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Respiratory Infection and Antimicrobial Prescribing: How Well Are the Guidelines Adhered To?

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RESPIRATORY INFECTIONS AND ANTIMICROBIAL PRESCRIBING:

HOW WELL ARE THE GUIDELINES BEING ADHERED TO?

by

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Abstract

Approximately two million people in the United States (US) are infected annually by organisms that have developed resistance to one or more of the antimicrobials designed to eradicate them. The highest-ranking category of illness for which antibiotics are most commonly overprescribed is respiratory infections (CDC, 2014a). The purpose of this project was to explore current antimicrobial prescribing trends for respiratory infections at an urgent care facility**.** The ACE Star Model of Knowledge Transformation (Stevens, 2004) was utilized to serve as a guide in conducting this research study. Utilizing the detailed guidelines and treatment criteria for respiratory infections developed by the American College of Chest Physicians, a determination regarding the appropriateness of treatment was made. In this study, the rate of overprescribing at the study site was found to be approximately 22.66% as compared to the national average of 50% (CDC, 2013). Calculating the current prescribing trends and overprescribing rates is the first step in acknowledging the issue within this particular setting. Much more progress needs to be made to address methods and strategies for resolution including the adaptation of a modified antimicrobial stewardship applicable to ambulatory/urgent care settings Regardless of how the resolution to this worldwide problem will come about, it will not happen without multi-disciplinary cooperation. Advanced practice nurses are in a unique position to be able to act as leaders and educators regarding this issue.

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Background and Statement of the Problem

In a digital press kit released by the Centers for Disease Control and Prevention (CDC, 2012), Associate Director for Healthcare Associated Infection Prevention Programs, Arjun Srinivasan MD, stated that we are nearing maximum potential in our ability to treat infectious diseases and that organisms are evolving faster than the antibiotics manufactured to treat them. While the number of lives saved by antibiotics is undoubtedly staggering, so also, is the steadily increasing number of lives lost due to the inefficacy, in part related to overuse of those same drugs. Decades of poor prescribing practices have paved the way for the rapid upsurge of drug sensitivities, allergic reactions, resistant infections and potentially fatal cases of diarrhea (CDC, 2014a).

Approximately two million people in the United States (US) are infected annually by organisms that have developed resistance to one or more of the antimicrobials designed to eradicate them. Roughly 23,000 of those people will succumb to drug-resistant infections; this is in addition to the tremendous number of lives lost due to conditions complicated by the infection (CDC, 2013). Nearly 250,000 people each year are hospitalized for Clostridium difficile infections, with the majority of cases attributed to antibiotic use as a predisposing factor. It is estimated that at least 14,000 people die each year as a result of this particular type of infection (CDC, 2013). The highest-ranking category of illness for which antibiotics are most commonly overprescribed is respiratory infections (CDC, 2014a).

Though the issue of antibiotic resistance is a worldwide concern, the already overburdened US healthcare system finds itself particularly affected by the considerable amount of avoidable cost. Antibiotic resistant infections, as compared to those easily treated with antibiotics, necessitate additional or lengthier treatments, longer hospital stays, more attention from healthcare workers, increased utilization of healthcare dollars and are associated with greater morbidity and mortality. Though difficult to calculate, estimates reveal that up to 20 billion dollars annually has been appropriated for excess health care costs, with an additional 35 billion dollars in costs to society for lost productivity of the workforce (Infectious Diseases Society of America, 2010). These figures become particularly striking when taking into account that nearly 50% of prescribed antibiotics are unwarranted or ineffectual as prescribed (CDC, 2013).

Contributing to the progression of antimicrobial resistance is the practice of using antibiotics to prevent, control, treat and promote growth in animals (Hawkey & Jones, 2009). Though the US Food and Drug Administration (FDA) has undertaken measures to eliminate the use of antibiotics for growth purposes, the practice is still prevalent. The CDC (2013) stated that although unable to directly measure the amount of antibiotics used in food animals versus humans, there is evidence supporting higher usage in the production of food.

With the ever-growing presence of antimicrobial resistant strains of bacteria, the risk for person-to-person transmission increases, as people and the surfaces they come in contact with have now become the hosts, vectors, and vehicles for these deadly organisms. While antibiotic resistance is somewhat of a matter of inevitability, measures must be undertaken to slow its progression and prevent new resistance from developing. After much research for the *Threat Report 2013*, the CDC employed four core actions to combat resistant infections: prevention of disease and its spread; following and monitoring resistant bacteria; improving the utilization of antibiotics; and promoting innovation for new drugs and diagnostic tests (CDC, 2013).

Utilizing the four-prong attack in addition to the fiscal year 2015 President's Budget request for funding to the CDC and National Healthcare Safety Network to address the problem, the multitude of contributory factors can finally be addressed (CDC, 2014c). Many of the contributing factors have been presented as barriers to proper prescribing. These include lack of patient education, patient expectation and subsequent satisfaction, unbridled prescribing without antibiogram monitoring, a dearth of antimicrobial stewardship programs, lack of prescriber support, cost, and a lack of innovation on behalf of the pharmaceutical industry (Dovey, 2014). Barriers will inevitably exist but must be overcome in order to achieve improved healthcare outcomes. The purpose of this project was to explore current antimicrobial prescribing trends for respiratory infections at an urgent care facility.

Review of the Literature

A search of the MEDLINE, CINAHL, PubMed, Ovid, CDC, and World Health Organization databases was conducted using the terms antimicrobial resistance, antibiotic resistance, proper antimicrobial prescribing, antimicrobial stewardship, and prescribing guidelines. The terms patient expectation and patient satisfaction were also linked with antibiotic. The search was conducted for articles and information from 2006 to the present, with inclusion of articles from 1996, 2002, 2003, 2004, and 2005 demonstrating the longstanding knowledge of this worldwide issue and the lack of progress toward improvement and resolution. The literature review will include the following subsections: epidemiology; inappropriate antimicrobial/antibiotic use; antimicrobial/antibiotic resistance; American College of Chest Physicians prescribing guidelines and use of those guidelines in clinical practice; overall current antibiotic prescribing trends and trends specific to respiratory illness; barriers to proper prescribing and improvement strategies; and lastly antimicrobial stewardship.

Epidemiology

According to global statistics, pneumonia is the number one cause of death worldwide and the sixth most common cause of death in the US (Dhar, 2012). Pneumonia is the number one cause of death from infectious disease in the US and, in its community-acquired form, is responsible for roughly 45,000 deaths annually (Dhar).

In 2014, the CDC released the 2011 edition of the National Hospital Ambulatory Medical Care Survey. The survey is administered and collected by the Ambulatory and Hospital Care Statistics Branch (AHCSB) of the National Center for Health Statistics for purposes of tracking the utilization and provision of care in emergency rooms and ambulatory clinics throughout the US. According to the survey, 1,558,000 people visited emergency rooms and ambulatory care clinics for visits characterized by and subsequently coded as either bronchitis or pneumonia. Of these 1,558,000 people, 1,056,000 were over the age of 65 and thus vulnerable to increased morbidity and mortality (AHCSB, 2011).

Though impressive at first glance, these numbers are gross underestimates of the breadth of these annual diagnoses. This survey collects data only from those emergency departments and outpatient departments of non-institutional general and short-stay hospitals that choose to participate. Federally run institutions, urgent care/walk-in clinics, and primary care offices are unaccounted for. This becomes particularly significant when taking into consideration that the majority of cases of bronchitis and pneumonia are managed outpatient. Only a small percentage of cases that end up in the participating emergency rooms are tracked. When cough is the most common symptom bringing patients to see their primary care doctors and acute bronchitis is the most commonly bestowed diagnosis, this data seems skewed and appears much smaller than it actually is (Albert, 2010).

Given that roughly 50% of all antibiotics are unwarranted or ineffectual as prescribed combined with an inability to enumerate exactly how many people are receiving these unwarranted prescriptions contribute significantly to the seemingly uncontrollable cycle of the epidemiological evolution of resistance. Despite warnings, providers continue to prescribe citing fatigue (Linder, Doctor, & Friedberg, 2014), patient expectation, and time constraints as justification to do so (Albert, 2010). Furthermore, antimicrobial resistance has been able to strengthen in its adaptability and evolution via a three-prong attack consisting of increased use of antibiotics (in both humans and animals), greater movement of people, and increased industrialization (Hawkey & Jones, 2009).

