ANTIBIOTIC STEWARDSHIP IN THE UNITED STATES: ANTIBIOTIC OVER-PRESCRIPTION, FACTORS ASSOCIATED WITH ANTIBIOTIC PRESCRIPTION, AND PEOPLE'S AWARENESS OF ANTIBIOTIC RESISTANCE

A Dissertation

by

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ABSTRACT

Antibiotics touch upon almost all aspects of our modern life. They contribute towards increasing life expectancy by reducing the negative outcomes of bacterial infections. Unfortunately, antibiotics tend to lose their effectiveness over time due to the emergence of antibiotic resistant bacteria. The overuse, misuse, and over-prescription of antibiotics all lead to the development of antibiotic resistant bacteria. This dissertation is a series of three studies that build on each other, each addressing different aspects of the human and organizational factors associated with antibiotic overuse, misuse, and over-prescription in the United States.

Study I: The first study focuses on the reasons for antibiotic over-prescription from the point of view of family medicine residents. This qualitative study strives to better understand why medical professional prescribe antibiotics in cases in which antibiotics are not necessary or not useful. The findings suggest that physicians' behaviors of over-prescribing antibiotics are affected by the organizational conditions within the medical practice including the use of an antibiotic control system and by patients' expectations.

Study II: The second study assesses the potential associations between the duration of visit with a doctor and antibiotic prescriptions for viral infections in outpatient settings. The assessment was done by utilizing National Ambulatory Medical Care Survey data. The results from multivariate logistic regression showed that for every additional minute spent with a physician during an office visit, the mean probability of receiving unnecessary antibiotic prescriptions decreased by 2.4%.

Study III: The third is a qualitative study of the general public's experiences and awareness of antibiotic overuse and antibiotic resistance. Focus groups conducted with twenty people who have traveled into the United States from countries with unrestricted

access to antibiotics revealed a paucity of knowledge and awareness of antibiotic resistance and appropriate antibiotic use that must be addressed for any antibiotic stewardship policy to be successful.

Despite the very restrictive policies overseeing antibiotic use in the United States, physicians tend to over-prescribe antibiotics and patients often insist on receiving a prescription. The findings of these studies show the need to educate patients through healthcare providers about the consequences of antibiotic overuse and misuse. This would curb the rate of antibiotic overuse, over-prescription, and subsequently, antibiotic resistance.

DEDICATION

This dissertation is dedicated to my parents, my brother, and the love of my life, Adnan

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NOMENCLATURE

ACS	Antibiotic control system
IDT	Infectious disease team
WHO	World Health Organization
CDC	Centers for Disease Control and Prevention
URI	Upper respiratory infection
IDSA	Infectious Diseases Society of America
AMA	American Medical Association
MDR	Multidrug-Resistant
TB	Tuberculosis
MRSA	Methicillin-Resistant Staphylococcus Aureus
VRE	Vancomycin-Resistant Enterococci
MSSA	Methicillin-Susceptible Staphylococcus Aureus
KPC	Klebsiella Pneumoniae Carbapenemase-Producing
CA-MRSA	Community-Associated MRSA
GT	Grounded theory
OTC	Over The Counter
TOEFL	Test of English as a Foreign Language
C. difficile	Clostridium difficile

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CHAPTER I

INTRODUCTION

1.1 Background

Antibiotics are used to treat bacterial infectious diseases such as tuberculosis, ear infections, gonorrhea, bronchitis (chest colds), and a host of other health conditions including skin infections, pneumonia, and meningitis.[1-3] Penicillin, the first antibiotic, was discovered by Alexander Fleming in September 1928. By the 1940s, penicillin was available for public use.[4] The average person's lifespan increased by fifteen years within five years of public access to penicillin.[5] During World War II, penicillin saved millions of lives, especially those of soldiers wounded during battle.[6] However, antibiotics are problematic when overused, misused, or over-prescribed.[7]

