. Improved antibiotic stewardship has the potential to avert adverse effects related to unnecessary antibiotic use and prevent multi-drug resistant infection-related illness and death, leading to enhanced patient outcomes and lower healthcare costs.

Key words: antibiotic resistance, antibiotic stewardship, acute respiratory tract infections, behavioral change strategy

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Introduction

Background

Antibiotic resistance is a significant issue facing health care providers around the globe that has the potential to wreak havoc on the state of health care. Despite widespread knowledge that inappropriate antibiotic prescribing methods contribute to antibiotic resistance, an astounding number of inappropriate antibiotic prescriptions are still written each year. Approximately 30% of antibiotics prescribed in outpatient settings in the United States are entirely unnecessary (Centers for Disease Control and Prevention [CDC], 2019a). Furthermore, up to 50% of all antibiotic prescriptions in outpatient settings in the United States are either unnecessary or inappropriate in medication selection, dosage, or duration of therapy. Since antibiotic resistance increases at a faster rate with improper prescribing practices, health care providers must practice antibiotic stewardship and work to reduce the number of inappropriate antibiotic prescriptions. This quality improvement project explores one urgent care clinic's efforts to increase antibiotic stewardship in the treatment of acute respiratory tract infections (ARTIs).

Organizational Needs Statement

An urgent care clinic in eastern North Carolina identified a need for quality improvement of antibiotic stewardship. Many urgent care patients present with infectious disease-related illnesses, which can raise issues regarding antibiotic stewardship and resistance. The organizational partners of the urgent care clinic have acknowledged that inappropriate antibiotic prescribing practices exist in the urgent care setting ([redacted], personal communication, July 1, 2020). Furthermore, as a member of an accountable care organization, specific benchmarks affect shared savings for the organization. One benchmark addresses the impropriety of antibiotic use in the treatment of acute bronchitis ([redacted], personal communication, June 24,

2020). Inappropriate prescribing practices for the treatment of acute bronchitis have prompted the organization to discourage urgent care providers from writing antibiotic prescriptions for this diagnosis ([redacted], personal communication, June 24, 2020). In addition to concerns regarding shared savings, the organization is dedicated to providing quality, evidence-based medicine. Therefore, this urgent care clinic expressed an interest in the quality improvement of antibiotic stewardship to reduce inappropriate antibiotic prescriptions in the treatment of ARTIs such as acute bronchitis, rhinosinusitis, and nonspecific upper respiratory infections.

This antibiotic stewardship project aligns with the Triple Aim for health care. The Triple Aim's first arm is to improve the health of the population (Institute for Healthcare Improvement (IHI), 2020). The goal of this project was to increase antibiotic stewardship in the treatment of respiratory infections. Antibiotic stewardship helps slow the development of antibiotic resistance, granting scientists and researchers time to develop new antibiotics to combat antibiotic-resistant infections that may arise (CDC, 2019b). The ultimate goal of antibiotic stewardship is to slow antibiotic resistance and limit the number of deaths related to antibiotic-resistant infections. If antibiotic stewardship is practiced on a broad scale, the burden of antibiotic resistance can be reduced.

The second arm of the Triple Aim is to enhance patient experiences and outcomes (IHI, 2020). While valuable in the treatment of certain infections, antibiotics have the potential to cause numerous adverse effects. Common side effects include nausea, vomiting, and diarrhea. Furthermore, antibiotics can eradicate some of the body's normal flora, leading to the development of antibiotic-associated infections such as *Clostridium difficile* and candidiasis (CDC, 2019b). Antibiotic stewardship reduces inappropriate antibiotic prescriptions and can enhance patient outcomes by sparing unnecessary discomfort related to antibiotic use.

The third arm of the Triple Aim is to reduce the per-capita cost of healthcare (IHI, 2020). Antibiotic-resistant infections are often severe and difficult to treat, sometimes requiring hospitalization and intravenous antibiotic therapy. Through decreasing antibiotic resistance, antibiotic stewardship can reduce healthcare costs (CDC, 2019b).

Problem Statement

Organizational partners of an urgent care clinic in eastern North Carolina acknowledged that inappropriate antibiotic prescribing practices exist in the treatment of ARTIs such as acute bronchitis, rhinosinusitis, and nonspecific upper respiratory infections. The inappropriate use of antibiotics is a major contributing factor to antibiotic resistance (U.S. Food and Drug Administration, 2019).

Purpose Statement

The purpose of this project was to improve antibiotic stewardship in an urgent care clinic to decrease inappropriate antibiotic prescriptions for ARTIs, including acute bronchitis, rhinosinusitis, and nonspecific upper respiratory infections. This project focused on optimizing the antibiotic prescribing behaviors of full- and part-time urgent care providers.

Evidence

Literature Review

A review of the literature was conducted using three databases: Cumulative Index to Nursing & Allied Health Literature (CINAHL), MEDLINE via PubMed, and American Academy of Family Physicians (AAFP). Database search terms were selected to retrieve relevant literature regarding antibiotic stewardship in the outpatient setting and the treatment of upper respiratory infections. These search terms included *primary health care, ambulatory care, outpatient care, antibiotic stewardship, respiratory tract infections*, *upper respiratory infection*, *microbial drug resistance, antimicrobial resistance, prescribing patterns, prescribing practices,* and *attitude of health personnel.* Search limits were applied, including publishing dates between 2015 and 2020, articles written in the English language, and articles for which the full text was available. See Appendix A for more specific search details.

In seven searches, 104 results were obtained. Inclusion and exclusion criteria were applied to the results. Articles were excluded if they focused on pediatric or older adult populations, specialty practices, inpatient settings, or bacterial infections. Articles were also excluded for redundancy and for being primarily narrative or opinion-based. Fifteen articles that were not excluded using the above criteria and were relevant to the quality improvement (QI) project were retained. Melnyk & Fineout-Overholt's Hierarchy of Evidence was employed to determine the level of evidence of each article (Fineout-Overholt et al., 2010). Articles of Evidence Levels I through VI were included to allow for the inclusion of quantitative and qualitative studies. Using the information gleaned from this literature review, the current state of knowledge regarding antibiotic resistance and optimal antibiotic prescribing, the current approaches to improving antibiotic stewardship, and evidence to support the chosen intervention were identified. See Appendix B for full literature matrix.

Current State of Knowledge

The most frequently presenting illnesses at outpatient health care facilities are acute respiratory tract infections (ARTIs), including acute bronchitis, acute rhinosinusitis, and nonspecific upper respiratory infections (Harris et al., 2016). ARTIs also account for 41% of antibiotic prescriptions written for adults at outpatient visits each year. Since ARTIs are some of the most common reasons for outpatient health care visits, health care providers in the urgent care setting should follow clinical guidelines regarding the appropriate use of antibiotics in the treatment of these conditions.

Acute bronchitis accounts for about 10% of outpatient visits in the United States each year (Harris et al., 2016). Nonbacterial pathogens cause over 90% of cases of acute bronchitis, and antibiotics are not routinely indicated in the treatment of this disorder. Infrequently, bacterial pathogens such as *Mycoplasma pneumoniae, Chlamydophila pneumoniae,* and *Bordatella pertussis* have been identified as causes of acute bronchitis. Despite the potential for bacterial origin, evidence suggests that there is no benefit of the use of antibiotics in the treatment of acute bronchitis. Therefore, the current recommendation is that providers refrain from prescribing antibiotics for acute bronchitis.

Rhinosinusitis is a common cause of ARTI, with more than 4.3 million adults diagnosed with this illness each year (Harris et al., 2016). Rhinosinusitis is typically caused by a viral, allergic, or irritant source, but has the potential to lead to secondary bacterial infection. Acute bacterial rhinosinusitis should be treated with an antibiotic; however, it should only be diagnosed if the patient has had symptoms for greater than ten days, severe symptoms (fever, purulent nasal discharge, or facial pain), or worsening of illness after initial improvement. In cases that do not meet the above criteria, antibiotics should not be prescribed.

Nonspecific upper respiratory infections cause a set of symptoms that are often referred to as the common cold (Harris et al., 2016). The common cold accounts for 37 million outpatient visits each year. Multiple viruses can cause these symptoms, and antibiotics are not indicated in the treatment of these nonspecific upper respiratory infections.

Despite evidence-based guidelines that urge providers to refrain from writing antibiotic prescriptions for acute bronchitis, acute uncomplicated rhinosinusitis, and nonspecific upper respiratory infections, millions of antibiotic prescriptions are still written for these conditions each year. Approximately 70% of visits for acute bronchitis, 80% of visits for rhinosinusitis, and 30% of visits for nonspecific upper respiratory infections result in antibiotic prescriptions (Harris et al., 2016). Furthermore, broad-spectrum antibiotics are prescribed at approximately 61% of visits that result in antibiotic prescriptions, although narrow-spectrum agents are typically recommended. Recent studies in Sri Lanka, Ecuador, and Qatar have also revealed inappropriate antibiotic prescribing practices in the treatment of ARTIs, demonstrating the global nature of this issue (Butt et al., 2017; Sanchez Choez et al., 2018; Tillekeratne et al., 2017).

The inappropriate prescription of antibiotics contributes to antibiotic resistance. Antibiotic-resistant bacteria cause approximately 2 million infections and 23,000 deaths in the United States annually (Harris et al., 2016). In order to slow bacterial resistance, clinicians around the globe must practice antibiotic stewardship and work to eliminate inappropriate antibiotic prescribing practices.

Current Approaches to Improving Antibiotic Stewardship

There are several approaches that have been utilized to attempt to increase antibiotic stewardship in the treatment of ARTIs. One approach includes the utilization of procalcitonin (PCT), a blood marker for bacterial infections (Schuetz et al., 2017). The use of PCT levels to

guide initiation of antibiotic therapy in ARTIs led to lower mortality rates, lower antibiotic consumption, and a lower risk for antibiotic-related adverse reactions (Schuetz et al., 2017; Tonkin-Crine et al., 2017). Another laboratory test, C-reactive protein (CRP), has been used at point-of-care and likely reduces the number of antibiotics prescribed for ARTIs in general practice (Tonkin-Crine et al., 2017).