A study conducted by Albrich, Monnet, and Harbarth in 2004 demonstrated a direct correlation between outpatient antibiotic consumption and perpetuation of drug resistant bacteria. The relationships between antibiotic use and the prevalence of the following resistant bacteria were examined across 20 countries: penicillin non-susceptible Streptococcus pneumoniae (PNSP), macrolide-resistant Streptococcus pneumonia (MRSP), and Streptococcus pyogenes (MRGAS) (Albrich, Monnet, & Harbarth, 2004). Total antibiotic use was correlated with PNSP ($r = 0.75$; $p < 0.001$), as was macrolide use with MRSP ($r = 0.88$, $p < 0.001$), and MRGAS ($r = 0.71$; $p = 0.004$) (Albrich et al). The results demonstrated highly statistically significant strong correlations between outpatient antibiotic use and subsequent prevalence of drug resistant bacteria. After having studied this trend across 20 counties, the researchers were able to conclude, with statistically strong evidence, that streptococcal resistance was directly correlated with antibiotic selection pressure on a national level (Albrich et al.)

Despite this and other studies that have provided tangible evidence supporting the detriment of overprescribing, inappropriate use continues to occur. Even with heightened awareness of overprescribing, the global mobility of people and food and increased industrialization contribute to antibiotic resistance and it will likely continue to develop more rapidly than innovation (Hawkey & Jones, 2009). A primary target then is to slow the spread of drug and multi-drug resistant infections, which contribute to the deaths of 23,000 people each year; this number will continue to rise if nothing changes and inappropriate use continues (CDC, 2013).

Inappropriate Antimicrobial/Antibiotic Use

The proper utilization and prescription of antibiotics and antimicrobials carries with it the ability to thwart bacterial resistance, decrease excess healthcare costs, and optimize the patient experience and outcome (Deuster, Roten, & Muehlebach, 2010). Rates of inappropriate antimicrobial/antibiotic therapeutic intervention are estimated to be as high as 25-50%. Reasons contributing to this gross excess include unwarranted prescriptions, longer than necessary treatment length, inaccurate dosing, and inadequacy of drug versus pathogen-susceptibility (CDC, 2013). Consequentially, this practice causes an increase in adverse events and reactions, increased mortality, lengthened hospitals stays, and excessive healthcare costs (Deuster et al., 2010). Each year, roughly $1.1 billion dollars is spent on the estimated 41 million unnecessary antibiotic prescriptions for patients experiencing viral respiratory tract infections; this does not include the excess healthcare costs related to the adverse effects and complications of unwarranted pharmacotherapy (Fendrick, Monto, Nightengale, & Sarnes, 2003).

An example of inappropriate use was epitomized in a retrospective review of billing and electronic medical record data regarding time of prescription. Data were collected from over 20,000 adult patients at 23 health centers and revealed a significant relationship between provider fatigue and inappropriate antibiotic prescription (Linder et al., 2014). The odds ratio steadily increased as time passed during the patient care session. The ratios increased from the first hour to 1.01 in the second hour, 1.14 in the third hour, and 1.26 in the final hour, establishing a pattern of decision fatigue (Linder et al.). The study, however, never discussed methods for addressing and reducing the effects of decision fatigue.

Further exploration surrounding the prevalence and consequence of inappropriate antimicrobial use lead to a systematic review and meta-analysis conducted to examine subsequent antibiotic resistance in patients' prescribed antibiotics (Costelloe, Metcalfe, Lovering, Mant, & Hay, 2010). The review included 24 studies, 22 of which involved symptomatic infection and two involved healthy volunteers; 19 were observational studies and five were randomized trials (Costelloe et al.).

In seven studies (2,605 participants) particular to respiratory bacteria, the pooled odds ratio for resistance was 2.4 within two months of antibiotic treatment and at twelve months of treatment. Multiple studies reported that the quantity, duration, and number of courses were directly associated with higher rates of resistance (Costelloe et al., 2010). Only one prospective study showed changes in odds ratios over a period of time falling from 12.2 at one week to 6.1 at one month, 3.6 at two months, and 2.2 at six months. The authors concluded that patients prescribed antibiotics for respiratory infections developed bacterial resistance to that antibiotic. The effect is greatest in the month immediately following and gradually tapers, but can persist for up to a period of 12 months. Not only does this facilitate patients' becoming vectors for organisms resistant to first line antibiotics, but this also potentiates the overuse of second line antibiotics.

This residual year long resistance is a likely catalyst behind the widespread antibiotic resistance in the community when antibiotics are appropriately prescribed, and more concerning when antibiotics are overprescribed and unwarranted. The author noted that after years of inappropriate use and pervasive defiance, clinicians still do not see antibiotic resistance as a reason to refrain from unnecessary antibiotic use (Costelloe et al., 2010). The detriment is tangible and increasing at an alarming rate.

Antimicrobial/Antibiotic Resistance

Antimicrobial resistance was first identified in the 1940s with the discovery of penicillin resistant *Staphylococcus aureus* (Schofield, 2011). Roughly 20 years later came the advent of what is largely the most well known of resistant organisms, methicillin-resistant *Staphylococcus aureus* (MRSA). As time progressed, so too did resistance. In the 1990s, the appearance of extended spectrum B-lactamases (ESBL) emerged as the greatest concern for infectious-disease specialists and public-health officials to date. Bacteria utilize ESBLs in a way such that multiple drug resistance is conferred (Schofield). This has been an important contributing factor to the development of hospital-acquired and community-acquired infections.

Bacteria are classified by four broad categories: oxygen requirements (aerobes [versus] anaerobes); cell wall (gram-positive vs. gram-negative); shape (cocci vs. rods) and atypical features (Haddock, 2013). Aerobes require an oxygenated environment to survive. In contrast, anaerobes have adapted to survive in poorly oxygenated areas such as the mouth, and intestinal and genital tracts (Haddock). The cell wall components differentiate bacterial types by thickness.

Gram-positive bacteria possess a thick peptidoglycan cell wall capable of retaining a Gram stain. Bacteria can be further divided into cocci and rods. Common Gram-positive cocci include staphylococci (skin), streptococci (group A & group B-hemolytic – throat; group B. *Streptococcus* – genital tract; S. *pneumoniae* – lungs) (Haddock, 2013). Common Gram-positive rods include *Clostridium* and *Listeria* (Haddock).

Gram-negative bacteria possess a thin peptidoglycan cell wall incapable of retain a Gram stain. Common Gram-negative cocci include *Neisseria menigitidis, Neisseria gonorrhoeae*, and numerous respiratory microbes (Haddock, 2013). Common Gram-negative rods include bowel pathogens such as *E. coli*, *Salmonella spp*., *Shigella spp*., and *H. pylori*, as well as respiratory microbes such as *H. influenza* (Haddock).

Atypical pathogens differentiate themselves from other bacteria by characteristics that do not conform to the broad categories. An example of an atypical pathogen is Mycobacteria tuberculosis. Mycobacteria, similar to Gram-positive bacteria, possess a thick cell wall, however the cell wall is lipid based instead of peptidoglycan based (Haddock, 2013). Another example of atypical pathogens is the small intracellular organism known as *Chlamydia*. They do not have their own cell and thus must rely on other cells for survival (Haddock).

Antibiotic or antimicrobial (antiviral, antibacterial, antifungal) resistance to the mechanism of action of antimicrobial drugs can occur in two ways: innate and acquired (Gascoigne, 2014). If a type of bacteria is innately resistant to a class of drugs, it means that all strains of that particular bacteria are resistant to all members of that antimicrobial class (Gascoigne). Acquired resistance is a case of natural selection in its most basic, but deadly form. Repeated exposure to the same antimicrobial causes bacteria to gain familiarity with the antimicrobial agent and ultimately acquire resistance to it. The surviving resistant bacteria replicate, whereas the susceptible bacteria are eliminated. The survival of these fittest bacteria allows for the propagation of resistance to future bacterial generations (CDC, 2013).

There are three processes by which bacteria may go about obtaining resistance: enzymatic barrier mechanism; mechanical barrier mechanism; and target protection barrier mechanism (Gascoigne, 2014). The enzymatic barrier mechanism is the most common and utilizes a modified version of an already existing enzyme. The modified enzyme is able to cleave or alter the antimicrobial, rendering it inactivated and useless (Gascoigne). Using the mechanical barrier mechanism, the bacteria has the ability to alter the permeability of its cell membrane, thereby limiting the amount of antimicrobial allowed into the cell such that the minimum effective concentration is not reached (Gascoigne). Additionally, bacteria may possess outflow pumps that transport the antimicrobial out of the cell before it is able to reach its target destination and be effective. Lastly, the target protection barrier mechanism utilizes a decoy method. The bacteria are able to mutate such that they create decoy target sites to which the antimicrobial agent is lured. Some bacteria may also produce a protective molecule that hides the target site from the antimicrobial by way of providing a mask of sorts (Gascoigne).