Overuse such as patients taking antibiotics for diseases of viral origin; misuse, including taking leftover antibiotics or not finishing the entire course of prescribed antibiotics; and over-prescription, when physicians prescribe antibiotics for diseases of viral origin, lead to spread of antibiotic resistance.[8] Antibiotic resistance is defined as a natural phenomenon in which bacteria evolve to survive in the presence of an antibiotic.[9] Multidrug-resistant (MDR), tuberculosis (TB), methicillin-resistant Staphylococcus aureus (MRSA), and vancomycin-resistant enterococci (VRE) are common antibiotic-resistant bacteria that have evolved from a controllable nuisance into a serious public health concern.[10] According to Llor, C. and Bjerrum, L (2014) antibiotic resistance is now a global public health challenge.[11]

This public health concern is not new. Already in 1945, Fleming called for a stop to the overuse of antibiotics; he warned of the consequences of antibiotic resistance.[8] These consequences have been realized across the globe. The World Health Organization (WHO) recently reported that the emergence of new antibiotic resistance has created a worldwide public health concern resulting in the death or disability of thousands of people who could have continued a healthy course of life.[12] For example, the emergence of bacteria resistant to the third generation of cephalosporin, a broad spectrum antibiotic, has been confirmed in Austria, Australia, Canada, France, Japan, Norway, Slovenia, South Africa, Sweden, and the United Kingdom.[13] The United States (US) is not exempt from antibiotic resistance. In 2013, the Centers for Disease Control and Prevention (CDC) reported that 23,000 people die annually as a result of antibiotic resistance.[14] Moreover, deaths related to Clostridium difficile, a hospital-acquired infection, increased 400% between 2000 and 2007, in part because a stronger, more resistant strain of the bacteria emerged. The total economic cost of antibiotic resistance to the US economy is estimated to be as high as 20 billion USD in direct healthcare costs, with additional costs to society for lost productivity as high as 35 billion USD a year.[14] The CDC's report shows that approximately 8 billion USD in hospital bills could be avoided over the next five years just by halting the spread of antibiotic resistance.[9,14]

Antibiotic-resistant infections typically occur in health care-related settings, such as hospitals and nursing homes where infections can spread quickly between patients who often have weak immune systems. Forty-seven to 79% of nursing home residents in the US receive at least one course of antibiotics per year,[15] and approximately 54% of the antibiotics prescribed in nursing homes were ordered without a doctor ever visiting the patients to evaluate the symptoms.[16] Some 25% to 75% of the antibiotic prescriptions in nursing homes

do not meet clinical guidelines for appropriate prescribing.[17] Thus, the development of antibiotic-resistant bacteria in such settings is likely related to overuse and over-prescribing practices there.[18]

Hospitals are no different. The CDC's report entitled "*Antibiotic Resistance Threats in the United States, 2013*" shows that more than half of all patients admitted to hospitals receive a course of antibiotics during their hospital stay.[14] In the US, 20–50% of all antibiotics prescribed in acute-care hospitals were unnecessary or inappropriate.[19,20] In total, in more than 10 million doctor visits annually, antibiotics were prescribed were for viral upper respiratory infections (URI). Furthermore, patients with resistant bacteria experience longer hospital stays; the median length of stay for patients with MRSA bacteremia, meaning the presence of bacteria in the blood, spent two days longer in the hospital than patients with methicillin-susceptible Staphylococcus aureus (MSSA) bacteremia.[21] Unless necessary action is taken quickly, antibiotic-resistant infections will continue to kill more than 10 million people a year around the world by 2050 while costing the world up to 100 trillion USD.[22]

Policies to combat antibiotic overuse are crucial in today's healthcare landscape. European countries have been successful in creating policies to oversee the prescription and use of antibiotics. For example, in 2001 France implemented a stewardship program entitled "*Antibiotics Are not Automatic Anymore*" and was able to reduce antibiotic prescription by 26.5%.[23] In 2015, the US issued a National Action Plan for combatting antibiotic resistance. This plan is designed to improve antibiotic stewardship in healthcare settings, prevent the spread of drug-resistant threats, eliminate the use of medically-important antibiotics for growth promotion in food animals, and expand surveillance for drug-resistant bacteria in

humans and animals by 2020.[24] The US needs to conduct more research to achieve the desired outcomes by 2020.

1.2 Purpose of the Research

The purpose of this dissertation is to shed light on our understanding of the human and organizational determinants of antibiotic resistance by answering four research questions in three studies. The research questions are as follows:

1. How do family medicine residents in an integrated health system describe antibiotic over-prescription?
2. In case of a viral origin disease, what is the association between time spent with a doctor during a visit and antibiotic prescription?
3. How aware are individuals about antibiotic resistance?
4. What are individuals' experiences of using antibiotics?