Another approach to increasing antibiotic stewardship is the use of shared decision making. According to Schuetz et al. (2017), shared decision making, or the collaboration of the clinician and the patient to make decisions, has the potential to reduce the number of antibiotics prescribed for the treatment of ARTIs. Patient education using pamphlets or handouts has also been used to help reduce inappropriate antibiotic prescriptions, although there is not a strong level of evidence to support the efficacy of this intervention (Schuetz et al., 2017). Computerized decision support systems (CDSS), which provide prompts and guidance to clinicians in the electronic health record (EHR), can have a moderate effect on the reduction of inappropriate antibiotic prescriptions (Nageeti et al., 2019). However, the override rate on CDSS is high, with clinicians choosing to disregard computerized prompts up to 50% of the time.

The approach used in this QI project was a multifaceted provider behavioral change strategy. This type of approach has been conducted using various combinations of interventions, including provider education and training, public commitment, peer comparison, and viral prescription pads (Kandeel et al., 2019; Lee et al., 2020; Yadav et al., 2019). The approach for this QI project specifically included provider education and training and public commitment.

Evidence to Support a Behavioral Change Strategy

The literature supports a multifaceted behavioral change strategy to increase antibiotic stewardship. Provider education-focused interventions, implemented in two separate studies,

successfully reduced the number of inappropriate antibiotics prescribed for ARTIs (Kandeel et al., 2019; Yadav et al., 2019). Additionally, Kandeel et al. (2019) found through analysis of provider survey responses that provider attitudes regarding antibiotic stewardship improved after the educational intervention. Yadav et al. (2019) also utilized public commitment as part of the implementation strategy. Providers were asked to sign a commitment letter obtained from the CDC, and this letter was placed in a public space where both providers and patients would see the letter.

The provider behavioral change strategy to help increase antibiotic stewardship among clinicians at the urgent care clinic was chosen in collaboration with organizational partners at the clinic and took into consideration feasibility, cost, and available evidence. Provider education and public commitment were the focus of this behavioral change strategy. The literature supports that this approach has the potential to reduce the number of inappropriate antibiotic prescriptions written in the urgent care clinic.

Evidence-Based Practice Framework

Theoretical Framework

Icek Ajzen's Theory of Planned Behavior served as the theoretical framework for this QI project. The Theory of Planned Behavior suggests that intention, attitudes regarding the behavior, subjective norms concerning the behavior, and perceived control over the behavior can influence behavior (Ajzen, 1991). Attitudes, subjective norms, and perceived control all relate to beliefs about the behavior.

The Theory of Planned Behavior was relevant to this QI project as the goal of this project was to change the behavior of the urgent care clinicians and influence them to practice antibiotic stewardship. Therefore, the interventions of this project, which included educational intervention

and public commitment, were tailored to alter providers' intentions, attitudes, and perceived control over their behavior. Through focusing on antibiotic stewardship on an organizational level, antibiotic stewardship should become the subjective norm, making provider behavioral change more likely. Through the implementation of this behavioral change strategy, it was expected that provider intentions, attitudes, and perceived control over their antibiotic prescription practices would be transformed, leading to an alteration in behavior among providers and optimization of antibiotic stewardship in the urgent care setting.

Operational Framework

The operational framework for this project was the Plan-Do-Study-Act (PDSA) Model for Improvement. This model was developed by Associates in Process Improvement and includes four steps. The first step in the process is to plan, and this step is accomplished by considering the objective; preparing for the intervention, including selecting the site and the participants; and planning the data collection process (Associates in Process Improvement, 2020). The second step is to do, and this step encompasses the implementation of the intervention. The third step is to study, which includes analysis of data and summarization of findings. The fourth step is to act, and this step allows for the identification of necessary changes to be implemented in the next PDSA cycle. The PDSA Model for Improvement is meant to improve processes through multiple cycles that identify and seek to address weaknesses or barriers to process improvement. Through conducting multiple PDSA cycles, the goal was to increase antibiotic stewardship in the urgent care setting.

Ethical Consideration & Protection of Human Subjects

In preparation to address ethical considerations in the implementation of this project, social and behavioral research investigators and key personnel training modules, available

through the Collaborative Institutional Training Initiative (CITI), were reviewed. The CITI modules first introduced the *Belmont Report*, in which the three basic ethical principles, respect for persons, beneficence, and justice, were discussed. This project maintained respect for persons since participation by providers was voluntary, and providers retained autonomy and the ability to prescribe antibiotics as they deemed necessary throughout the entirety of the project. Beneficence was maintained as the interventions of this project did not pose any threat of harm to participating providers, but merely sought to increase clinician knowledge of and dedication to antibiotic stewardship. Justice was sustained in this project by providing all of the participating urgent care clinicians with the same training and resources, ensuring equality and equity.

The CITI modules also presented the definitions of research and human subjects. As this project was designed to accomplish quality improvement, it does not meet the definition of research. Urgent care providers served as the participants in this project, and therefore this study involves human subjects. The CITI modules discussed the importance of minimizing risk to participants and identifies employees as a vulnerable population. While the participants in this project were providers, and they were employees of the organization, the data collected did not focus on provider attributes or performance, but on the number of antibiotic prescriptions written and the circumstances under which they were written. To minimize the risk to participating providers, participation in the project was on a voluntary basis. Furthermore, provider privacy was maintained as the data collected did not identify the prescribing providers, but instead reflected overall antibiotic prescribing practices.

Institutional Review Board Approval

In order to necessitate institutional review board (IRB) approval, a project needs to meet the definition of research and involve human subjects. A letter of organizational support for the

project was obtained from the project site. Furthermore, institutional approval for this project was obtained from the project lead's university. This was accomplished through the submission of a detailed statement of the project purpose, goals, setting, intervention, and data collection methods to the university. Additionally, a self-certification tool was submitted for review. This tool allowed the university to determine that this project was deemed as quality improvement and required no further IRB approval review.

Patient Considerations

While the participants in this project were providers, ethical consideration was given to the patients these providers encountered during the implementation of the project. Providers retained the ability to use their discretion and clinical knowledge in the treatment of patients. Therefore, the risk of harm that patients faced by seeking medical treatment for their illnesses was not altered through the implementation of this quality improvement project. Patient confidentiality was preserved through the process of depersonalization, which excluded any patient identifying information being collected. Patient privacy was also maintained as all patient health information was stored on a secure electronic health record that could only be accessed by authorized personnel with the appropriate passwords. To further decrease the risk to patients, no data from vulnerable populations, including children, pregnant women, and prisoners, was included in this project. The project was equal and equitable to patients as all patients retained the right to seek care or refrain from seeking care for their illnesses, and no patient was mandated to seek care at this practice. Through these measures, the risks to patients were minimized.

Project Design

Project Site and Population

This quality improvement project was conducted in an urgent care clinic located in eastern North Carolina. The population consisted of ten full- and part-time health care providers that work at the clinic. This clinic primarily serves patients local to eastern North Carolina. Patients who are uninsured and those with private insurance, Medicare, Medicaid, and Tricare are treated at this clinic.

Description of the Setting

The urgent care clinic that served as the setting for this quality improvement project is privately funded, large in scale, and is equipped with various resources that allow providers to obtain many same-day laboratory tests and imaging studies. This ability to obtain laboratory and point of care tests is a facilitator with the potential to aid providers in avoiding prescribing antibiotics inappropriately. The clinic is staffed with four providers each day. On a typical day, this clinic serves between 80 and 110 patients. The majority of patients evaluated in the urgent care clinic present with acute health complaints, many of which involve respiratory symptoms.

Description of the Population

The providers that staffed the urgent care clinic consisted of three physicians, one physician assistant, and six nurse practitioners. Five of the providers worked full-time and five worked part-time in the urgent care clinic. The average number of years of experience was approximately ten years. The provider with the least experience had been practicing for less than one year, and the provider with the most experience had been practicing for 31 years. Three of the providers were males and seven were females.

Project Team

The project team consisted of a Doctor of Nursing Practice (DNP) student, a site

champion, and a faculty mentor. The role of the DNP student was to serve as the project lead in the planning, implementation, and evaluation processes of this project. The site champion is a Master's prepared family nurse practitioner who works in the urgent care clinic. The role of the site champion was to serve as a liaison between the project lead and organization and to help ensure that the project aligns with organizational goals. The site champion also assisted the project lead in planning and implementing the project. The faculty mentor is a doctoral prepared nurse and certified nurse executive. The role of the faculty mentor was to guide the project lead through the processes of planning, implementing, and evaluating a quality improvement project.

Project Goals and Outcome Measures

The goal of this project was to increase antibiotic stewardship in the treatment of acute respiratory tract infections (ARTIs), as evidenced by a decrease in the number of antibiotics prescribed inappropriately for these disorders. Measurable outcomes included the rate of appropriate diagnosis of ARTIs, the percentage of ARTIs for which antibiotics were prescribed, and the rate of inappropriate antibiotic prescription for ARTIs. These measurable outcomes were obtained through biweekly chart reviews.

Description of the Methods and Measurement

The rate of appropriate diagnosis of ARTIs served as the process measure in this quality improvement project, as appropriate diagnosis is essential for antibiotic stewardship. For the purpose of this project, ARTIs included visits with the following ICD 10 codes: J06.9 (acute upper respiratory infection), J20.9 (acute bronchitis), and J32.9 (sinusitis). The rate of appropriate diagnosis was measured by reviewing history and physical exam findings for each visit and evaluating whether the findings supported the final diagnosis. The number of visits for

which the diagnosis was supported by history and physical exam findings was divided by the total number of visits and multiplied by 100 to obtain this measure.

The outcomes measures for this project included the percentage of ARTIs for which antibiotics were prescribed and the rate of inappropriate antibiotic prescriptions. Inappropriate antibiotic prescriptions consisted of those that were unnecessary and those that were inappropriate in medication selection, dosage, or duration. The propriety of antibiotic prescriptions for ARTIs was determined by examining subjective and objective findings, patient allergies, the diagnosis, and the antibiotic prescription written by the provider. The percentage of ARTIs for which antibiotics were prescribed was obtained by dividing the number of visits resulting in an antibiotic prescription by the total number of visits for ARTIs, then multiplying the result by 100. The rate of inappropriate antibiotic prescriptions was determined by dividing the number of visits for which antibiotic prescriptions were inappropriate by the number of visits for ARTIs that resulted in antibiotic prescriptions, then multiplying the result by 100.