The process of acquiring resistance, regardless of the method, involves the transfer of resistant deoxyribonucleic acid (DNA). There are two ways in which this can occur: vertical gene transfer and horizontal gene transfer (Gascoigne, 2014). Vertical gene transfer propagates resistance from genetically superior bacteria to future generations, this is known as the "survival of the fittest" tactic. Horizontal gene transfer involves the transfer of small pieces of DNA from one bacteria to another of the same or different species. This occurs by: cell-to-cell contact (conjugation), the uptake of DNA from the environment (transformation) or the utilization of bacteriophages (bacteria-specific viruses) as a vehicle for transport between two related bacteria (transduction) (Gascoigne).

Despite the urgency for solutions to the ever-growing issue of bacterial resistance, clinical research is severely lacking with respect to randomized controlled trials. This dearth of research is attributed to the severity of illness in the population that would be examined, as well as unwillingness on behalf of the pharmaceutical industry to fund such studies until new antibiotics, capable of eliminating multi-drug resistant organisms, have been developed (Infectious Diseases Society of America, 2010). Much of the stagnation with respect to antimicrobial resistance research is due to the lack of appropriation of funding and whether those funds should be allocated toward improving the old antibiotics or developing new ones. This lack of progress with evidence-based research serves to explain why current research articles and principles often cite older information and guidelines. Thus, it is important that the US FDA demand and expect studies of patients at high risk for developing multi-drug resistant infections (Paterson & Rogers, 2010).

American College of Chest Physicians Prescribing Guidelines

In 2006, the American College of Chest Physicians (ACCP) in conjunction with the CDC developed clinical practice guidelines in order to potentially enhance a clinician's ability to practice evidence-based medicine. It is the position of the ACCP that these clinical guidelines are to be used in conjunction with clinical judgment, with the understanding that the recommendations may not apply to every patient and may be affected by patient preference and resource availability (Irwin, 2006). The ACCP acknowledges that these guidelines are recommendations, not mandates, and as such may not always be applicable as there will always be exceptions (Irwin).

Every recommendation found within the expansive list of guidelines that ACCP has set forth is graded based upon two components. These two components are quality of evidence and the net benefit of the diagnostic and therapeutic procedure. The levels of evidence are as follows: A, strong; B, moderate; C, weak; D, negative; I, inconclusive (no recommendation possible; E/A, strong recommendation based on expert opinion only; E/B, moderate recommendation based on expert opinion only; E/C weak recommendation based upon expert opinion only; and E/D negative recommendation based on expert opinion only (Irwin, 2006).

The ACCP guidelines state that for patients with acute cough and sputum production suggestive of acute bronchitis, the absence of the following findings sufficiently reduces the need for chest radiography: heart rate >100 beats/min, respiratory rate >24 breaths/min, oral temperature >38°C, and evidence of consolidation upon chest examination (Irwin, 2006). Though this quality of evidence was found to be low, the benefits of lowering exposure to radiation whenever possible are substantial and, as such, this recommendation was ranked as a category B (Irwin). Another recommendation states that for patients with a presumed diagnosis of acute bronchitis, routine treatment with antibiotics is not warranted and should not be offered (Irwin). The quality of evidence for this recommendation was found to be good and without benefit, and was ranked as a category D meaning a negative recommendation or to be recommended against (Irwin). Lastly, for patients with a diagnosis of acute bronchitis, decisions to not use antibiotics should be discussed with patients on an individual basis and explanations should be offered due to patient and public expectation to receive an antibiotic based on prior experience (Irwin). The quality of evidence for this recommendation was purely expert opinion and showed intermediate level of benefit, thereby earning this recommendation a category E/B grade of recommendation (Irwin).

According to the CDC, the most common types of infections for which antibiotics are prescribed are lung infections. Roughly 22% of all antibiotics are prescribed for lung infections, almost one and one-half-times more than the next highest ranking of 14% for urinary tract infections (CDC, 2014a). The most common types of lung infections include acute and chronic bronchitis and pneumonia. Acute bronchitis is largely thought to be viral in origin and often does not warrant an antibiotic (Irwin, 2006). In the past, should a patient experience a fever with an increase in dyspnea and volume or purulence of sputum, the illness was treated as an exacerbation of chronic bronchitis and antibiotics were prescribed (Deuster et al., 2010). Studies have shown that antibiotics are no longer indicated for acute uncomplicated bronchitis and sputum cultures for suspected acute bronchitis have proven unsuccessful in determining the need for an antibiotic. Treatment is reserved solely for patients with an acute exacerbation of chronic bronchitis and/or chronic obstructive pulmonary disease (Wong, Blumberg, & Lowe, 2006).

If the symptoms are greater in severity, bacterial pneumonia or community acquired pneumonia become part of the differential diagnoses. These diagnoses are characterized by the presence of acute onset fever of 38°C or greater, tachypnea at or above 24 breaths/minute, tachycardia at or above 100 beats/minute and evidence of consolidation on chest exam including rales, egophany, or fremitus (Irwin, 2006). Chest radiography should be performed for patients for whom complete recovery is the goal. This is performed as a confirmation of physical exam findings, to assess the severity and to establish a baseline radiograph for confirming resolution (Irwin). The diagnosis of bacterial pneumonia is made largely upon clinical assessment data and radiography as sputum cultures are unavailable unless in the inpatient setting.

For many years the initial empirical treatment of pneumonia was largely 'organism-based' as it was thought that the causative agents manifested themselves differently both in physical exam and on radiograph. Though this method may have benefited some patients, the area of overlap for pathogens' location preference within the lung was far too large. According to Christiansen (1996), well-controlled studies utilizing radiographic parameters to predict the type of pathogen showed a positive correlation in less than 50% of cases.

Patients with underlying illnesses are predisposed to infection. As mentioned previously, most common and concerning of these underlying illnesses is COPD. The respiratory tracts of patients with COPD are colonized by S*treptococcus pneumoniae, Haemophilus influenzae* and *Moraxella catarrhalis,* which predisposes patients to have more frequent exacerbations or infections (Dhar, 2012). Patients may also be predisposed to pathogens if they have any of the following comorbidities: smoking history, diabetes mellitus, renal disease, congestive heart failure, alcoholism, altered mental status, or patients post-splenectomy (Irwin, 2006).

A traditional approach to the selection of empirical therapy has incorporated three risk factors for patient morbidity and mortality. These contributory risk factors include age, underlying illness, and severity of illness. Patients over the age of 60 should be treated more aggressively than those in lower age brackets as these patients experience a much higher morbidity and mortality (Ramsdell, Narsavage & Fink, 2005). Additionally, research has shown that some age groups find themselves particularly susceptible to certain pathogens. The elderly are much more susceptible and likely to acquire *Streptococcus pneumoniae*, though it does occur in all age groups, whereas those between the ages of 20-40 are more likely to acquire *Mycoplasma pneumoniae* (Ramsdell et al.).

Properly prescribing antibiotics is of utmost importance for optimal patient response due to exacerbations of chronic bronchitis and pneumonia. The aforementioned recommendations for antibiotics offer adequate coverage for each of the previously discussed conditions. In cases where more than one drug can offer coverage, the antibiotic chosen should be the one that the patient is most likely to take, have the fewest side effects, and the lowest cost (Irwin, 2006).

Since the development of the guidelines, some research has been conducted related to usage. For example, a 2010 study conducted by Linder, Schnipper, Tsurikova, Volk and Middleton examined self-reported antibiotic therapy guideline familiarity and subsequent antibiotic prescribing practices. The clinicians in the study were asked to rank their familiarity with the ACCP/CDC antibiotic guidelines on a Likert scale ranging from 'not at all' to 'extremely' familiar. In the review of 11,164 non-pneumonia acute respiratory infection cases treated by the clinicians, 44% were prescribed antibiotics. Clinicians that reported their familiarity as 'not at all' ($n = 15$), 'somewhat' ($n = 62$), 'moderately' ($n = 93$), and 'extremely' ($n = 38$) prescribed antibiotics in 42, 37, 46, and 46% of cases respectively ($p < 0.001$). The authors concluded that self-reported familiarity with the ACCP/CDC guidelines for antibiotic treatment for acute respiratory infections appeared to be associated with increased prescribing. Findings suggest that familiarity with guidelines does not necessarily correlate with adherence to the guidelines or higher patient outcomes (Linder et al.).