The results of the three studies help medical and public health professionals create targeted programs to reduce and prevent the spread of antibiotic resistance threats as part of the National Action Plan.

1.3 Framework of the Dissertation: The Antibiotic Smart Use Model

This dissertation investigatesthe human and organizational factors associated with antibiotic overuse, misuse, and over-prescription in the US. It focuses on decreasing antibiotic resistance rates in the US. From a health services point of view, determining the human factors in antibiotic resistance can result in enhancing the quality of care while simultaneously decreasing the cost of care and broader cost to society. For example, patients

infected with antibiotic-resistant bacteria have a median length of hospital stay 5 days longer than patients infected with nonresistant bacteria (36 and 31 days, respectively; $P < 0.0060$).[25] A longer stay results in lower quality of care and services due to financial considerations.[26] In addition, patients with infections due to antimicrobial-resistant organisms have ever higher costs (~6,000–30,000 USD) than patients with infections due to antimicrobial-susceptible organisms.[21] Therefore, by controlling the spread of antibiotic resistance, two main dimensions of healthcare services – quality and cost of care – can be improved.

The three studies conducted approached the topic from different angles. Chapter II, entitled "Toward a Better Understanding of Physicians' Perspectives on Antibiotic Over-Prescription: A Qualitative Study of Family Medicine Residents in an Integrated Health System in the South Texas," focuses on the reasons for antibiotic over-prescription from the point of view of family medicine residents. Chapter III, the second study, analyzes potential associations between the duration of a visit with a doctor and antibiotic prescriptions written for viral infections such as the common cold, runny nose, bronchitis, chest colds, the flu, sore throats, and fluid in the middle ear (otitis media with effusion) in outpatient settings. Chapter IV, the third study is a qualitative investigation of peoples' experiences and awareness of antibiotic overuse, and antibiotic resistance.

Introduced in 2007 by the World Health Organization, the Antibiotic Smart Use (ASU) program is an innovative model to increase the rational use of antibiotics worldwide and decrease overuse, misuse and over-prescribing. This conceptual framework is employed to tie together the three studies in this dissertation (Figure 1). Reducing unnecessary use of antibiotics in patients with the common cold, URIs, and sore throat was the main purpose of implementing the ASU model.[27] ASU focuses on understanding how prescribing practices

(supply side) and self-medication (demand side) affect the health of patients. The ASU model was built around two main points: First, at the time the ASU model was developed, few resources were available to fight the irrational use of antibiotics, which was and remains a rampant problem. Second, the concept of the rational use of medicines is not always translated into practice, and the ASU model was designed to bridge this gap.