Discussion of the Data Collection Process

Data were collected through chart reviews and informal provider interviews. Chart reviews began at the start of implementation and were conducted on a biweekly basis. Chart reviews included patients seen in the two weeks prior to implementation and in all weeks during implementation. A list of medical record numbers of patients seen in urgent care and diagnosed with one of the qualifying ICD 10 codes was compiled by the informational technology department and provided to the project lead on a biweekly basis. The provider's chart note from each of these visits was reviewed for history and physical exam findings, diagnosis, and antibiotic prescriptions. The data collected during chart reviews did not include any patient identifying information.

Informal provider interviews were conducted periodically throughout implementation as determined necessary by the project lead and the site champion. These interviews allowed the project lead to identify factors influencing antibiotic prescribing practices. A list of model questions can be found in Appendix C. The data retrieved from the chart reviews and the informal provider interviews were recorded in two separate Excel spreadsheets (See Appendices D and E) and stored on the project lead's password protected personal computer to which only the project lead had access.

Implementation Plan

The implementation of this project began with the electronic delivery of a PowerPoint presentation to each urgent care provider. This PowerPoint was delivered via email and detailed the importance of antibiotic stewardship and current antibiotic prescribing guidelines. Antibiotic recommendation tables (See Appendix F) detailing the current antibiotic prescribing guidelines for ARTIs were distributed to the providers. After delivery of the PowerPoint presentation and distribution of the antibiotic recommendation tables, urgent care providers were asked to sign both a checklist verifying that they reviewed the presentation and an antibiotic stewardship pledge (See Appendix G).

During implementation, the urgent care providers continued to provide care for patients in the urgent care clinic. On a biweekly basis following the initial educational session, chart reviews for patients diagnosed with ARTIs were performed. Data were collected regarding subjective and objective findings, diagnoses, and antibiotic prescriptions. Subjective and objective findings, in combination with the antibiotic recommendation table, were utilized to determine the propriety of each diagnosis. The data retrieved from chart reviews were recorded in an Excel spreadsheet for data analysis. As noted above, informal interviews with providers

were conducted periodically. These interviews included questions regarding whether providers noticed any factors that influenced, positively or negatively, their antibiotic prescribing habits. The data gleaned from these interviews were recorded on a separate Excel spreadsheet for analysis.

Based on a review of the data from the biweekly chart reviews and informal provider interviews, barriers to antibiotic stewardship were identified and addressed in new PDSA cycles. A total of five PDSA cycles were conducted. After concluding the final PDSA cycle, data from all five PDSA cycles were compiled in an Excel spreadsheet for analysis. Data were presented using tables and a trend line.

Timeline

This project was implemented over three months. Implementation began on January 23, 2021, and included an educational training session, distribution of resource materials, and signing of the antibiotic stewardship pledge. A chart review was conducted for the two weeks prior to implementation to obtain baseline data, and was followed by biweekly chart reviews during implementation. Each subsequent chart review marked the start of a new PDSA cycle. A final chart review was conducted on April 19, 2021. Final data analysis was completed in May of 2021, with dissemination of findings at the project site and the university occurring in late July of 2021. See Appendix H for a visual depiction of the implementation timeline.

Results and Findings

This project aimed to improve antibiotic stewardship in an urgent care clinic to decrease inappropriate antibiotic prescriptions for acute respiratory tract infections (ARTIs). After an intervention consisting of a provider educational session and signage of an antibiotic stewardship pledge by all participating providers, data were collected over a 12-week period regarding visits in which patients were diagnosed with the ICD-10 codes J06.9 (acute upper respiratory infection), J20.9 (acute bronchitis), and J32.9 (sinusitis). The results of the data analysis are presented below.

Results

The process measure for this project was the rate of appropriate diagnosis of ARTIs. Of the 161 patients treated in the urgent care clinic during implementation and diagnosed with qualifying ICD-10 codes, 158 were diagnosed with ICD-10 codes that were fully supported by history and physical exam findings. Therefore, approximately 98.1% of patients seen throughout the project were diagnosed appropriately.

The outcomes measures for this project included the percentage of ARTIs for which antibiotics were prescribed and the rate of inappropriate antibiotic prescription. During the two-week period prior to implementation, 59 patients were seen in the clinic and diagnosed with a qualifying ICD-10 code. Of these 59 patients, three patients (5.1%) were prescribed an antibiotic. Of the three antibiotics prescribed, 100% were potentially inappropriate, with two prescriptions (66.7%) classified as unnecessary and one prescription (33.3%) classified as inappropriate medication selection.

During the 12-week implementation period, 161 patients were evaluated in the urgent care clinic and diagnosed with one of the qualifying ICD-10 codes. Of these 161 patients, 26 patients (16.1%) were prescribed antibiotics. Of the 26 antibiotics prescribed for ARTIs, 12

prescriptions (46.2%) were potentially inappropriate. Eleven of the 12 prescriptions (91.7%) were classified as unnecessary, and one prescription (8.3%) was classified as inappropriate drug selection. Biweekly data collection throughout implementation revealed an antibiotic prescription rate that varied from 5.6% to 26.7%. Furthermore, the inappropriate antibiotic prescription rate varied from 0% to 75%. See Appendix I for biweekly data.

Informal provider interviews were conducted on three occasions as part of the PDSA review process. Providers consistently identified patient expectations as a barrier to antibiotic stewardship. Facilitators of antibiotic stewardship identified by providers included use of a viral prescription pad, which is available to all providers within the organization. Furthermore, some providers identified being cognizant of the importance of antibiotic stewardship as a facilitator. Interestingly, many providers cited the COVID-19 pandemic as a facilitator of antibiotic stewardship.

As implementation progressed, it was noted that the number of antibiotics being prescribed was lower than anticipated. As mentioned from provider interviews, one factor identified that could have influenced the number of antibiotic prescriptions for ARTIs was the COVD-19 pandemic. Therefore, a decision was made to compare data for one day prior to the onset of the COVID-19 pandemic in the United States with data for one day during implementation (See Appendix J). Data reviewed from 1/10/20 indicated that antibiotics were prescribed for the qualifying ICD-10 codes far more often prior to the onset of the COVID-19 pandemic. From the review, 13 patients were diagnosed with qualifying ICD-10 codes, and eleven of these patients (84.6%) were prescribed an antibiotic. Of these eleven prescriptions, seven were inappropriate (63.6%). All seven (100%) of the inappropriate antibiotics were classified as unnecessary.

During implementation, the question arose whether providers were prescribing antibiotics inappropriately for patients being tested for COVID-19 without utilizing one of the ICD-10 codes being reviewed for this project. To examine this information, data were collected for one day, 3/1/21, using the COVID diagnosis code (Z20.822) as the qualifying diagnosis. Of the 16 patients diagnosed with this ICD-10 code on this day, two (12.5%) were prescribed antibiotics. Of the two antibiotic prescriptions, one (50%) was inappropriate and likely unnecessary.

Discussion of Major Findings

The evidence found in literature suggests that a behavioral change strategy, including an educational session and public commitment, are successful interventions to increase antibiotic stewardship (Kandeel et al., 2019; Yadav et al., 2019). The project findings did support the evidence found in literature regarding this behavioral change strategy. In the pre-implementation period, 100% of antibiotics prescribed were potentially inappropriate. The rate of potentially inappropriate antibiotic prescriptions varied throughout implementation, from as low as 0% to as high as 75% (See Appendix K). While the decrease in inappropriate antibiotic prescriptions was not consistent, this number was below the pre-implementation rate. Although the percentage of inappropriate antibiotic prescriptions ranged as high as 75% during weeks 9-10, the overall number of inappropriate prescriptions was low. During implementation, of the 161 patients diagnosed with qualifying ICD-10 codes, only 12 patients (7.5%) were prescribed antibiotics inappropriately.

One barrier to antibiotic stewardship that was commonly identified during informal provider interviews was the patient expectation to be prescribed an antibiotic for acute respiratory symptoms. This project focused on a provider behavioral change strategy, and

therefore did not include patient education as an intervention or examine patients' perceptions of antibiotic prescribing.

The COVID-19 pandemic seems to have affected antibiotic prescribing practices for ARTIs. Providers identified in informal interviews that COVID-19 was a facilitator of antibiotic stewardship. The presence of the viral COVID-19 pandemic enabled providers to have discussions with patients regarding the inefficacy of antibiotics in the treatment of viral illnesses. Furthermore, when comparing pre-COVID-19 data with data collected during the pandemic, it was interesting to note that while the rate of inappropriate antibiotic prescription was similar, there was a large discrepancy between the overall number of antibiotics prescribed, with more than twice as many being prescribed in the pre-COVID period. While a trend cannot be established based upon the limited scope of this quality improvement project, the findings suggest that COVID-19 has contributed to increased antibiotic stewardship in the treatment of ARTIs.

Interpretation and Implications

Cost and Resource Management

The monetary cost of this project was calculated based upon the cost of physical resources as well as the projected costs of project lead time, informational technology staff time, and provider time. A detailed budget can be found in Appendix L. The time spent by the project lead in research, development, collaboration, implementation, management, project revision, and analysis of findings was approximately 150 hours, which equated to approximately $3,450. Further costs associated with tasks that would have gone undone if the project lead were not a student include labor and patient care. This would have cost the organization an additional $2,990. The time that informational technologists spent running biweekly reports for data collection was approximately five hours, which was estimated at approximately $100. Lastly, the time spent by providers reviewing antibiotic stewardship educational material was approximately five hours. This time was worth approximately $382.50. The cost of physical resources, such as paper and ink needed for printing provider educational materials, was $30. This brings the total estimated cost of this project to $6,952.50.

If implemented on a larger scale, this project would have higher associated costs. The time required by the project lead to perform data collection would be significantly increased. Furthermore, the time required by providers to review appropriate material would be increased. The cost of resources needed to print and distribute antibiotic recommendation tables would also be increased. In order to decrease the associated costs of this project, time spent could be decreased by streamlining the data collection process. This could be accomplished by working with informational technology staff to build a system to identify patients who were prescribed antibiotics. This would allow for a streamlined data collection process and would provide the opportunity for more comprehensive evaluation of antibiotic prescribing practices.