While guidelines are supposed to be based upon the most current and up to date research, they are also expansive, encompassing, and time-consuming to produce. Although the ACCP guidelines are from 2006, they are still the ultimate resource for practice guidelines and standard of care for prescribers and should be adhered to as closely as possible.

Antibiotic Prescribing Trends – Overall

According to the CDC's study published in the New England Journal of Medicine (2013), it is estimated that healthcare providers prescribed 258 million courses of antibiotics, which translates to 833 prescriptions per 1000 people, or four out of five (Hicks & Taylor, 2013). While antibiotic-prescribing rates declined in the 1990s, they have been steadily rising since then (Ashiru-Oredope, Sharland, Charani, McNulty, & Cooke, 2012).

Every winter, antibiotic resistance experiences a rise that is in direct proportion to an increase in antibiotic prescriptions (Walker, 2012). A study conducted by Johns Hopkins University found that cold weather-related prescribing and subsequent resistance was an additive result of drug popularity and extreme weather changes (Walker). Another, cohort-style study utilized a time-series analysis from 1999 to 2007 on antibiotic usage from Intercontinental Marketing Services (IMS) Health and antibiotic resistance from The National Surveillance (Sun, Klein, & Laxminaryan, 2012). The authors found that rates of resistance fluctuated greater than 6% in a pattern similar to rates of prescribing (Sun et al.). A significant correlation between the prevalence of resistant E. coli and the prescription of aminopenicillins approximately one month prior was detected ($p = 0.03$). Similar results, ($p = 0.03$), were found for the prevalence of ciprofloxacin-resistant MRSA and the prescription of fluroquinolones one-month prior (Sun et al.). The authors concluded that the seasonal increase of antibiotic prescriptions being filled were likely causing community resistance and could be directly correlated to the frequency with which patients visited outpatient settings (Sun et al.).

Antibiotic Prescribing Trends – Respiratory

Roughly 90% of cases of uncomplicated acute bronchitis have nonbacterial etiologies and, therefore, would not benefit from antibiotic therapy (Evans et al., 2002).

A randomized controlled-trial was conducted to support this theory. Patients that were diagnosed with acute bronchitis were randomized into one of two groups. One of the groups received azithromycin (n = 112) and the other vitamin C placebo (n = 108). Differences in health-related quality of life were measured on day seven and were found to be small and clinically insignificant ($p = 0.8$). Eighty-nine percent of patients in both the azithromycin group (n = 100) and the placebo group (n = 96) returned to normal day activities by day seven ($p > 0.9$). The study showed that while there was an evident reduction of cough at follow-up (number needed to treat = 5.6) there was no change in the patients' activity limitations. The study also showed that the number needed to harm, based upon the antibiotics' adverse effects, was 16.7 (Evans et al.). The results showed that at days 3 and 7 there were no differences between the two groups and 89% of patients in each group showed clinical improvement. Therefore, there was no advantage in prescribing azithromycin versus low-dose vitamin C for acute bronchitis (Evans et al.).

A study of 807 patients diagnosed with acute lower respiratory infection, including those with fever and purulent sputum, were assigned into one of three treatment groups: immediate antibiotic; delayed antibiotic; or no antibiotic (Little et al., 2005). These groups were each further divided into two groups. One group was given a one page information leaflet about the diagnosis natural history as well as answers to patients' most frequently asked questions and advice on when to seek additional treatment and the other group was not given any information. It was found that the information leaflet had no effect on outcomes. In comparison to the group that received an immediate antibiotic, only a portion of patients in the delayed treatment and no treatment groups went on to fill antibiotics (96%, 20%, and 16% respectively; $p<0.001$). The study concluded there were no significant differences between groups and as such delayed antibiotics or no antibiotics were acceptable approaches (Little et al.).

In a study conducted between December 2007 and November 2008 (Walker, 2012), in both public and private facilities, current prescribing rates for uncomplicated respiratory tract infections were examined. At least one antibiotic was prescribed for an acute respiratory tract infection 45% of the time in public facilities and 57% of the time in private facilities. In the public facilities, penicillins were the main class of antibiotics prescribed (31%), followed by macrolides (25%), fluoroquinolones (20%), and cephalosporins (10%). This study clearly illustrates unmitigated amounts of overprescribing, as uncomplicated respiratory infections are largely due to viruses.

More recently, a 2009 cohort study conducted by Grijalva, Nuorti, and Griffin used data from the National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey to assess and analyze trends in antibiotic prescribing for acute respiratory tract infections from 1995 through 2006. Antibiotic prescription rates for non-otitis media acute respiratory tract infections, for which antibiotics are rarely indicated, decreased by 24% (Grijalva, Nuorti, & Griffin, 2009). This trend was true for all penicillins, cephalosporins, sulfonamides, and tetracycline; however this was not the case for azithromycin and fluoroquinolones. Prescription rates for azithromycin, and fluoroquinolones increased significantly among adults (Grijalva et al.). While a decrease in antibiotic use may appear to be a step in the right direction, this particular shift represented a decrease in targeted therapy and an uptrend in broad-spectrum coverage (Grijalva et al.).

Resistance begins in the community and impacts resistance in the inpatient setting. In sum, a community's prescribing trends, especially shifting to broader spectrums of coverage in lieu of appropriately targeted therapies, impacts the level of resistance in that community. It then potentiates sicker people with more resistant pathogens, who must seek care in hospital settings, thereby increasing prevalence of the resistant pathogens (Walker, 2012). In order to prevent this cycle from continuing, it is necessary to address factors contributing to inappropriate prescribing, to prescribe according to the guidelines, and to meet these barriers with appropriate and well thought out strategies for resolution.

Barriers to Proper Prescribing & Improvement Strategies

Barriers to appropriate antimicrobial prescribing have been researched and explored, though the problem has not been solved. Barriers include, but are not limited to, lack of patient confidence in their practitioner, patient expectation and satisfaction, and defensive prescribing in fear of malpractice liability (Crombie, 2012). Prescribers must first and foremost ensure that they have undergone the training necessary to achieve a solid understanding of pharmacotherapeutics. Not only must the prescriber possess confidence in their prescribing methods, but other members of the healthcare team, including patients, must have faith in the prescriber's ability to accurately and adequately prescribe (Blanchflower, Greene, & Thorp, 2013). The ability to properly prescribe medication to treat disease is a major factor in the establishment of a trusting rapport with patients, without which a connection between patient and prescriber will not be made and healing will not take place (Blanchflower et al.).

Contributing to the development of a patient-prescriber relationship is patient expectation and subsequent satisfaction. Often, patients expect an antibiotic to treat an acute respiratory infection (Wong et al., 2006). Given that patient satisfaction is a main priority for the provider and the institution for which they work, prescribers feel pressured to prescribe an unnecessary antibiotic (Wong et al.). On the other hand, when patients are not given their requested, yet unwarranted, dose of antibiotics, the rationale behind the prescriber's decision is often not adequately explained due to time constraints. This can lead to lack of trust, malcontent, and even anger. Dissatisfaction is especially detrimental when patient satisfaction surveys, which often affect prescriber raises and/or bonuses, shed a negative light upon the prescriber despite having done what was medically prudent (Crombie, 2012).

Occasionally, prescribers will provide unnecessary antibiotics to patients in attempt to mitigate the potential for malpractice should something that was not evident on assessment or testing be missed. In 1994, the Congressional Office of Technology Assessment (OTA) supplied a definition for defensive medicine that is still used today:

> "Defensive medicine occurs when doctors order tests, procedures, or visits, or avoid high-risk patients or procedures, primarily (but not necessarily or solely) to reduce their exposure to malpractice liability. When physicians do extra tests or procedures primarily to reduce malpractice liability, they are practicing positive

defensive medicine. When they avoid certain patients or procedures, they are practicing negative defensive medicine" (U.S. Congress OTA, 1994, p.13).

The OTA expanded the definition to include over prescribing in attempts to provide coverage for medical uncertainty (U.S. Congress OTA, 1994).

Detecting the prevalence of defensive medicine is very difficult. The ways in which data can be collected are limited to surveys or linking differences in physician procedure utilization rates to differences in risk of liability (Manner, 2007). In attempts to obtain tangible data, a poll of 300 physicians and other hospital staff was conducted. Seventy-nine percent reported that malpractice litigation had hurt their ability to provide quality care to patients, 41% reported over prescribing antibiotics, and 73% reported knowledge of colleagues prescribing in that same fashion (Manner). The study revealed that 66% of the 100 nurses and 100 hospital administrators reported unnecessary testing out of fear for litigation (Manner).