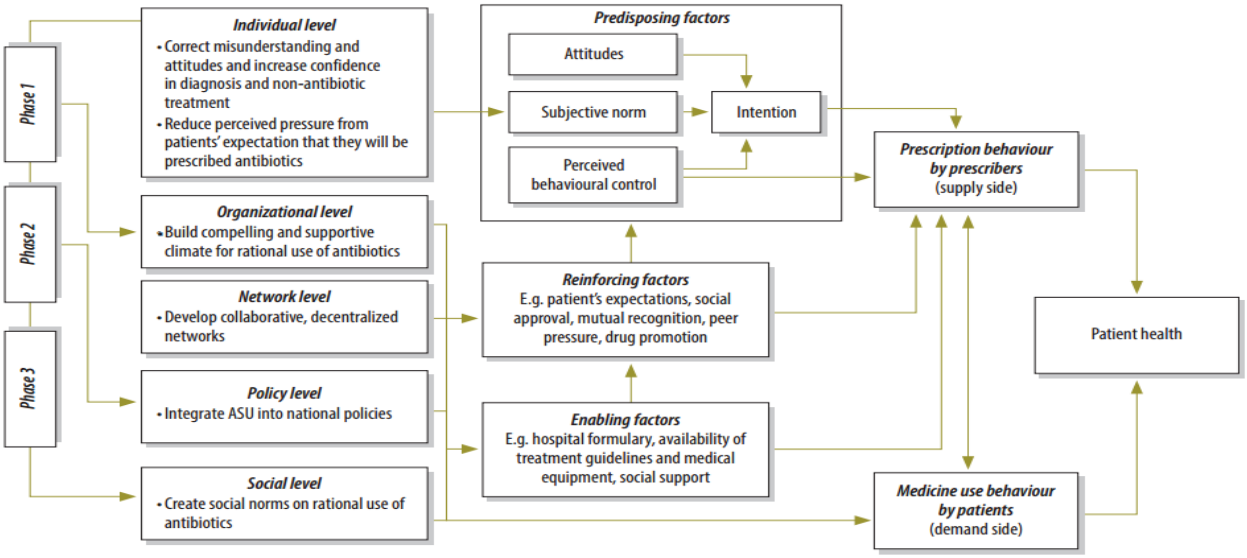

Figure 1—Conceptual Framework of the Antibiotics Smart Use Model[28,29]

The ASU model was first implemented in Thailand. In the Thai healthcare system, there is no divide between prescription and dispensing: Both physicians and pharmacists may prescribe and dispense antibiotics. Moreover, incentives to sell antibiotics are skewed since physicians and pharmacists benefit from selling antibiotics under a fee-for-service system. In addition, the consumer demand for antibiotics is high in Thailand. Due to these

circumstances, the ASU model was drafted with Thailand in mind, intended to change prescription practices and behavior among patients and healthcare providers alike.[30] . According to the ASU model, any changes in individual and organizational-level behavior will change the predisposing factor and, ultimately, the prescribing behavior of the professionals and the health of patients.

The first study aligns with the Thai test phase of the ASU model. Its results increase understanding of different factors that influence physicians' prescribing behavior. This improved understanding of why physicians are inclined to prescribe antibiotics in inappropriate situation allows public health officials to create more effective policies to help medical professionals change their prescribing behavior in order to improve patients' health.

The second phase of the ASU model addresses the effects of network and policy-level changes on prescribing any type of antibiotics. The ASU model indicates that inappropriate prescribing is more likely to occur when (1) physicians have a poor understanding of antibiotics, (2) physicians have a poor understanding of their role in disease management, and/or (3) patients pressure doctors to receive antibiotics. It also predicts that a decentralized network leads to improved doctor-patient relationships, which eventually causes improved prescribing behaviors and consequently improves patient health. The second study of this dissertation is designed to explore the association between the length of time spent with a doctor during a visit and the prescription of antibiotics for inappropriate ailments, and it coordinates with the second phase of the ASU model. National level data from the US were analyzed to find potential associations between time spent with a physician and antibiotic prescriptions. The hypothesis was that spending more time with the doctor during a visit might allow time to elaborate on available treatment options and their effectiveness which

might decrease the number of unnecessary antibiotic prescriptions. The second phase of ASU theorized that creating a decentralized network could allow the time to increase mutual respect between a doctor and patient, which in turn, could influence the prescribing behavior.

The third phase of the ASU model highlights the fact that moving social norms away from perceiving antibiotics as the first and only treatment for any condition decreases the rate of unnecessary antibiotic use and prescription. This can be done through public awareness campaigns both to the general public and to medical professionals. The message that ASU attempts to convey is that three conditions, namely URIs, acute diarrhea, and simple wounds, can be cured without antibiotics. This message gradually improves the public's understanding of appropriate antibiotic use and corrects the social norms toward antibiotics.

However, in order to challenge and change social norms and attitudes associated with antibiotic use, we must have a good understanding of those norms and attitudes. The third study in this dissertation examines people's awareness and experience of antibiotic use and antibiotic resistance. Since very little is understood regarding the social norms associated with antibiotic use, this study serves as starting point by focusing on a population with the most potential exposure to unfettered antibiotic access – people from countries with little to no regulation of antibiotics. Implementing any interventions to oversee antibiotic overuse and misuse in the US is unachievable without targeting the need of this group of people. Consequently, the third study aims to understand these needs and therefore, this study aligns with the third phase of the ASU model, which targets changing social norms and medicine use behavior in order to improve population health by curbing the antibiotic resistance rate worldwide.

1.4 Gap in Knowledge

Antibiotic misuse, overuse, and over-prescribing as well as the resulting antibiotic resistance are major public health concerns that demand immediate action. Previous research closely examines antibiotic prescription in hospitals.[31,32] However, few studies investigate the reasons behind over-prescription in such settings. Thus, the first study describes the reasons for antibiotic over-prescription from family medicine residents' point of view. This study is conducted in an integrated health system in south Texas.