The project's benefit, which includes a small and inconsistent yet clinically significant decrease in the percentage of inappropriate antibiotic prescriptions, does support the cost of the project. Antibiotic stewardship decreases antibiotic resistance, which decreases infection from multidrug resistant organisms. The avoidance of unnecessary antibiotic prescriptions also helps prevent infections secondary to antibiotic use, such as *C. difficile*. While there are costs associated with the project, decreased antibiotic resistance will provide long-term benefit to patients, the organization, and the healthcare system. The cost of one case of *C. difficile* infection is approximately $24,000 (Zhang et al., 2018). Therefore, the prevention of just one case of *C. difficile* through avoiding an unnecessary antibiotic prescription would cover the cost of the antibiotic stewardship project. The organization would benefit from continuation of an antibiotic stewardship program, even if continuation of a formal project is not feasible. An antibiotic stewardship program should focus on highlighting the importance of antibiotic stewardship and providing resources for provider use and patient education.

Implications of the Findings

The decrease in inappropriate antibiotic prescription that resulted from this antibiotic stewardship project shows that antibiotic stewardship programs have the potential to impact patients, nursing practice, and the healthcare system as a whole. While a formal project may not be feasible for every ambulatory clinic, there are more sustainable steps that can be taken to increase antibiotic stewardship and achieve a similar outcome in other clinics.

Implications for Patients

Continued inappropriate prescription of antibiotics for acute respiratory tract infections (ARTIs) on a large scale will increase the rate of growing antibiotic resistance. This project contributed to a notable decrease in the percentage of inappropriate antibiotic prescriptions for

ARTIs. As gleaned from provider interviews, one barrier to antibiotic stewardship is the patient expectation that they will receive an antibiotic for their upper respiratory symptoms. Patient education coupled with provider avoidance of inappropriate antibiotic prescriptions will help to slow the rate of developing antibiotic resistance. This will directly impact patients by slowing the development of multidrug resistant infections that could cause severe disease or death; decreasing the future cost of healthcare; and preventing costly adverse reactions from unnecessary antibiotic use.

Implications for Nursing Practice

This project affects the nursing practice by highlighting the need for increased antibiotic stewardship. Advanced practice nurses must strive to provide evidence-based care, which includes practicing antibiotic stewardship. Advanced practice nurses should be prepared to meet patient expectations of receiving an antibiotic with education regarding antibiotic resistance and appropriate alternative therapies. Nurses at any level of practice can affect change and increase antibiotic stewardship by educating patients regarding the antibiotic spectrum of coverage and the grave consequences of rising antibiotic resistance rates. Through taking on leadership roles within the nursing community, nurses can play a significant role in quality improvement practices aimed at antibiotic stewardship, which can help translate evidence-based research into practice to improve patient outcomes.

Impact for Healthcare System

This project demonstrates that antibiotics are being prescribed inappropriately for ARTIs and highlights the importance of providers incorporating antibiotic stewardship into practice. The impact of antibiotic resistance on the healthcare system is immense. Through increased antibiotic stewardship, healthcare providers can improve the health of the population by decreasing the rate

of antibiotic resistance. This will lead to enhanced patient outcomes through the prevention of death or disability secondary to multidrug resistant infections. Furthermore, decreased antibiotic resistance will prevent increased healthcare costs related to multidrug resistant infections. Health care organizations, particularly accountable care organizations, may increase reimbursement through the reduction of antibiotic prescriptions for certain diagnosis codes. The prevention of antibiotic resistance through increased antibiotic stewardship will aid the healthcare system in its pursuit of the Triple Aim for healthcare.

Sustainability

Time and cost are factors to consider when determining sustainability of an antibiotic stewardship program. A formal project process including data collection may not be feasible due to costs and time restraints. It may benefit the organization to form an antibiotic stewardship committee or designate an antibiotic stewardship champion. An antibiotic stewardship committee could monitor the state of antibiotic stewardship within the organization and advocate for antibiotic stewardship through ongoing provider training and provision of resources for provider use and patient education. The cost associated with forming a committee and advocating for antibiotic stewardship exists but is less than the predicted cost of rising antibiotic resistance related to continued inappropriate antibiotic prescription.

Dissemination Plan

This project will be formally presented at the organization where it was conducted and at the university. The project findings will be presented at the university on July 13, 2021. Results will also be disseminated at the project site during a provider meeting in July of 2021. This project will also be published to the university's institutional repository, The ScholarShip. The

project lead will submit an abstract to the 7th International Conference on Infectious and Rare Diseases, as this conference promotes the importance of antimicrobial stewardship.

Conclusion

Limitations and Facilitators

The COVID-19 pandemic served as both a limitation and a facilitator in this project. Most patients presenting with upper respiratory symptoms underwent COVID testing and were diagnosed with the organization's identified COVID-19 ICD-10 code. Due to time constraints in data collection and the volume of patients diagnosed with the COVID-19 ICD-10 code during implementation, this ICD-10 code was not included in the review process. The exclusion of these patients may have led to limitations in the findings. The COVID-19 pandemic was also identified by many providers as a facilitator of antibiotic stewardship. The public focus on COVID-19 enabled provider discussion of viral versus bacterial infections with patients and facilitated a conversation regarding antibiotic spectrum of coverage. Many providers reported that this led to a lower antibiotic prescription rate for acute respiratory tract infections.

Another limitation of this project was the exclusion of potentially revealing ICD-10 codes from the data collection process. Only codes J06.9 (acute upper respiratory infection), J20.9 (acute bronchitis), and J32.9 (sinusitis) were utilized in this project. Additional codes such as J01.90 (acute sinusitis), J00 (common cold), and J22 (acute lower respiratory infection) could have revealed additional findings regarding inappropriate antibiotic prescriptions. Given the limited time frame for project implementation and data collection, these diagnosis codes were not included in order to keep a primary focus on the three originally identified conditions – sinusitis, bronchitis, and acute upper respiratory infection.

One primary facilitator that contributed to the success of this project was stakeholder's support. All full- and part-time providers within the organization were willing to participate in the project. Providers were open to the steps of implementation and data collection, which allowed for a smooth implementation period. Providers also contributed to project success by

identifying facilitators of antibiotic stewardship, including use of the viral prescription pad and placing an emphasis on the importance of antibiotic stewardship. Another facilitator was organizational support and interprofessional collaboration. Support from the organizational partners and practice manager allowed for the participation of informational technology in the project, which streamlined the data collection process and allowed for necessary changes in data collection along the way.

Recommendations for Others

Were this project to be replicated, it would be beneficial to utilize a similar intervention including a provider educational session, distribution of antibiotic recommendation table, and public commitment. The message to providers regarding antibiotic stewardship may be stronger if the disbursement of educational materials is accomplished in person rather than via email. The inclusion of more ICD-10 codes in data collection, particularly J01.90, J22, and Z20.822, would be beneficial. The inclusion of pre- and post-educational session surveys to gauge provider attitudes regarding antibiotic stewardship may prove useful. With proper stakeholder support as well as interprofessional collaboration and the availability of necessary technology for data collection, this project is both scalable and sustainable and has the potential to impact the entire healthcare system in the decades to come.

Recommendations Further Study

This project could be replicated in other urgent care clinics in the United States to help reduce inappropriate antibiotic prescriptions. Provider education coupled with public commitment did seem to affect the percentage of inappropriate antibiotic prescriptions. To build upon this project, it would be interesting to incorporate patient education into the intervention, as this seemed to be a barrier commonly identified by providers. Patient education, not only when

the patient is sick, but also at well visits, may have the potential to increase patient understanding about upper respiratory infections, antibiotic spectrum of coverage, and antibiotic resistance. Another interesting project would be to analyze the rate of inappropriate antibiotic prescription before and after the COVID-19 pandemic. One may question whether the pandemic has significantly impacted provider prescribing practices and has potentially decreased the rate of antibiotic prescription.

Final Thoughts

The purpose of this project was to increase antibiotic stewardship in the treatment of ARTIs in an urgent care setting. A provider educational session was coupled with public commitment to antibiotic stewardship through the signing of an antibiotic stewardship pledge. Data was collected regarding antibiotic prescriptions for specific ICD-10 codes prior to and throughout implementation, which revealed a small but significant decrease in the percentage of inappropriate antibiotic prescriptions after the intervention. Continuation of antibiotic stewardship programs such as the one implemented will contribute to decreased rates of antibiotic resistance, a decreased rate of multidrug resistant infections, and cost savings for the entire healthcare system.

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Appendix A

Project Search Log

Date of Search	Database	Key Word Searches	Limits	# of Citations Found / Kept	Rationale for Inclusion / Exclusion (include rationale for excluding articles as well as for inclusion)
7/20/2020	CINAHL Complete (EBSCO Host)	Primary health care AND antibiotic stewardship	5 year period, English language, full text available	6 found / 1 kept	Included articles directly related to clinical question. Excluded articles that focus on specialty practices or bacterial infections. Excluded opinion-based articles.
7/20/2020	CINAHL Complete (EBSCO Host)	Respiratory tract infections AND prescribing patterns AND ambulatory care	5 year period, English language, full text available	2 found / 1 kept	Included articles directly related to clinical question. Excluded articles that focused on the pediatric population.
7/20/2020	CINAHL Complete (EBSCO Host)	Ambulatory care AND drug resistance, microbial	5 year period, English language, full text available	13 found / 2 kept	Included articles directly related to clinical question. Excluded articles related to the hospital setting. Excluded articles detailing studies that have not yet been completed. Excluded results that were primarily ads or narratives. Excluded articles not related to antibiotic prescribing practices.

7/21/2020	MEDLINE via PubMed	Antimicrobial resistance AND upper respiratory infection AND prescribing practices AND (ambulatory care OR outpatient care)	5 year period, English language, free full text available, human subjects only	19 found / 4 kept	Included articles directly related to clinical question. Excluded articles related solely to inpatient settings or long-term care settings, the pediatric population, or bacterial infections. Excluded articles detailing studies that have not yet been completed. Excluded redundant articles.
7/23/2020	MEDLINE via PubMed	Antibiotic stewardship AND intervention AND upper respiratory infection	5 year period, English language, free full text available, human subjects only, meta-analysis/randomized controlled trials/systematic reviews	23 found / 4 kept	Included articles directly related to clinical question. Excluded articles related solely to inpatient care, the pediatric population, or bacterial infections.
7/23/2020	CINAHL Complete (EBSCO Host)	Antimicrobial stewardship AND attitude of health personnel	5 year period, English language, full text available	30 found / 1 kept	Included articles directly related to clinical question. Excluded articles related solely to the hospital setting or long-term care setting. Excluded redundant articles. Excluded articles that focus solely on infection preventionists. Excluded articles related to the care of older adults or pediatric patients. Excluded articles for which the free text was not available.
7/24/2020	American Academy of Family Physicians	Antibiotic stewardship AND upper respiratory infection	Treatment focused, practice guidelines	11 found / 2 kept	Included articles directly related to clinical question. Excluded articles related to specific disorders not addressed in QI project.