In 2010 a similar survey was conducted. A total of 89 gerontological physicians were evaluated in six clinical vignettes based upon their knowledge of the Beers criteria regarding medications to avoid in the elderly (Ramaswamy et al., 2011). During the debriefing portion of the survey, the physicians had an opportunity to rank perceived prescribing barriers (Ramaswamy et al.). Responses included the following perceived barriers:

"Patient taking large number of medications (91%)

Cost to patient (89%)

Potential drug interactions (87%)

Limited options on insurance formularies (85%)

Lack of time in office schedule (67%)

Difficulty communicating with other doctors (61%)

Lack of information about patient's present medications (60%)

Lack of formal education on prescribing for the elderly (54%)

Lack of acceptable therapeutic alternatives (47%)

Patient's request to maintain a specific medication (41%)

Unwillingness to discontinue a medication started by another doctor (34%)

Patient's request to begin a specific medication (26%)

Lack of access to pharmacist (16%)" (Ramaswamy et al., 2010, p. 1156)

Though some of the barriers are inevitable and difficult to navigate around, many are able to be quelled with simple solutions and learning opportunities (Blanchflower et al., 2013). If it is a matter of prescribing confidence, all prescribing clinicians should be encouraged to enroll in pharmacology continuing education classes as appropriate and available in order to fulfill, and go above and beyond, state specific requirements (Blanchflower et al.).

Rhode Island physicians are required to partake in 40 hours of continuing education, with a minimum of two hours applied to current public health needs (Rhode Island Department of Health [RIDOH], 2014). Physician's assistants are mandated to attend 30 hours of continuing education without specification of type (RIDOH). Nurse practitioners must complete at least 30 hours of continuing education in pharmacology every six years, however they may apply the 10 hours of continuing education biennially as required for their RN license to those 30 hours (RIDOH).

The provider caring for a patient with a viral illness needs to be prepared to provide a thorough explanation regarding why an antibiotic should not be prescribed and educate the patient on the difference between a viral versus a bacterial infection (Wong et al., 2006). Additionally, the provider may provide and educate the patient on the use of symptomatic relief measures including antipyretics, decongestants, non-steroidal anti-inflammatories, antitussives and antihistamines as appropriate. Another useful technique, described in the literature, is providing patients with a prescription for an antibiotic, but requesting that the patient not fill it unless the symptoms worsen or persist after a certain number of days (Wong et al.). For patients for whom an antibiotic is entirely unwarranted, developing an open communication plan and ensuring easily accessible follow-up will often times quell the anxiety patients may develop regarding not getting an antibiotic (Wong et al.). Prescribers have noted patients' desire to leave with something tangible in order to feel as though the visit was worthwhile. It has been reported by clinicians that patients leaving with a discharge summary with contact information, information pamphlets about their diagnosis, a non-antibiotic prescription, or a note for work exude much more satisfaction with their visit than those leaving empty-handed (Blanchflower et al., 2013).

Antimicrobial Stewardship

A major effort to control and monitor antimicrobial resistance is gaining recognition worldwide through the implementation of antimicrobial stewardships. According to a report by the CDC (2014b), antimicrobial stewardship programs can help clinicians properly treat infections, reduce adverse reactions, aid practitioners in improving quality and safety of care, increase treatment success, decrease treatment failure, and provide guidance for proper therapeutic and prophylactic prescribing.

Though initially developed for inpatient settings, antimicrobial stewardships have been found to be able to adapt to meet the differing requirements of a variety of settings so long as the core principles remain intact (CDC, 2014b). The CDC has identified the following seven core elements crucial to the successful implementation of a stewardship: leadership commitment; accountability; drug expertise; action; tracking; reporting; and education. In order to properly execute the program, adequate staffing, as well as financial, and technological resources must be allotted. This includes the appointment of a responsible program leader as well as a lead pharmacist to oversee the implementation and evaluation of at least one program action, such as an “antibiotic timeout” (CDC). Technological resources such as tracking software must be purchased and assigned staff must become trained to operate the software. Results of tracking must then be appropriately disseminated to relevant staff in the form of facility-specific antimicrobial education (CDC).

As far back as 15 years ago, studies were demonstrating the benefits of antimicrobial stewardship programs. A prospective study of 655 infected patients who required admission to an intensive care unit was conducted to examine outcomes for patients whose care was guided by an antimicrobial stewardship program versus those whose care was not (Kolleff, Sherman, Ward, & Fraser, 1999). Patients for whom care was guided by antimicrobial stewardship received targeted pharmacotherapy allowed for by in vitro cultures predicating bacterial susceptibility to the prescribed antimicrobial. Those patients for whom care was not guided by antimicrobial stewardship strategies received broad-spectrum antimicrobial coverage. The authors discovered a significantly lower rate of infection-associated mortality for patients who received appropriate antimicrobial therapy as compared to those who received inappropriate therapy. The mortality rate for patients that received appropriate therapy was 18% as compared to 42% for those who did not ($p < 0.001$) (Kolleff et al.).

A cross sectional, stratified study of U.S. hospitals conducted in 2006 displayed similar results (Zillich et al., 2006). The study examined the relationship between stewardship strategies and antimicrobial resistance trends. A survey inquiring about the implementation and dissemination of information regarding practice guidelines, use of antimicrobial-related technology such as antibiogram mapping and support tools, and communication with prescribers was sent to the infection control leaders at 670 hospitals across the US. Additionally, data were collected regarding prevalence of the four most epidemiologically significant drug-resistant pathogens: methicillin-resistant Staphylococcos aureus, vancomycin-resistant Enterococci, ceftazidime-resistant Klebsiella, and quinolone-resistant Escherichia coli (Zillich et al.).

The results displayed that the implementation of antimicrobial stewardship strategies regarding recommended antimicrobial use ($p < 0.01$) and the optimization of the duration of empirical antibiotic prophylaxis ($p < 0.01$) were associated with a lower prevalence of antimicrobial resistance. In contrast, restrictive formularies were found to be associated with a higher prevalence of antimicrobial resistance ($p = 0.05$). In sum, the study concluded that the implementation of guideline-recommended practices and stewardship strategies to control and guide antimicrobial selection and prescription appears to help control antimicrobial resistance rates in the U.S. (Zillich et al., 2006).

If and when antimicrobial stewardship programs are implemented, program evaluation and quality assurance and improvement must be conducted to determine the efficacy of the program (Looke & Duguid, 2011). While some hospitals may employ antibiogram software to monitor prescribing trends, many of the other core elements are not performed, rendering the program essentially ineffective. It is imperative that all of the requirements of the core elements are implemented and evaluated in the inpatient setting so that those antimicrobial stewardship programs can serve as a template, which can be adapted and utilized in various other settings.

Critique of the Literature

While the current literature surrounding antimicrobial resistance is overwhelmingly vast, more research needs to be conducted in the form of statistical analysis utilizing data from antimicrobial stewardship programs. Older studies have shown consistent correlations between prescribing trends and subsequent trends in resistance. Unfortunately, much of the more current research takes the form of systematic reviews, which discuss results from studies no longer considered to be current. Therefore, although hospitals may hesitate to invest the immense amount of time, energy, finances, and manpower, the return on investment should speak for itself as direct excess healthcare cost decreases as a direct result of the program.

Another area for further investigation includes researching various settings in which antimicrobials are prescribed, as the majority of studies are performed within the inpatient setting. Just as hospitals may hesitate to invest, so too will other settings in which the cost-benefit analysis may not be as evident. Exploring different ways to shape the antimicrobial stewardship programs to meet the needs of various settings would prove beneficial.

The purpose of this project was to explore current antimicrobial prescribing trends for respiratory infections at an urgent care facility. The research question motivating this project was: What are the antimicrobial prescribing trends for respiratory infections at an urgent care facility as compared to the national average?

Theoretical Framework

The ACE Star Model of Knowledge Transformation (Stevens, 2004) was utilized to serve as a guide in conducting this research study. The model was primarily developed to address obstacles to the thorough utilization and implementation of ever evolving evidence-based practice (EBP). Two overarching hurdles were identified: the complexity of knowledge, including volume, and the form of the knowledge available (Stevens).

The theory guides the understanding of the evolution of knowledge in all of its forms, cycles, and characteristics. Furthermore the theory lays a framework for seamlessly integrating newly acquired knowledge with older concepts. The model depicts various stages of the evidence-based practice processes that occur as new knowledge is discovered and transformed into practice (Figure 1). The five-step model represents a systematic approach to putting evidence-based practice processes into effect.