Different studies highlight the factors associated with antibiotic over-prescription such as race, age, ethnicity, and type of insurance, but less is known about potential associations between the time that a patient spends with a doctor in a visit and subsequent antibiotic prescription. Does spending more time with the patient and explaining the source of disease affect the prescription of antibiotics? The second study is designed to analyze possible associations between spending time in a visit and the possibility of prescribing antibiotics for viral origin diseases. This study will isolate the effect of other factors (such as patients' demographical information, type of payment, office location, physicians' characteristics) on antibiotic over-prescription in office based practices.

In seeking solutions to the problem of antibiotic overuse, targeting the users of antibiotics seems natural. Patients are just as responsible for the high prevalence of antibiotic use as doctors and should, therefore, patients must also be targeted for any interventions. Existing studies regarding developing antibiotic resistance do not point only toward doctors as a cause of antibiotic overuse, but they also recognize patients as a source of spreading resistant bacteria. The general public is not aware of the consequences of antibiotic overuse and antibiotic resistance.[33-35]

Little information is available for the general public on antibiotic resistance; one of the few examples is the Get Smart program by the CDC, which was launched in 2009 with the goal of educating and helping people with the rational use of antibiotics.[36] Considering the relative scarcity of public educational or informational resources regarding antibiotic resistance, the third study attempts to explore peoples' awareness and experience of antibiotic use and resistance focusing on a group of people with the most potential opportunity to be exposed to antibiotic misuse, overuse, and over-prescribing – people who lived in countries with high access to antibiotics and little to no regulation of antibiotic prescribing practices. This group of people have different experiences of antibiotic use back in their home countries that may contribute to the rate of antibiotic overuse in the US.

CHAPTER II

TOWARD BETTER UNDERSTANDING PHYSICIANS' PERSPECTIVES ON ANTIBIOTIC OVER-PRESCRIPTION: A QUALITATIVE STUDY OF FAMILY MEDICINE RESIDENTS IN AN INTEGRATED HEALTH SYSTEM IN SOUTH TEXAS

2.1 Overview of Study I

Research Question: How do family medicine residents in an integrated health system describe antibiotic over-prescription?

Significance of the Study*:* Unnecessary antibiotic prescribing can lead to antibiotic overuse and result in antibiotic resistance. Although clinicians are the point of contact for antibiotic prescriptions in the United States, relatively little is known about clinicians' perceptions of antibiotic over-prescription. Understanding antibiotic over-prescribing from the clinician's lived experience can enhance our ability to create targeted antibiotic stewardship interventions.

Conceptual Framework: This study addresses phase one, the test phase, of the Antibiotic Smart Use (ASU) model, which highlights the changes in individual and organizational levels of antibiotic prescribing practices necessary to promote antibiotic stewardship. According to the model, the following predisposing factors affect the prescribing behavior of physicians: attitude, perceived behavioral control, subjective norm, and intent. The main purpose of this study, in alignment with the assumption of the model, is to understand, from the physicians' viewpoint, how these predisposing factors influence their prescribing behavior. Understanding the manner in which these factors work will highlight

elements that can be adapted in order to change the prescribing behavior of physicians, which will eventually result in reducing mortality, morbidity, and costs associated with antibiotic resistance.

Participants: Sixteen family medicine residents working in an integrated health system located in the south of Texas participated.

Data Acquisition: Data were collected in individual interviews that were recorded. The interviews were then transcribed.

Study Setting: The integrated health system, which is one of the largest integrated health systems in south Texas, contains more than 20 community health centers, 5 school-based clinics, and 2 full service hospitals. Choosing an integrated health system provided an overview of how various different healthcare facilities operating under the same umbrella implement guidelines to oversee antibiotic prescription.

Study design: Research question dictated using qualitative methodology.

Study limitation: The data, collected solely from family medicine residents, did not yield a paradigm model.

Data Privacy: The Texas A&M University Institutional Review Board for Human Subjects approved this study in January 2015 (IRB number: 0238D).