Appendix B

Literature Matrix

Authors	Year Pub	Article Title	Theory	Journal	Purpose and Take Home Message	Design/Analysis/ Level of Evidence	IV, DV, or Themes Concepts or Categories	Instrument Used	Sample Size	Sample Method	Subject Charac.	Comments/Critique of the Article/Method Gaps
Schuetz, P., Wirz, Y., Sager, R., Christ-Crain, M., Stolz, D., Tamm, M., Bouadma, L., Luyt, C. E., Wolff, M., Chastre, J., Tubach, F., Kristoffersen, K. B., Burkhardt, O., Welte, T., Schroeder, S., Nobre, V., Wei, L., Bucher, H. C., Bhatnagar, N., … Mueller, B.	2017	Procalcitonin to initiate or discontinue antibiotics in acute respiratory tract infections	N/A	*Cochrane Database of Systematic Reviews*	To assess the safety and efficacy of using procalcitonin for starting or stopping antibiotics over a large range of patients with varying severity of acute respiratory infections (ARIs) and from different clinical settings	Level I Systematic review	IV: procalcitonin level measurement (or control) DV: antibiotics prescribed, mortality rates, antibiotic consumption rates, antibiotic side effects (various studies)	"Risk of bias" tool	6078 participants from 26 trials	All eligible trials of randomized participants with ARIs to receive antibiotics based on procalcitonin levels Trial eligibility was assessed using titles, abstracts, full text reports	Trials of randomized participants with ARIs to receive antibiotics based on procalcitonin levels	The authors of this systematic review found that the use of procalcitonin to guide antibiotic prescribing decisions results in lower mortality rates, lower antibiotic consumption, and lower risk for antibiotic-related side effects. Limitaitons: Most trials did not use blinding. Usefulness: This systematic review is useful as it provides strong evidence to support the use of procalcitonin levels in the decision-making process of initiating or stopping antibiotics. Synthesis: This systematic review provides evidence that procalcitonin levels can be useful in guiding decisions regarding antibiotics in the
Yadav, K., Meeker, D., Mistry, R. D., Doctor, J. N., Fleming-Dutra, K. E., Fleischman, R. J., Gaona, S. D., Stahmer, A., & May, L.	2019	A multifaceted intervention improves prescribing for acute respiratory infection for adults and children in the emergency department and urgent care settings	N/A	*The Society for Academic Emergency Medicine*	To compare an adapted intervention (education for patients and providers) and the enhanced intervention (education for patietns and providers, audit and feedback, peer comparisons, and nudges) in the reduction of inappropriate antibiotic prescribing for antibiotic non-responsive ARI	Level II Cluster-randomized clinical trial	IV: type of intervention (adapted or enhanced) DV: antibiotic prescribing practices	CONSORT checklist	Not stated	All eligible visits with all eligible providers at all participating sites	Licensed clinicians at participating sites except resident physicians Visits with ICD-10 codes consistent with antibiotic non-responsive ARIs	The authors found that inappropriate antibiotic prescribing rates were decreased by about 33% in both the adapted and the enhanced intervention groups. There was not a significant difference in differences between the two intervention methods. Limitaitons: No control. No process to measure uninted harm of return visits for illness progression. Usefulness: This study proved that educational methods can be useful in helping decrease the number of antibiotic prescriptions. Synthesis: There is need for more research in the effectiveness of educational interventions in decreasing inappropriate antibiotic prescriptions. However, this study showed that these interventions can be effective.

Gulliford, M. C., Prevost, A. T., Charlton, J., Juszczyk, D., Soames, J., McDermott, L., Sultana, K., Wright, M., Fox, R., Hay, A. D., Little, P., Moore, M. V., Yardley, L., & Ashworth, M.	2019	Effectiveness and safety of electronically delivered prescribing feedback and decision support on antibiotic use for respiratory illness in primary care: REDUCE cluster randomised trial	Social cognitive theory Self-determination theory	*British Medical Journal*	To evaluate the effectiveness and safety of electronically delivered prescribing feedback and decision support interventions at reducing antibiotic prescribing for self-limiting respiratory tract infections	Level II Open label, two arm, cluster randomized controlled trial	IV: electronically delivered prescribing feedback and decision support DV: antibiotic prescribing practices	N/A	79 practices	Practices that use the UK Clinical Practice Research Datalink (CPRD) electronic health record, were actively contributing data to CPRD, and agreed to participate in the trial	Practices in the United Kingdom, including England, Scotland, Wales, and Northern Ireland	The authors found that electronically delivered prescribing feedback and decision support tools decreased antibiotic prescribing for self-limiting respiratory tract infections in adults. The intervention did not reduce antibiotic prescribing to children or people greater than 85 years old. Limitaitons: Practices that agreed to take part might have been motivated to reduce antibiotic presribing. Number of practices included was smaller than intended.
Tonkin-Crine, S. K. G., Tan, P. S., van Hecke, O., Wang, K., Roberts, N. W., McCullough, A., Hansen, M. P., Butler, C. C., & Del Mar, C. B.	2017	Clinician-targeted interventions to influence antibiotic prescribing behaviour for acute respiratory infections in primary care: An overview of systematic reviews	N/A	*Cochrane Database of Systematic Reviews*	To systematically review evidence regarding the effects of interventions aimed at influencing clinician antibiotic prescribing behavior for ARIs in primary care	Level I Systematic review	IV: intervention DV: antibiotic prescribing practices	ROBIS tool	Five Cochrane and three non-Cochrane reviews (44 trials)	Included all published systematic reviews of randomized controlled trials testing interventions aimed at changing antibiotic prescribing in primary care for ARIs except for those with overlaping reviews	Reviews targeted at antibiotic prescribing behavior of clinicians for treatment of ARIs in primary care Interventions designed to change antibiotic prescribing practices of healthcare professionals for the treatment of ARIs in primary care	The authors found that CRP testing, shared decision making, and procalcitonin-guided management reduce antibiotic prescribing for patients with ARIs in primary care. There do not appear to be negative effects of these interventions. The quality of evidence to support clinical educational materials or decision support was low, so conclusions could not be drawn about the effects of these interventions. Limitations: None noted. Usefulness: This systematic review is useful as it helps identify the interventions with the strongest supporting evidence to influence antibiotic prescribing practices in the treatment of ARIs. Synthesis: While there is strong evidence that CRP testing, shared decision making, and procalcitonin-guided management can help reduce antibiotic prescriptions, there is more evidence needed to support the use of clinical educational materials and decision support to reduce antibiotic prescriptions.

Sanchez Choez, X., Armijos Acurio, M. L., & Jimbo Sotomayor, R. E.	2018	Appropriateness and adequacy of antibiotic prescription for upper respiratory tract infections in ambulatory health care centers in Ecuador	N/A	*BMC Pharmacology and Toxicology*	To evaluate the state of antibiotic prescribing for upper respiratory infections	Level IV Cross-sectional study	Concept themes: gender of prescriber, hours dedicated to clinical practice, category of health professionals	N/A	1393 patients	All patients that met inclusion criteria (3 months and above who require care for upper respiratory tract infections (URTIs) at the given health centers that had complete information in the EHR	Mean age of 16 (0-93), 57.7% female, 42.3% male	The authors found that 523 of 1393 patients were prescribed antibiotic, and of the 523 patients who received an antibiotic only 51 patients (9.75%) required an antibiotic. Limitaitons: Relied on retrospective EHR information. Usefulness: This study is useful as it demonstrates that there is a problem with inappropriate antibiotic prescriptions in the outpatient setting. Synthesis: This study demonstrates the need for interventions to reduce inappropriate antibiotic prescriptions in the outpatient setting.
Milani, R. V., Wilt, J. K., Entwisle, J., Hand, J., Cazabon, P., & Bohan, J. G.	2019	Reducing inappropriate outpatient antibiotic prescribing: normative comparison using unblinded provider reports	N/A	*BMJ Open Quality*	To evaluate the impact of unblinded normative comparison on rates of inappropriate antibiotic prescribing for ARIs	Level III Non-randomized controlled interventional trial	IV: provider and patient education, provider feedback biweekly, unblinded normative comparison highlighting inappropriate antibiotic prescribing for ARI DV: antibiotic prescription	N/A	192	Included all primary care providers (physicians, advanced practice providers) of a large regional healthcare system	Mean age of 44. 55% female, 45% male. 133 physicians, 59 advanced practice providers.	The authors found that provider and patient education, combined with unblinded normative comparison with peers, resulted in a decrease of inappropriate antibiotic prescriptions for ARI in the primary care setting. Limitaitons: Conducted at one health care center. Significant baseline differences in the rate of inappropriate antibiotics prescribed between the test and control groups. Usefulness: This article is useful as it supports peer comparison as an effective component of an educational intervention to decrease inappropriate antibiotic prescriptions for ARIs. Synthesis: Despite study limitations, there is evidence that educational methods and peer comparison can help improve antibiotic stewardship in the treatment of ARIs.