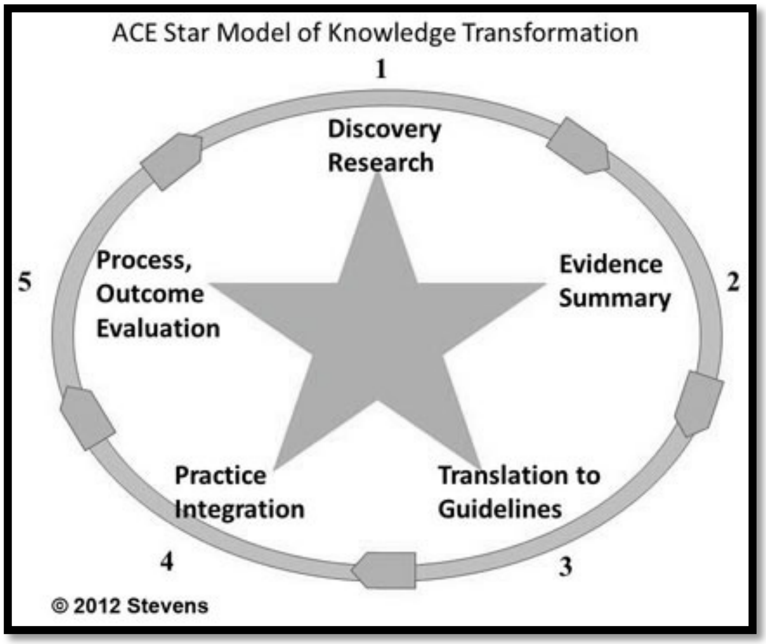

Figure 1. Ace Star Model of Knowledge Transformation.

Stevens (2004) stated, "Not only is the volume of literature a hurdle, but the *form* of the knowledge is a hurdle as well. Literature contains a variety of knowledge forms, many of which are NOT suitable for direct practice application" (p. 1). Using a model that utilizes a step-wise system of checkpoints, vast amounts of information can be organized into something of value to clinicians and employed as a new frame of reference for clinical decision-making.

In a campaign by the CDC (2014a) to improve antibiotic prescribing practices, a model was instituted to help incorporate necessary change. The model, in striking resemblance to the ACE Star Model, also contained five steps arranged in a star-like shape (Figure 2). In addition to providing the framework for integrating new knowledge into practice, the model was able to blend the research aspect with diagnosis-specific clinical guidelines that help clinicians with 'in the moment' decision making.

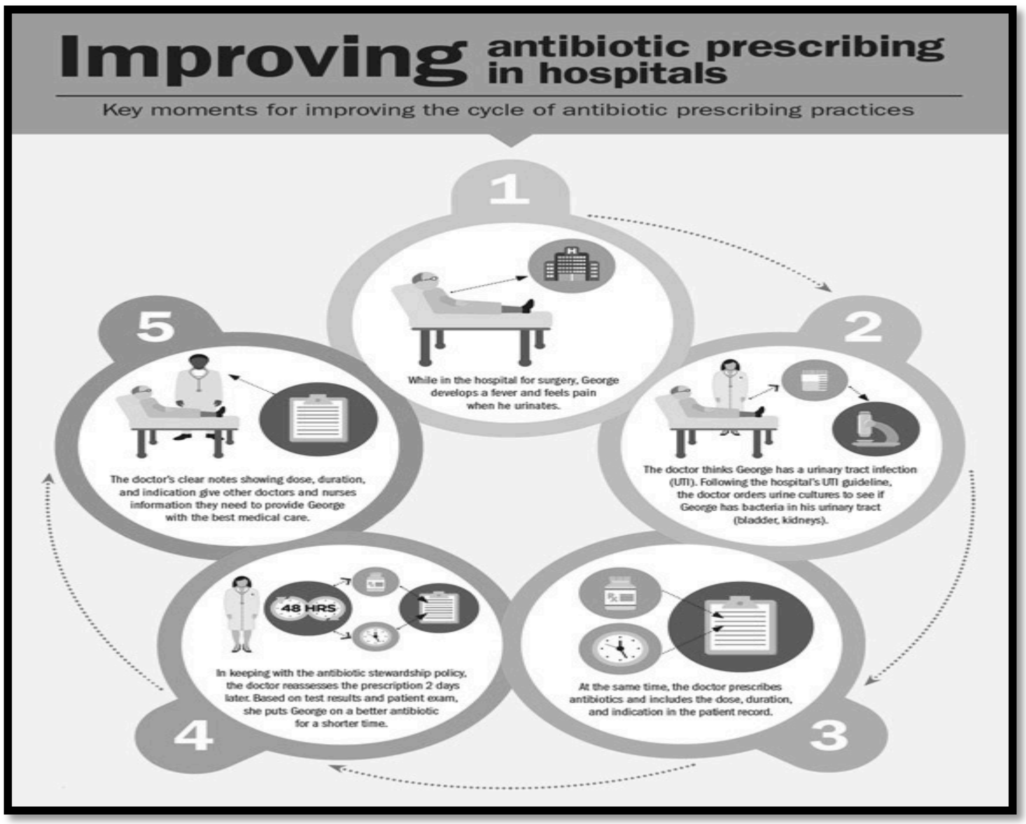

Figure 2. Improving Antibiotic Prescribing in Hospitals.

The ACE Star Model of Knowledge Transformation (Stevens, 2004) was extremely useful in guiding this research project. As antimicrobial resistance trends cycle and fluctuate so to must the prescribing practices that influence them. Given the ever-evolving nature of science, medicine and life, clinicians must embrace the never-ending opportunities for learning and find a harmony between intuition from experience and the advent of new organisms and drugs. Given that this research project focuses on one particular time frame, the model serves as an organizational tool for collecting massive amounts of continually changing information in a step-wise and incremental fashion. Utilizing this type of model will allow for seamless incorporation of and expansion upon the resulting conclusions.

Methodology

Purpose & Research Question

The purpose of this project was to explore current antimicrobial prescribing trends for respiratory infections at an urgent care facility. The research question was: What are the antimicrobial prescribing trends for respiratory infections at an urgent care facility as compared to the national average?

Background

The providers working at urgent care facilities face a unique set of barriers to prescribing due to the inherent nature of the practice. Such barriers encountered in the urgent care setting include lack of follow-up, time constraints, lack of insurance, and patient satisfaction and expectation. While it is the goal of all providers to follow evidence-based practice guidelines for antimicrobial prescribing, this may not always occur. It was not the purpose of this project to determine why overprescribing may occur, but rather to explore how often it was occurring.

Design

The design for the research project was a non-experimental retrospective chart review.

Site

The study was conducted at Concentra Urgent Care and Occupational Health in Warwick, Rhode Island. Concentra provides services to patients seeking treatment for non-life threatening illnesses and injuries. In addition, Concentra provides a wide-range of occupational health services to support employers in maintaining a healthy workplace.

Of the more than three hundred Concentra facilities across 40 of the 50 states, the Warwick, Rhode Island location is the busiest urgent care facility in the nation. This researcher did not have authorized access to site-specific census information as these documents are protected internally. However, based on the researcher's work experience and observation, approximately 30 to 70 urgent care patients are seen at Concentra Warwick each day, 363 days per year. Of those visits, the researcher estimated that roughly one-third of all visits are due to respiratory complaints. Urgent care patients may see any of the six medical doctors (MDs), two physician assistants (PAs), or four nurse practitioners (NPs) depending on the rotation of the schedule.

Sample

The inclusion criteria were the ICD-9 codes for the following diagnoses: cough; bronchitis; pneumonia; and upper respiratory infection (as characterized by acute bronchitis) for any adult patient seen between January 1, 2014 and October 1, 2014. Exclusion criteria included: pediatric patients; patients for whom symptom severity warranted a transfer to the hospital; and patients whom had multiple confounding diagnoses for which an antibiotic may have been prescribed. A maximum of 200 charts were approved for review.

Measurement

The researcher developed a data collection tool based on the literature and clinical experience that was utilized to collect and organize data. The tool included: age, diagnosis, ICD-9 code, symptoms, if there is an underlying diagnosis of COPD, if a CXR was performed, prescriber credentials, insurance status, if an antibiotic was prescribed, and if so whether or not the prescription was appropriate in accordance with the ACCP guidelines. Most importantly, the data analysis examined whether or not the patient met the criteria to warrant a prescription for an antibiotic. The specific criteria warranting treatment included: fever $\geq$ 38°C; respirations $\geq$ 24 breaths/min; heart rate $\geq$ 100; evidence of consolidation upon physical exam or confirmation of infiltrate on chest x-ray. A patient need not meet all the criteria in order to be diagnosed and subsequently treated appropriately, as every patient, immune response, and course of illness is different. Therefore, an only slightly tachycardic, afebrile patient that shows no signs of tachypnea may exhibit evidence of consolidation upon physical exam and subsequently have infiltrates on x-ray. As such, the inevitable variability in the guidelines due to inherent differences in patients may account for their overly wide interpretation.