Data Analysis: Grounded theory designed by Katy Charmaz was used to analyze the data. Grounded theory (GT) is a systematic methodology in the social sciences, developed by Glaser and Struss (1976), involving the construction of theory through the analysis of data.

Results: Eight subthemes emerged from the data. These subthemes were grouped into three overarching themes, two of which focus on factors that encourage antibiotic over-prescribing and thereby limiting antibiotic stewardship and one of which highlights a factor

that encourages antibiotic stewardship, thereby potentially limiting antibiotic over-prescribing. Each overarching theme is assigned a number, and each subtheme is given a letter. The first two themes highlight that over-prescription of antibiotics occurs in part due to (1) contextual factors associated with clinical practice such as (a) a busy schedule with little time to educate patients and (b) a clinical panel with a case mix of vulnerable populations; and (2) patients' perceptions of antibiotics, such as the view that antibiotics are the main treatments for all kind of infections, leading to (c) patients' insistence on receiving antibiotics. A variety of (d) information sources such as websites and family members' advice shape patients' perceptions of the use of antibiotics, eventually affecting (e) the doctor-patient relationship. The third theme points to how antibiotic stewardship programs could potentially affect clinician prescribing practices. The clinicians participating in the study mentioned a local antibiotic control system (3) consisting of (f) a computer prompt which alerted the residents whenenver they prescribed an antibiotic, (g) prescription approval by the hospital's infectious disease team (IDT) when prescribing broad-spectrum antibiotics, and (h) laboratory tests to identify the origin of the disease.

Conclusions: Working hurried schedules with a vulnerable patient panel could lead clinicians to over-prescribe antibiotics based on a 'better safe than sorry' practice of medicine. Patients' perceptions of when they should receive antibiotics, which stem largely from various sources of information (e.g. online sources), can play a major role in over-prescribing antibiotics as patients pressure already taxed clinicians into providing antibiotics. However, an antibiotic control system could mitigate these influences and lead to more appropriate prescription of antibiotics and improved antibiotic stewardship.

2.2 Introduction

Every year, approximately 2 million people in the US acquire serious infections from bacteria that are resistant to one or more of the antibiotics designed to treat those infections. Antibiotic resistance is a natural phenomenon in which bacteria gain the ability to go through mutation process and withstand the effect of an antibiotic.[14] The first signs of penicillin (the first antibiotic) resistance due to overuse, misuse, and over-prescribing of antibiotics began to appear by 1947,[37] and by 1968, penicillin-resistant pneumonia began to spread across the world. The CDC's 2013 report entitled "*Antibiotic Resistance Threats in the United States, 2013*"[7] shows that at least 23,000 people die each year as a direct result of antibiotic-resistant infections in the US.

Exposure to specific antibiotics is linked to the development of certain strains of antibiotic-resistant Clostridium difficile (C. difficile), one of the fastest growing superbugs.[38,39] At least 250,000 people each year require hospital care for C. difficile infections.[7] In addition to C. difficile, several other strains of antibiotic-resistant bacteria have been identified in the US, including MRSA, VRE, MDR-TB, and klebsiella pneumoniae carbapenemase-producing bacteria (KPC).[40,41] In total, 20,000 people in the US are infected with VRE every year, resulting in about 1,300 deaths;[7] 80,461 people get infected with MRSA annually, and 11,285 die as a result.[14] In 2014, 480,000 people were infected with MDR-TB, and 190,000 of them died from it.[42] Direct costs associated with MDR-TB are estimated to be as high as 134,000 USD per patient, compared to 17,000 USD per patient for non-MDR-TB infections.[43]

The risk of contracting an antibiotic-resistant bacterial infection was initially limited to in-patient settings. From the 1970s to the 1990s, hospital-acquired antibiotic-resistant

infections were the main undesirable outcome of antibiotic overuse, misuse, and over-prescription. From 1989 to 1997, among hospitals participating in the CDC's National Nosocomial Infection Surveillance System, the percentage of enterococci recorded as resistant to vancomycin increased from 0.4% to 23.2% in intensive-care settings.[44] In 2003, the percentage of hospital-onset Staphylococcus aureus infections that were methicillin-resistant reached 64.4% in the US intensive care units.[45] As a result, interventions to reduce the rate of antibiotic-resistant infections focused on hospital infection control protocols.[46,47] However, recent years have seen a rise in the rate of antibiotic-resistant infections in the community, outside hospitals and other inpatient settings.[7]