Butt, A. A., Navasero, C. S., Thomas, B., Al Marri, S., Al Katheeri, H., Al Thani, A., Al Khal, Abdullatif, Khan, T., & Abou-Samra, A.-B.	2017	Antibiotic prescription patterns for upper respiartory tract infections in the outpatient Qatari population in the private sector	N/A	*International Journal of Infectious Diseases*	To evaluate the state of antibiotic prescribing for upper respiratory infections in Qatar	Level IV Cross-sectional study	Concept themes: category of health professional	N/A	75,733	Included all claims to the National Health Insurance Company between May 2014 and December 2015	Information de-identified, so no characteristics noted.	The authors found that 45% of the antibiotics prescribed during this period were inappropriate based on diagnosis. Limitaitons: Exclusion of non-Qatari nationals, limitaiton to private sector providers, and inability to generate rates of prescription per unit population. Usefulness: This study is useful because it confirms that there is inappropriate antibiotic prescribing for ARIs. Synthesis: This study shows that antibiotics are inappropriately prescribed for ARIs. This demonstrates the need for future studies to address antibiotic stewardship in the treatment of ARIs.
Kandeel, A., Palms, D. L., Afifi, S., Kandeel, Y., Etman, A., Hicks, L. A., & Talaat, M.	2019	An educational intervention to promote appropriate antibiotic use for acute respiratory infections in a district in Egypt - Pilot study	N/A	*BMC Public Health*	To describe antibiotic prescribing practices for ARIs and knowledge and attitudes of physicians, pharmacists, and patients before and after a behavior change strategy	Level IV Comparative study	Concept themes: antibiotic prescribing, physician and pharmacist attitudes, clinical scenarios, public attitude	Survey	315 physicians and pharmacists Unstated number of patients	Included physicians and pharmacists who attended the training workshops Included patients age 18 or older or caregivers of pediatric patients who presented to one of 41 primary health clinics on specific days	Clinician average age 41 (pre-intervention) and 39 (post-intervention). Adult patient average age 37 (pre-intervention) or 36 (post-intervention). Pediatric patient average age 4 (pre- and post-intervention).	The authors found that, after an educational intervention (communication campaign, training of physicians and pharmacists, provider outreach), antibiotic prescribing for ARIs decreased and knowledge and attitude sores increased among physicians, pharmacists, and the public. Limitaitons: Study conducted in a single district in Egypt. Baseline surveys conducted in May-July while post-intervention surveys conducted October-December. Usefulness: This study is somewhat useful in that it shows that educational interventions can have some degree of success in decreasing inappropriate antibiotic prescriptions for ARIs. Synthesis: This study can be replicated in order to see if this type of educational intervention will be successful in decreasing inappropriate antibiotic prescriptions for ARIs in other settings.

Lee, C., Jafari, M., Brownbridge, R., Phillips, C., & Vanstone, J. R.	2020	The viral prescription pad - A mixed methods study to determine the need for and utility of an educational tool for antimicrobial stewardship in primary health care	N/A	*BMC Family Practice*	To determine which antimicrobial stewardship interventions are optimal to introduce into primary care practices	Level VI Mixed methods study of sequential explanatory design	Concept theme: optimal medium of information transfer	Survey Viral prescription pad	234 prescribers (survey) 12 physicians (interview)	Survey respondants Not stated	21 family physicians (57% male), 12 nurse practitioners (92% female), 138 pharmacists (71% female), and 63 dentists (63% male) Not stated	The authors found that providers are willing to engage in antibiotic stewardship but feel they need more resources to educate themselves and patients. Physicians indicated that the viral prescription pad was a useful tool to promote conversation about antibiotic stewardship. Limitaitons: Less than optimal sample size. Usefulness: This study, though limited, may be useful in showing that providers may be open to using viral prescription pads to promote conversations about antibiotics in the treatment of ARIs. Synthesis: This study had a limited sample size, but the results show that the implementation of a tool such as a viral prescription pad could help providers promote and explain antibiotic stewardship to their patients.
Tillekeratne, L. G., Bodinayake, C. K., Dabrea, T., Nagahawatte, A., Arachchi, W. K., Sooriyaarachchi, A., Stewart, K., Watt, M., Ostbye, T., & Woods, C. W.	2017	Antibiotic overuse for acute respiratory tract infections in Sri Lanka: A qualitative study of outpatients and their physicians	N/A	*BMC Family Practice*	To assess Sri Lankan patients' and physicans' attitudes towards acute respiratory tract infection (ARTI) diagnosis and treatment	Level VI Qualitative study	Theme concepts (patients): health-seeking behavior, knowledge of ARTIs, treatment recevied during visit Theme concepts (physicians): diagnosis and management of ARTIs, antibiotic over-prescription, antimicrobial resistance, opportunities for improving ARTI care	Survey	50 patients, 5 physicians	Convenience sample of willing participants who met eligibility criteria from a tertiary care hospital in Sri Lanka.	Patient charac.: Mean age of 49 years among adults with range of 18-80. Mean age of 9 years among pediatric patients with range of 1-17. 56% of patients were female. Mean age of 42 years among pediatric caregivers with range of 27-61 and 92% were female. Physician charac.: Mean duration of time on staff of 3 years with range of 0-8. Mean time since obtaining medical degree of 21 years with range of 8-33. Four of five physicians reported they treat 100-150 patients per day.	The authors of this study found that antibiotics were commonly prescribed for ARTIs at this hospital in Sri Lanka. Prescriptions were driven in part by physicians' perception of patient demands, diagnostic uncertainty, and fear of bacterial infection. High patient volume and short visit times also contributed. This study found that there is a need for provider and public education to improve antibiotic prescribing practices. Limitations: Small number of physicians included. Interviews were brief. Potential social desirability bias. Usefulness: This study is useful as it provides insight to provider and patient attitudes surrounding antibiotic prescriptions for ARTIs. Synthesis: Despite limitations, this study provides opportunities for QI to focus on the themes identified in this study.

Nageeti, T., Al-Harbi, R., Al-Malki, K., Natto, O., Binhamdan, A., Aldosari, H., Aldosari, B., Alshammari, F., & Alanazi, A.	2019	Improving antimicrobial prescriptions with computerized decision support systems: Where are we?	N/A	*IOS Press*	To determine the impact of computerized decision support systems (CDSS) on antibiotic stewardship	Level V Review of Literature	Theme concepts: CDSS in hospitals, CDSS in primary care, reduction in inappropriate antibiotic prescriptions	N/A	4 articles	Literature review	3 systematic reviews, 1 quasi-experimental study	The authors found that CDSS interventions were based on decision guidelines. These studies do not show consideration of non-expert decision making, engagement of clinicians, and end users' work flow. There was a high physician override rate (50%). CDSS had only a modest effect on antibiotic prescribing practices for ARIs in the primary care setting. Limitaitons: Trials faild to control for confounding variables. Usefulness: This study is somewhat useful. It indicates that CDSS may not be the best choice for a quality improvement project based in primary care or outpatient settings. Synthesis: CDSS can be useful in some settings and under certain circumstances, but the physician override rate is high, and it is not likely the best intervention to be used in primary care practices.
Touboul-Lundgren, P., Jensen, S., Drai, J., & Lindbaek, M.	2015	Identification of cultural determinants of antibiotic use cited in primary care in Europe: A mixed research synthesis study of integrated design "Culture is all around us"	N/A	*BMC Public Health*	To identify cultural determinants and describe the influence of culture on antibiotic use	Level VI Mixed research synthesis study	Theme concepts: patient-related determinants, practitioner-related determinants, or both	NICE recommendation tools Effective Public Health Practice Project QA tool	13 studies	Included eligible studies: cross-cultural studies concerning antibiotic use in primary care in at least two European countries which included a description of cultural determinants published between 1997 and 2015 that ALSO met QA assessment criteria	11 quantitative, 2 qualitative or mixed methods	The authors found that various cultural determinants suggest that cultural factors should be considered as an influence on all stages of the disease process, including antibiotic consumption. Limitaitons: Lack of exclusively qualitative studies. Usefulness: This article is modestly useful as it details the importance of considering culture when discussing and prescribing antibiotics. Synthesis: In a quality improvement project focused on antibiotics, cultural competence should be a consideration.

Jenkins, T., Haukoos, J. S., Young, H. L., Knepper, B. C., Shihadeh, K. C., Sankoff, J., & Asdigian, N. L.	2020	Patterns of use and perceptions of an institution-specific antibiotic stewardship application among emergency department and urgent care clinicians	N/A	*Infection Control & Hospital Epidemiology*	To assess patterns of use and perceived usefulness of a local antibiotic stewardship application to deliver institution-specific prescribing guidance	Level VI Qualitative study	Theme concepts: frequency of use, assessment of usefulness	Self-administered online survey	114 clinicians	Not stated	44 attending physicians, 24 advanced practice providers, and 46 emergency medicine residents	The authors found that most responders had used the smart phone application and found it to be useful. Limitaitons: Users of the application might have been more likely to complete the survey than non-users. Potential for social desirability bias. Usefulness: This article is useful as it brings to light the potential place for smart phone applications in the push for antibiotic stewardship. Synthesis: Smart phone applications to promote antibiotic stewardship may be a useful intervention to decrease inappropriate antibiotic prescriptions.
Harris, A. M., Hicks, L. A., & Qaseem, A.	2016	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	N/A	*Annals of Internal Medicine*	To present best practices for antibiotic use in healthy adults presenting with ARTIs	Level I Narrative literature review of evidence/practice guideline	Theme concepts: bronchitis, group A streptococcal pharyngitis, rhinosinusitis, common cold	N/A	Not stated	Included current clinical guideline recommendations, meta-analyses, systematic reviews, and RCTs found using Cochrane Library, PubMed, MEDLINE, and EMBASE.	Not stated	The authors found that patients with acute bronchitis should not be treated with an antibiotic. Patients with symptoms suspicious for group A streptococcal pharyngitis should only be treated with an antibiotic if infection is confirmed. Acute rhinosinusitis should be treated with antibiotics only in cases that persist for more than 10 days; have severe symptoms, high fever, purulent nasal discharge or facial pain lasting for at least 3 consecutive days; or double sickening. Patients with the common cold should not be treated with antibiotics. Limitaitons: None identified. Usefulness: This article is useful as it provides current best practice for the treatment of ARTIs. Synthesis: This article provides guidelines for the treatment of acute bronchitis, suspected group A streptococcal pharyngitis, acute rhinosinusitis, or the common cold.

Wong, D. M., Blumberg, D. A., & Lowe, L. G.	2006	Guidelines for the use of antibiotics in acute upper respiratory tract infections	N/A	*American Family Physician*	To provide existing guidelines and summarized key practice points to help physicians with the appropriate use of antibiotics in children and adults with URTI	Level I Practice guideline	Theme concepts: otitis media, acute bacterial sinusitis, pharyngitis, nonspecific cough illness/bronchitis, bronchiolitis/nonspecific URI	N/A	Not stated	Not stated	Not stated	The authors found that acute bronchitis should not be treated with an antibiotic. If pneumonia is suspected based on clinical presentation, the diagnosis should be confirmed with chest radiograph before prescribing antibiotics. Nonspecific URTIs should not be treated with antibiotics, but with fluid intake, rest, humidified air, and over-the-counter analgesics and antipyretics. Patients with acute bacterial rhinosinusitis should be treated with antibiotics only when symptoms persist for more than 10 days or if experiencing worsening symptoms. Limitations: None stated. Usefulness: Although this guideline is somewhat outdated, it still addresses the importance of avoiding antibiotics in the treatment of nonspecific upper respiratory infections. Synthesis: This article provides evidence-based guidelines for the treatment of URTIs.