To reiterate, this study did not focus on whether or not the patient was treated with the appropriate antibiotic or if the correct duration of antibiotic treatment was prescribed.

Procedures

The research proposal was shared with the Medical Director, Center Operations Director, Area Operations Director, Regional Operations Director, the Risk & Regulatory Committee, and the Legal Team at Concentra, a division of Humana. Verbal agreement was obtained from all parties and a written research contract was drafted by the legal department and was signed by the researcher and all necessary parties. Additionally, the research proposal was submitted to and approved by the Institutional Review Board (IRB) at Rhode Island College and Humana.

The researcher completed all data collection after IRB approval and before December 31, 2014. Charts were selected at random from the storage file room; charts meeting the inclusion criteria were used to derive the sample. A master list (Appendix A) paired each medical record number with a corresponding chronological number from one through seventy-five; only the chronological numbers and not the medical record number appear on the actual data collection tool. This was done to ensure that the any and all of the data appearing on the data collection tool had been completely de-identified. The master list and data collection tool were kept on a password protected thumb drive and stored in a locked cabinet at the Concentra-Warwick facility. Only the researcher possessed the key to access the data.

Data Analysis

Basic descriptive statistics were utilized to analyze the antimicrobial prescribing trends within the clinic as compared to national averages. The ultimate measurement was percentage of patients for whom antibiotics were overprescribed. Additionally, correlations between patient demographic data, such as age and insurance status and prescribing tendencies, were also performed.

Results

A total of 200 charts were reviewed; 86 were excluded because they did not meet the inclusion criteria. Another 16 charts were eliminated as the patients were seen outside of the review timeframe of January 1, 2014 to October 1, 2014. After further review of the remaining 98 charts, an additional 23 charts were removed due to the potential confounding variable of multiple diagnoses for which antibiotics could have been prescribed. Thus, the remaining charts (n=75) were reviewed to identify the appropriateness of treatment.

The age range of the clients were from 19 to 87 with a mean of 41.7 years. Four percent (n=3) of the patients were uninsured. None of the charts reviewed contained any documentation pertaining to a history of COPD.

Fifty-six percent (n=42) of the patients were treated by medical doctors, 31% (n=23) were treated by nurse practitioners and 13% (n=10) were treated by physician assistants. Of the 75 charts reviewed, 39% (n=29) of the charts revealed a diagnosis of bronchitis, 29% (n=22) revealed a diagnosis of upper respiratory infection, 24% (n=18) revealed a diagnosis of pneumonia; and 8% (n=6) with a diagnosis of cough.

A total of 17 patients were identified as having been prescribed antibiotics inappropriately; two of the three uninsured patients were included (66.67%). A breakdown of the prescribing trends specific to each credentialed prescriber group is illustrated in Table 1.

Table 1

Prescribing Trends by Prescriber Credential

Prescriber Credential	# and % of Patients Treated	# and % of Patients Overprescribed	Overall Percent of Overprescribing
MD	42 (56%)	12 (70%)	16%
NP	23 (31%)	3 (18%)	4%
PA	10 (13%)	2 (12%)	2.66%
Total	75 (100%)	17 (100%)	**22.66%**

As can be seen, MDs exhibited the highest rate of overprescribing and PAs the lowest. There was nearly a one-in-three chance of obtaining an unnecessary and unwarranted antibiotic from an MD in this sample. Proportionally speaking, MDs saw nearly twice as many patients as NPs and more than four times as many as PAs. Next, rates of overprescribing were further broken down by diagnosis (Table 2).

Table 2

Prescribing Trends According to Diagnosis

Diagnosis	# and % of Patients Overprescribed
Cough	1 (6%)
URI	1 (6%)
Bronchitis	15 (88%)
Pneumonia	0 (0%)
Total	17 (100%)

Of the 17 patients that received unwarranted antibiotics, none of the patients exhibited any of the ACCP guideline criteria for treatment. All 17 patients were afebrile, eupneic, normocardic, and without evidence of consolidation on physical exam. Despite normal exams, 53% (n=9) of these 17 patients went on to have chest x-rays, all nine of which were read as negative.

Summary and Conclusions

Approximately two million people in the U.S. are infected annually by organisms that have developed resistance to one or more of the antimicrobials designed to eradicate them. Roughly 23,000 of those people will succumb to drug-resistant infections; this is in addition to the tremendous number of lives lost due to conditions complicated by the infection (CDC, 2013). Nearly 250,000 people each year are hospitalized for Clostridium difficile infections, with the majority of cases attributed to antibiotic use as a predisposing factor. It is estimated that at least 14,000 people die each year as a result of this particular type of infection (CDC, 2013).

Ranking highest among categories of illness for which antibiotics are most commonly overprescribed is respiratory infections (CDC, 2014a). Each year, roughly $1.1 billion dollars is spent on the estimated 41 million unnecessary antibiotic prescriptions for patients experiencing viral respiratory tract infections. This does not include the excess healthcare costs related to the adverse effects and complications of unwarranted pharmacotherapy (Fendrick et al., 2003).

Though the issue of antibiotic resistance is a worldwide concern, the already overburdened US healthcare system finds itself particularly affected by the considerable amount of avoidable cost. Antibiotic resistant infections, as compared to those easily treated with antibiotics, necessitate additional or lengthier treatments, longer hospital stays, more attention from healthcare workers, increased utilization of healthcare dollars and are associated with greater morbidity and mortality. Though difficult to calculate, estimates reveal that up to 20 billion dollars annually has been appropriated for excess health care costs, with an additional 35 billion dollars in costs to society for lost productivity of the workforce (Infectious Diseases Society of America, 2010). These figures become particularly striking when taking into account that nearly 50% of prescribed antibiotics are unwarranted or ineffectual as prescribed (CDC, 2013).

The inappropriate use of antimicrobials and the evolution of multi-drug resistant organisms continues to be a significant problem despite acknowledgment of the problem and familiarity with guidelines. The purpose of this project was to explore current antimicrobial prescribing trends for respiratory infections at an urgent care facility. The research question motivating this project was: What are the antimicrobial prescribing trends for respiratory infections at an urgent care facility as compared to the national average? The ACE Star Model of Knowledge Transformation (Stevens, 2004) was utilized to serve as a guide in conducting this research study. The model was primarily developed to assist when the sheer complexity and volume of knowledge alone becomes an obstacle when trying to sort through ever-evolving evidence-based practice. It serves as reassurance that at any time new information can enter in the perpetually revolving door of information processing, and can do so seamlessly, as this process will never be linear.

Exceptionally thorough and detailed guidelines have been developed by the ACCP to assist clinicians with an evidence-based approach to optimal management of chest infections (Irwin, 2006). While these guidelines serve as a reference tool for clinicians, they have not been updated since 2006 and are largely subject to interpretation as patients' can have wide variability in clinical presentation.

Perhaps a partial solution to the inherent outdated nature of guidelines, due to the large consumption of time dedicated to their compiling, would be to impose and uphold a mandatory proportion of antimicrobial pharmacology continuing education credits for all prescribing clinicians regardless of credentials. The education campaign can be spearheaded by the advanced practice registered nurses (APRNs) within the organizations that partner with the CDC to champion this cause. Organizations such as the ACCP can utilize their APRN members to transform change and disseminate pharmacological updates, threat reports, and news of emerging multi-drug resistant organisms.

While APRNs are capable of functioning using the upstream approach to educate and reduce the prevalence of inappropriate antimicrobial prescribing, much damage has already been done and as such APRNs must also function using the downstream approach as well. That is, APRNs must also be able to deal with the present effects of years worth of overprescribing. One of the ways in which this can be achieved is by research, development and innovation on behalf of the pharmaceutical industry. Unfortunately, antibiotics are relatively inexpensive drugs and consequently of little to no profit or interest for pharmaceutical companies. Therefore, it is imperative for APRNs to lobby on a national level on behalf of healthcare, healthcare dollars and in the best interest of patients.