Today, antibiotic-resistant infections transmitted throughout the community include tuberculosis and respiratory infections caused by Streptococcus pneumonia, skin infections caused by MRSA, and sexually transmitted infections such as gonorrhea.[14] Community-associated MRSA (CA-MRSA) strains appear to have rapidly spread among the general population in most areas of the US and affect patients with and without exposure to inpatient healthcare.[48] In some regions, CA-MRSA isolates account for 75% of community-associated Staphylococcus aureus infections in children.[49] This increase in community-acquired antibiotic-resistant infections and the resulting rise in morbidity, mortality, and costs associated with these infections has prompted a new focus on community-wide antibiotic stewardship. In the US, antibiotics are only available to the community by prescription after consultation with a medical doctor. Thus, any intervention or policy intended to reduce the rate of community-acquired antibiotic-resistant infections must include prescribing clinicians as a target population.

In studying the misuse, overuse, and over-prescribing of antibiotics, scholars have focused primarily on patients' expectations and satisfaction.[50,51] Less is known about the physicians' perspective, although physicians are the ones who prescribe the antibiotics. The main goal of this study is to explore physicians' points of view on prescribing antibiotics in an integrated health system. The research question guiding the present study was

1. How do clinicians experience antibiotic over-prescription?

2.3 Methods

2.3.1 Study Design

Qualitative research is an interdisciplinary field of study including different perspectives and practices for generating knowledge.[52] The research question of this study dictated the use of qualitative methodology.[53] Semi-structured interviews were conducted to understand family medicine residents' experiences with antibiotic over-prescription. The researcher followed a set of instructions to generate reliable, comparable qualitative data. Grounded theory (GT) was used to analyze the data. The main purpose of employing GT was to use inductive data to construct abstract analytic categories through an iterative process.[54]

2.3.2 Positionality

As a researcher, I chose a social constructivism epistemological approach because research shows that people experience multiple subjective realities as opposed to one single objective reality.[55] Therefore, reality is only understandable through interactions between people. This approach also helps researchers to understand the social meaning of interactions between the researcher and the participant. According to social constructivism epistemology,

the only way to perceive social reality is from the perspective of people who are enmeshed within it.[55] Charmaz's GT method is supported by social constructivism epistemology.

2.3.3 Recruitment and Participants

Prior research focuses on factors associated with antibiotic prescription by office-based physicians;[56,57] however, less is known about this issue in hospital settings. Rutschmann and Domino (2004) found that in hospitals, patients seeing family physicians were more likely to receive antibiotics than those seeing general internists.[58] Thus, the current study explores family medicine residents' perceptions of antibiotic over-prescription in hospital settings. Residents were selected over practitioners because residents, by virtue of their ongoing training, have to work in different hospitals and clinics within a health system, while family practitioners are usually constrained to the settings in which they choose to practice. Therefore, family medicine residents should have a broader understanding of the guidelines and stewardship programs that a healthcare system implements to oversee antibiotic prescription.

Purposive sampling of family medicine residents was used.[59] Purposive sampling is a non-probability sampling method that attempts to gain representative sample data by including members of a specific population with pre-defined characteristics in a sample. The inclusion criterion was that the individuals needed to have been in the residency program for at least two years prior to participation. The reasoning is that residents in the first year might not be as familiar with the various guidelines that the facilities implement to oversee antibiotic prescription, but by the time they complete the second year of residency they should be comfortable with the existing guidelines and stewardship programs that the system

utilizes to regulate prescription of antibiotics. Furthermore, second-year family residents may have encountered or experienced more incidents of antibiotic over-prescription than first-year residents.

I chose family residents who worked in an integrated health system in south Texas at the time of data collection. This healthcare system is one of the largest integrated healthcare systems in south Texas, and it concentrates mainly on primary care and prevention. To maintain anonymity, characteristics such as age from which identities of participants could be inferred are not reported.

2.3.4 Theoretical Sampling

The question of how many interviews a researcher should conduct is pervasive in qualitative research and yet remains contested. There is no exact answer for such this question. Charmaz argues that the researcher is unlikely to know what is necessary until data analysis begins.[54] For the current study, interviews were conducted until the "saturation level," the point at which more data added little or no new information because participants began to repeat what others had previously contributed.[60] In this study, 16 interviews were conducted, at which point it becamse clear that the saturation point had been reached.