Appendix C

Informal Provider Interview Questions

1. Have you encountered any barriers to antibiotic stewardship?
    a. If yes, what are these barriers?
2. Have you noted any facilitators to antibiotic stewardship?
    a. If yes, what are these facilitators?

Appendix D

Chart Review Data Collection Tool

Date	Diagnosis Code	Appropriate Diagnosis	Antibiotic Prescribed	Antibiotic Appropriate	Return Visit	Nature of Antibiotic Impropriety 1 = Unnecessary; 2 = Inappropriate drug selection; 3 = Inappropriate dosage or duration	
		0 = No; 1 = Yes					
TOTALS		0	0	0	0	Unnecessary Prescriptions	0
						Inappropriate Drug Selection	0
						Inappropriate Dosage/Duration	0

Appendix E

Informal Provider Interview Data Collection Tool

	Question Number	Answer (0 = No; 1 = Yes)	Elaboration
Provider 1	1		
	2		
	3		
	4		
Provider 2	1		
	2		
	3		
	4		
Provider 3	1		
	2		
	3		
	4		
Provider 4	1		
	2		
	3		
	4		

Appendix F

Antibiotic Recommendations for Treatment of Acute Respiratory Tract Infections in Adults

These recommendations do not apply to patients who have recently received antibiotics or have failed previous therapy.

Antibiotic dosages reflect normal renal and hepatic function.

Diagnosis	***Considerations***	***Recommended Antibiotic Therapy***	***Alternative Antibiotic Therapy***
Rhinosinusitis (Sinusitis)	Features of acute rhinosinusitis: · Less than 4 weeks purulent nasal drainage · Nasal obstruction and/or facial pain Most cases of acute rhinosinusitis lasting less than 10 days are of viral origin. Acute bacterial rhinosinusitis (ABRS) can be diagnosed when: · Symptoms last 10 or more days without evidence of improvement · Double worsening of illness ABRS should be treated with antibiotics. · Duration of initial antibiotic treatment should be 5-7 days · Reserve respiratory fluoroquinolones for patients with no alternative treatment options	amoxicillin-clavulanate 875-125 mg bid or amoxicillin 875 mg bid or amoxicillin 500 mg tid	If penicillin allergy: doxycycline 100 mg bid or if tolerable, third generation cephalosporin (cefixime 400 mg qday or cefpodoxime 200 mg bid) with or without clindamycin 300 mg qid or levofloxacin 500 mg or 750 mg qday or moxifloxacin 400 mg qday
Acute Bronchitis	Suspect acute bronchitis if: · Acute onset of persistent cough (one to three weeks) · No clinical findings suggestive of pneumonia (fever, tachypnea, rales) · No history of COPD Acute bronchitis is typically caused by viruses. Other symptoms that should raise suspicion for pneumonia include moderate dyspnea, hemoptysis, immunocompromised state, older age, and dementia. If suspicion for influenza, pertussis, or COVID-19, further testing may be indicated. Purulent sputum does not indicate bacterial source of infection.	Antibiotic treatment not routinely recommended.	Antibiotic treatment not routinely recommended.

Nonspecific Upper Respiratory Infection (Common Cold)	Clinical features of the common cold: · Rhinitis and nasal congestion (may be clear or purulent) · Sore throat · Cough · Malaise · Fever (uncommon in adults) · Sneezing · Headache · Pressure/discomfort in ears/face Adventitious lung sounds or other signs of lower respiratory tract involvement are typically not present. If suspicion for influenza or COVID-19, further testing may be indicated.	No indication for antibiotic therapy in absence of evidence of secondary bacterial infection.	No indication for antibiotic therapy in absence of evidence of secondary bacterial infection.

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Sexton, D. J. & McClain, M. T. (2019). The common cold in adults: Diagnosis and clinical features. In L. Kunins (Ed), *UpToDate*. https://www.uptodate.com/contents/the-common-cold-in-adults-diagnosis-and-clinical-features

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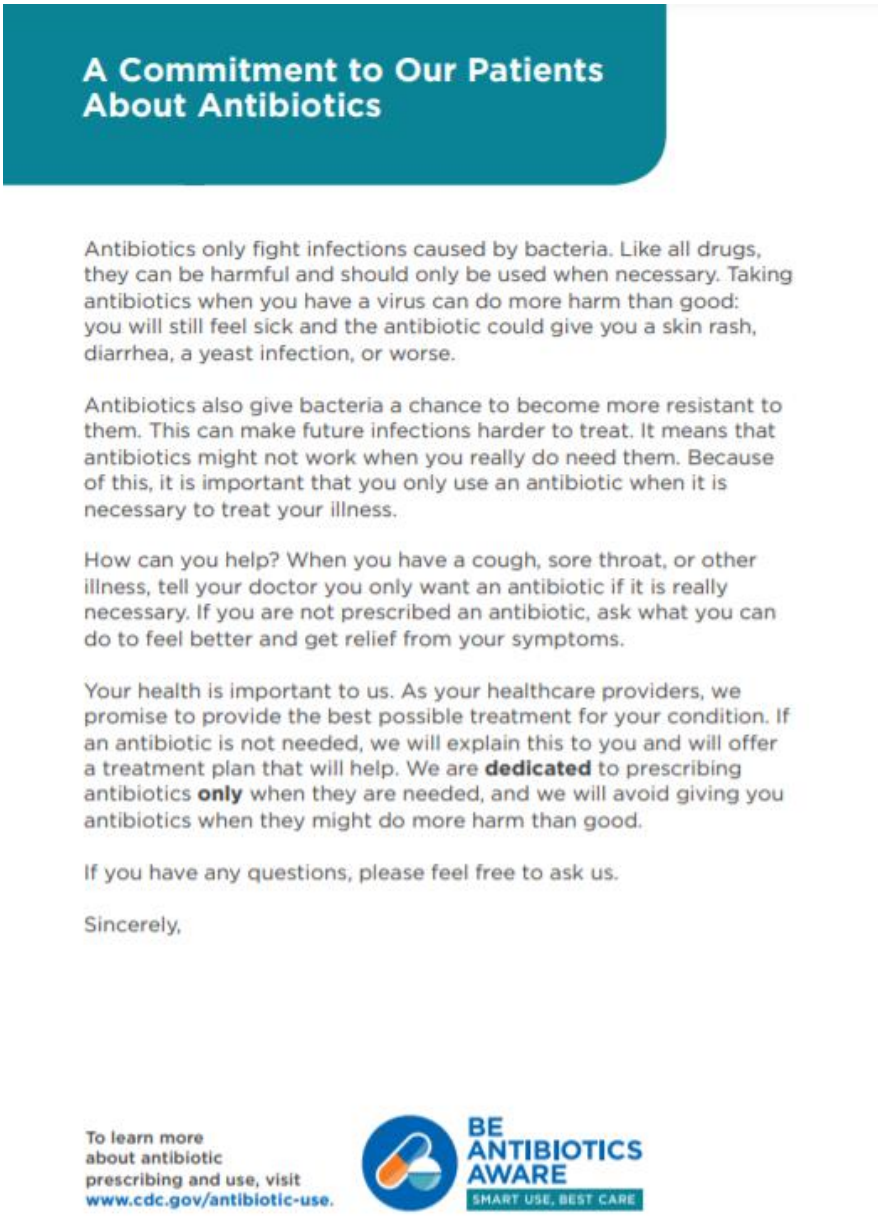
Appendix G

Antibiotic Stewardship Pledge



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,

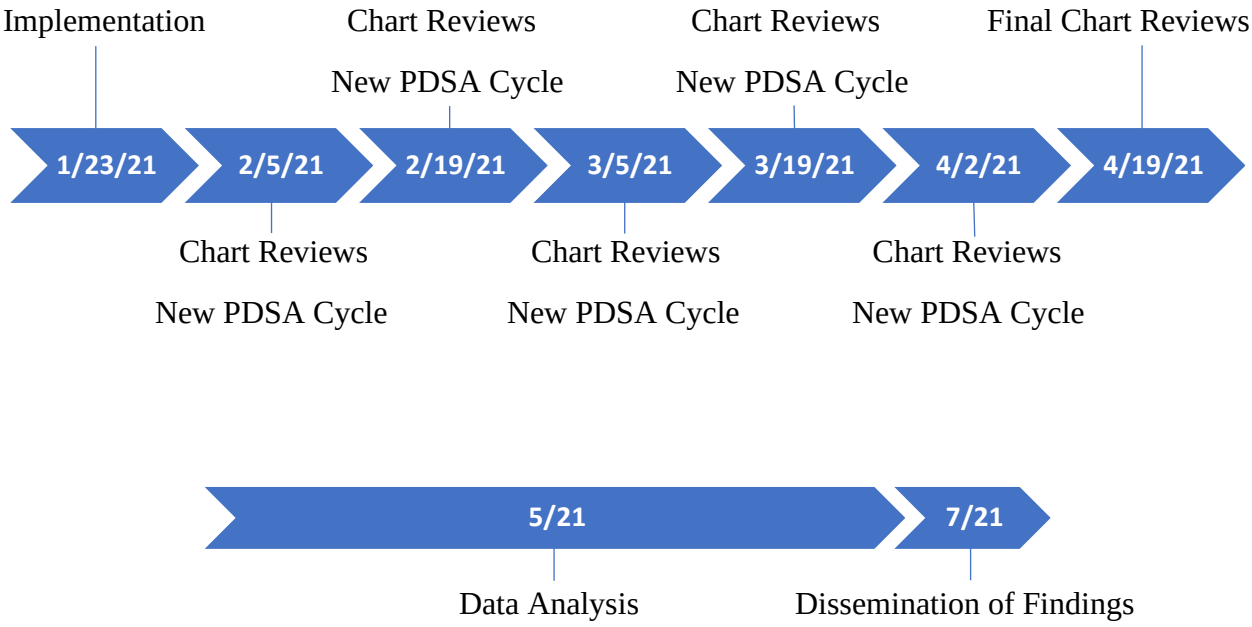
To learn more about antibiotic prescribing and use, visit www.cdc.gov/antibiotic-use.

BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

Note. Figure reprinted from *A Commitment to Our Patients About Antibiotics,* by Centers for Disease Control and Prevention, n.d. (https://www.cdc.gov/antibiotic-use/week/pdfs/Commitment-Poster-english-11x17.pdf)

Appendix H

Implementation Timeline



Appendix I

Biweekly Data Table

Weeks	Number of Patients	Number of Antibiotics Prescribed	Number of Appropriate Prescriptions	Number of Inappropriate Prescriptions
Pre-Implementation (2 weeks)	59	3	0	3
1-2	60	12	5	7
3-4	27	3	3	0
5-6	31	4	2	2
7-8	18	1	1	0
9-10	15	4	1	3
11-12	10	2	2	0
Totals	**220**	**29**	**14**	**15**

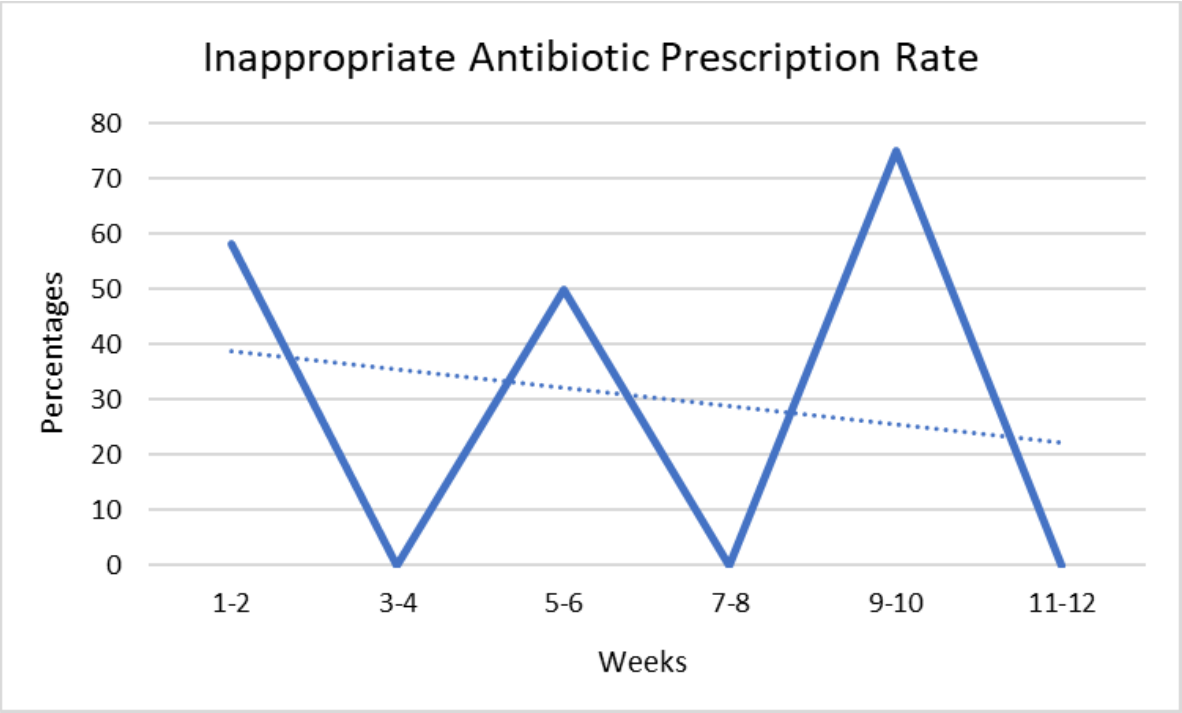
Appendix J

Pre-COVID-19 Data Table

	Pre-COVID-19 1/10/20	During COVID-19 1/25/21
Number of Patients	13	15
Number of Antibiotics Prescribed	11	5
Rate of Antibiotic Prescription	84.6%	33.3%
Number of Appropriate Prescriptions	4	2
Number of Inappropriate Prescriptions	7	3
Rate of Inappropriate Antibiotic Prescription	63.6%	60.0%

Appendix K

Inappropriate Antibiotic Prescription Rates



Appendix L

Project Budget

Item	Quantity	Unit Cost	Total
Project Lead Time			
Time spent performing research, development, collaboration, implementation, management, project revision, and analysis of findings	150	$23.00/hour	$3,450.00
Cost of "undone" labor and patient care	130	$23.00/hour	$2,990.00
Physician Time			
Time spent reviewing educational materials	1.5	$115/hour	$172.50
Physician Extender Time			
Time spent reviewing educational materials	3.5	$60/hour	$210.00
Informational Technology Staff Time			
Time spent running biweekly reports for data collection	5	$20/hour	$100.00
Physical Resources			
Ream of Paper	1	$7.00/unit	$7.00
Printer Ink	1	$23.00/unit	$23.00
Total			**$6,952.50**

Appendix M

Doctor of Nursing Practice Essentials

	Description	Demonstration of Knowledge
Essential I ***Scientific Underpinning for Practice***	**Competency** – Analyzes and uses the information to develop practice **Competency** -Integrates knowledge from humanities and science into the context of nursing **Competency** -Translates research to improve practice **Competency** -Integrates research, theory, and practice to develop new approaches toward improved practice and outcomes	• Researched project topic using evidence-based articles to formulate project plan and intervention. • Utilized knowledge of science and evidence-based guidelines to develop antibiotic recommendation table for provider use.
Essential II ***Organizational & Systems Leadership for Quality Improvement & Systems Thinking***	**Competency** –Develops and evaluates practice based on science and integrates policy and humanities **Competency** –Assumes and ensures accountability for quality care and patient safety **Competency** -Demonstrates critical and reflective thinking **Competency** -Advocates for improved quality, access, and cost of health care; monitors costs and budgets **Competency** -Develops and implements innovations incorporating principles of change **Competency** – Effectively communicates practice knowledge in writing and orally to improve quality **Competency** – Develops and evaluates strategies to manage ethical dilemmas in patient care and within health care delivery systems	• Developed project intervention through evaluation of evidence-based articles and consideration of current practice in project setting. • Developed project that has replicability and the potential to improve antibiotic stewardship.
Essential III ***Clinical Scholarship & Analytical Methods for Evidence-Based Practice***	**Competency** – Critically analyzes literature to determine best practices **Competency** – Implements evaluation processes to measure process and patient outcomes **Competency** – Designs and implements quality improvement strategies to promote safety, efficiency, and equitable quality care for patients **Competency** – Applies knowledge to develop practice guidelines **Competency** – Uses informatics to identify, analyze, and predict best practice and patient outcomes **Competency** – Collaborate in research and disseminate findings	• Conducted literature review of evidence-based articles to determine best intervention for antibiotic stewardship project. • Utilized Melnyk and Fineout-Overholt Levels of Evidence in evaluation of literature. • Design interventions to improve antibiotic stewardship in the outpatient setting. • Implement PDSA process to evaluate project throughout implementation timeline.

	Description	Demonstration of Knowledge
Essential IV ***Information Systems – Technology & Patient Care Technology for the Improvement & Transformation of Health Care***	**Competency -** Design/select and utilize software to analyze practice and consumer information systems that can improve the delivery & quality of care **Competency -** Analyze and operationalize patient care technologies **Competency -** Evaluate technology regarding ethics, efficiency and accuracy **Competency -** Evaluates systems of care using health information technologies	• Utilized technology in development of provider educational materials (PowerPoint presentation and antibiotic recommendation table) and in data collection process. • Utilized technology to analyze data and create graphics to aid in dissemination of findings.
Essential V ***Health Care Policy of Advocacy in Health Care***	**Competency-** Analyzes health policy from the perspective of patients, nursing, and other stakeholders **Competency** – Provides leadership in developing and implementing health policy **Competency** – Influences policymakers, formally and informally, in local and global settings **Competency** – Educates stakeholders regarding policy **Competency** – Advocates for nursing within the policy arena **Competency-** Participates in policy agendas that assist with finance, regulation, and health care delivery **Competency** – Advocates for equitable and ethical health care	• Met with stakeholders (providers, site champion, organizational partners) to advocate for, plan, and discuss project potential prior to implementation. • Developed table to compile antibiotic prescribing recommendations for acute respiratory tract infections.
Essential VI ***Interprofessional Collaboration for Improving Patient & Population Health Outcomes***	**Competency-** Uses effective collaboration and communication to develop and implement the practice, policy, standards of care, and scholarship **Competency** – Provide leadership to interprofessional care teams **Competency** – Consult intraprofessionally and interprofessionally to develop systems of care in complex settings	• Collaborated and consulted with project faculty mentor, site champion, organizational partners, informational technology staff to plan and implement project. • Served as project lead throughout research, planning, implementation of project.
Essential VII ***Clinical Prevention & Population Health for Improving the Nation's Health***	**Competency-** Integrates epidemiology, biostatistics, and data to facilitate individual and population health care delivery **Competency** – Synthesizes information & cultural competency to develop & use health promotion/disease prevention strategies to address gaps in care **Competency** – Evaluates, and implements change strategies of models of health care delivery to improve quality and address diversity	• Utilized PDSA cycle and Icek Ajzen's Theory of Planned Behavior to develop behavioral change strategy. • Synthesized guidelines regarding antibiotic use in treatment of acute respiratory tract infections to develop recommendation table for provider use.

	Description	Demonstration of Knowledge
Essential VIII ***Advanced Nursing Practice***	**Competency**- Melds diversity & cultural sensitivity to conduct a systematic assessment of health parameters in varied settings **Competency** – Design, implement & evaluate nursing interventions to promote quality **Competency** – Develop & maintain patient relationships **Competency** –Demonstrate advanced clinical judgment and systematic thoughts to improve patient outcomes **Competency** – Mentor and support fellow nurses **Competency**- Provide support for individuals and systems experiencing change and transitions **Competency** –Use systems analysis to evaluate practice efficiency, care delivery, fiscal responsibility, ethical responsibility, and quality outcomes measures	• Considered diversity of providers serving as participants in the project. • Designed, implemented, and evaluated project interventions to help incorporate evidence-based guidelines regarding the treatment of acute respiratory tract infections into practice.