In this study, the rate of overprescribing at the study site was found to be approximately 22.66% as compared to the national average of 50% (CDC, 2013). Of the 17 patients that received unwarranted antibiotics, none of the patients exhibited any of the

ACCP criteria for treatment. All 17 patients were afebrile, eupneic, normocardic, and without evidence of consolidation on physical exam. Despite normal exams, 53% (n=9) of these 17 patients went on to have chest x-rays, all nine of which were read as negative. Despite a low representation within the sample size, it is nevertheless noteworthy that 66% (n=2) of the uninsured patients were included in the total of patients (n=17) treated with antibiotics despite not meeting any criteria. Given the exceptionally small sample size correlations cannot be determined, however correlating overprescribing and insurance status would be an area for further exploration in both quantitative and qualitative studies to determine if rates of overprescribing to the uninsured are statistically significant and if so, why?

MDs exhibited the highest rate of overprescribing and PAs the lowest. There was nearly a one-in-three chance of obtaining an unnecessary and unwarranted antibiotic from an MD in this sample. Proportionally speaking, MDs saw nearly twice as many patients as NPs and more than four times as many as PAs and perhaps this could, in part, account for the higher percentage of overprescribing. Clinicians in this setting faced a unique set of challenges and barriers to prescribing appropriately. Not only do they experience time constraints, patient satisfaction and expectation responsibility, prescribing fatigue, and limited resources, but also on the forefront of these obstacles is the lack of continuity and follow-up with patients.

Taking into account the retrospective design of the study, the information obtained from the chart was limited to what was documented and was assumed to be adequate and accurate. The study was also limited by the small sample size, limited examination of variables, including ethnicity and gender, and inability to include date of service as a potentially confounding variable, as time year/season causes fluctuations in antimicrobial prescribing (Sun et al, 2012). Additionally, the urgent care setting is faced with inherent limitations such as an implausibility to perform sputum cultures due to time, follow-up and equipment.

Integrating an APRN to the study site's newly formed infection control panel would assist in the identification and prevention of problem areas, review and critique of current literature, development of resources and staff support tools, as well as implementation of changes in practice in accordance with clinical practice guidelines to enhance patient outcomes. Perhaps with further exploration and careful assessment and planning, reduction of rates of overprescribing could be achieved within this facility through increased clinician support and the implementation of prescription monitoring such as antimicrobial stewardship.

Recommendations and Implications for Advanced Practice

While healthcare providers are nearing maximum potential in the ability to treat infectious diseases, organisms are evolving faster than the antibiotics manufactured to treat them. While the number of lives saved by antibiotics is undoubtedly staggering, so also is the steadily increasing number of lives lost due to the inefficacy, in part related to overuse of those same drugs. Decades of poor prescribing practices have paved the way for the rapid upsurge of drug sensitivities, allergic reactions, resistant infections and potentially fatal cases of diarrhea (CDC, 2014a).

While explaining the ins and outs of antimicrobial resistance may not be the go-to lecture for patients inquiring as to the whereabouts of their antibiotic, the current recommendation is to stand firm in the judicious selection of antibiotics and only treat when appropriate. The emphasis must now be on prevention of dangerous and potentially fatal sequelae from unwarranted antibiotic prescribing, whatever the reason for overprescribing may be. In a largely litigious society, defending non-action will always be more challenging than defending action because of the connotation of neglect or withholding. As such, judicious use of antibiotics will be a huge hurdle to overcome. Defensive medicine and other means of overprescribing will continue until and unless there is identifiable leadership at all levels of practice willing to establish change. Change must occur not only at organizational levels, but at local, state, and federal levels and also protect the clinicians whom are prescribing in the best interest of the patients.

Part of this change must incorporate much needed education for clinicians entering the field regarding the detrimental downstream effects of overprescribing.

Additionally, education and pharmacological updates must be readily available for seasoned prescribers. This education could be effectively incorporated into pharmacological continuing medical education requirements, as information surrounding antimicrobial prescribing is ever-evolving due to the nature of prescribing trends and bacterial evolution.

Calculating the current prescribing trends and overprescribing rates is the first step in acknowledging the issue within this particular setting. Much more progress needs to be made to address methods and strategies for resolution including the adaptation of a modified antimicrobial stewardship applicable to ambulatory/urgent care settings. Once rates of overprescribing are identified, perhaps a subject for future exploration could be examining opinions from prescribers as to why it continues. Additionally, correlations between overprescribing and age, gender, ethnicity, and insurance status could be explored.

Despite the urgency for solutions to the ever-growing issue of bacterial resistance, clinical research is still severely lacking with respect to randomized controlled trials. This dearth of research is attributed to the severity of illness in the effected population, as well as unwillingness of the pharmaceutical industry to fund such studies until new antibiotics, capable of eliminating multi-drug resistant organisms, have been developed (Infectious Diseases Society of America, 2010). Much of the stagnation with respect to antimicrobial resistance research is due to the lack of appropriation of funding and whether those funds should be allocated toward improving the old antibiotics or developing new ones. This lack of progress with evidence-based research serves to explain why current research articles and principles often cite older information and guidelines. Thus, it is important that the US FDA demand and expect studies of patients at high risk for developing multi-drug resistant infections (Paterson & Rogers, 2010).

Additionally, APRNs can partner with the FDA and legislators to push forward for legislation and policy in an attempt to prevent the perpetuation of the bacterial resistance cycle. For example, legislation was introduced March 2, 2015 by US Senators Susan Collins (R-Maine), Kirsten Gillibrand (D-N.Y.) and Elizabeth Warren (D-Mass.) (Breslow, 2015). The bill seeks to close a gap in guidelines set forth by the FDA in 2013 for drug makers to end the use of antibiotics in farm animals as a means for gaining weight (Breslow, 2015). The drug maker must end the use of the antibiotic unless they can prove that the use of the antibiotic in the farm animal will not harm human health (Breslow, 2015). The bill also aims to establish limits on how long medications can be used for preventing or controlling disease. The FDA approximates that 107 antibiotics either have no limit on how long they can be used or are labeled for continuous use (Breslow, 2015). Subsequently, the fear is that the longer an animal remains on an antibiotic the higher the risk for the development of a multi-drug resistant organism.

APRNs represent a powerful catalytic agent and when partnered with legislators can instigate immense change. APRNs have the unique opportunity to partner with these three US Senators to expand the authority of the FDA to discontinue certain antibiotics from use. This could very well be the beginning of the cycle of change. Expanded FDA authority may start with antibiotic use in animals, but eventually extend to consumption in humans. It could lead to randomized controlled trials; biopharmaceutical innovation;

antimicrobial stewardship; policy on the national level; and mandated pharmacological update continuing medical education (CME). The rise against bacterial resistance is beginning and APRNs need to be there every step of the way.

In striving to hold clinician prescribers accountable, an interesting subject for further evidence based research and practice would be examining the amount of time it takes for antibiotic therapy to be changed from broad spectrum to targeted therapy after clinicians review culture results. Research of this type could potentially result in a mandatory medication reconciliation after initial review and verification of any and all culture and sensitivities. Not only can APRNs champion the fight against overprescribing and multi-drug resistant organisms within their own organization and amongst their peers and patients, they can help push for new innovation by continually producing quality evidence based research such as the example above.

Resistance begins in the community and impacts resistance in the inpatient setting. In sum, a community's prescribing trends, especially shifting to broader spectrums of coverage in lieu of appropriately targeted therapies, impacts the level of resistance in that community. It then potentiates sicker people, with more resistant pathogens, who must seek care in hospital settings, thereby increasing prevalence of resistant organisms (Walker, 2012). In order to prevent this cycle from continuing, it is necessary to address factors contributing to inappropriate prescribing, non-adherence to prescribing guidelines and to meet these barriers with appropriate and well thought out strategies for resolution.

Regardless of how the resolution to this worldwide problem will come about, it will not happen without multi-disciplinary cooperation. APRNs are in a unique position to be able to act as leaders and educators on both sides of prescribing. APRNs must take the time to educate their patients, their patients' families, co-workers, peers, and anyone who will listen about why antibiotics aren't always the answer. Hopefully educating the masses will be more contagious than the multi-drug resistant pathogens that may one day infect them.

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Figure 1. ACE Star Model. Adapted from "ACE Star Model of EBP: Knowledge Transformation," by K. R. Stevens. (2004). Copyright 2004 by the Academic Center for Evidence-based Practice at The University of Texas Health Science Center at San Antonio.

Figure 2. Improving Antibiotic Prescribing in Hospitals. Adapted from “Making Healthcare Safer,” by Center for Disease Control. (2014). Copyright 2014 by the Centers for Disease Control and Prevention.

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Appendix A

Chart Number	**Medical Record Number**