2.3.5 Interview Process

Interviews were conducted in February 2015. Informed consent documents were provided to each participant in writing before each interview (IRB number: 2015-0238D). Each interview lasted 30–45 minutes. All interviews were audio-recorded, resulting in approximately 10 hours of audio recordings, which were then transcribed.

2.3.6 Interview Protocol

Three main questions and three follow-up questions—a total of six open-ended questions—were asked during each interview (Table 1). The questions focused on residents' reasons for prescribing antibiotics, the patients' role in prescribing antibiotics, differences between inpatient and outpatient settings with regard to antibiotic prescription, and guidelines to curb antibiotic resistance. Open-ended questions were used to encourage participants to raise issues that they consider important.

Table 1—Interview questions

1. How do you describe the phenomenon of antibiotic over-prescription?
2. How do you explain the reasons behind over-prescription?
3. What is the patient's role in over-prescription of antibiotics? *Probe*: How do you describe using the internet and online sources to search the disease symptoms?
4. What are some practical ways to decrease the rate of unnecessary antibiotic prescription in hospitals?
5. How do you differentiate antibiotic prescription in hospital and office-based settings?
6. Is there anything else you would like to add that I did not cover them in the previous questions?

2.4 Data Analysis

The data were analyzed using a GT method designed by Charmaz.[60]. From a GT perspective, main themes emerge from the participants' narratives. Thus, the themes surface from the data rather than a researcher imposing them on the data. According to Charmaz, to analyze data using GT, three steps are necessary: Initial coding, focused coding, and theoretical coding.

1. Initial coding. Coding is the link between collecting data and developing a theory to explain the data. In qualitative research, the codes take form together as elements of an emerging theory that explains these data and direct further data gathering. Charmaz (2014) argued that coding means naming segments of data with a label that simultaneously categorizes, summarizes and accounts for each pieces.[54] Therefore, as a first step, after reading through the transcript, I started analyzing the data using an initial coding method. The main purpose of initial coding is exploring theoretical possibilities in the data. I defined a label for each line, and proceeded with the initial coding process until I reached the last line of the transcript.

2. Focused coding. Focused coding relates categories to subcategories and specifies the properties and dimensions of a category.[54] In this stage, I put the data back together as a whole and used the initial coding results to apply analytical frames to the data.

3. Theoretical coding. This is the last stage of building model in Charmaz's grounded theory method. The main purpose of this stage is to help the researcher to specify possible relationships between categories that have been developed through focused coding process. [54] As a last step of data analysis, I found the relationship between categories to define a core category (phenomena) for the theoretical model.

Charmaz also points out that researchers need to be aware of their preconceptions as they code the data.[54] In order to avoid the influence of the researcher's preconceptions during data analysis, Charmaz suggests "writing memos" throughout the data collection and data analysis. She asserts that memoing is the single most effective mechanism for raising the data to a conceptual level.[61] Thus, in order to put aside personal experiences and perceptions that

might bias interpretation of the data, the researcher wrote memos to put aside pre-existing knowledge during data collection and data analysis.

2.5 Results and Discussion of the Main Themes and Subthemes

The analysis revealed eight subthemes that could be grouped into three overarching themes. These are described below; each overarching theme is assigned a number, and each subtheme is given a letter. First, the participating residents indicated that (1) over-prescription results from the conditions in which they practice medicine in this healthcare setting, specifically (a) having a busy schedule and (b) treating large numbers of patients from vulnerable populations. The data also showed that (2) the residents perceived patients as having a key role in the prescription of antibiotics. The residents observed that a variety of (c) outside information sources such as websites and family members shape patient's perceptions of antibiotic use, which eventually affect (e) the doctor-patient relationship. Additionally, the residents all discussed the integrated health system's (3) antibiotic control system (ACS), which consists of (f) a computer alert system which reminds physicians to prescribe right antibiotics for the right duration (g) a requirement for prescription approval by the system's infectious disease team for sensetive antibiotics, and (h) laboratoraty tests to ensure whether prescribing the antibiotic is appropriate. Figure 2 shows the overarching themes and subthemes.

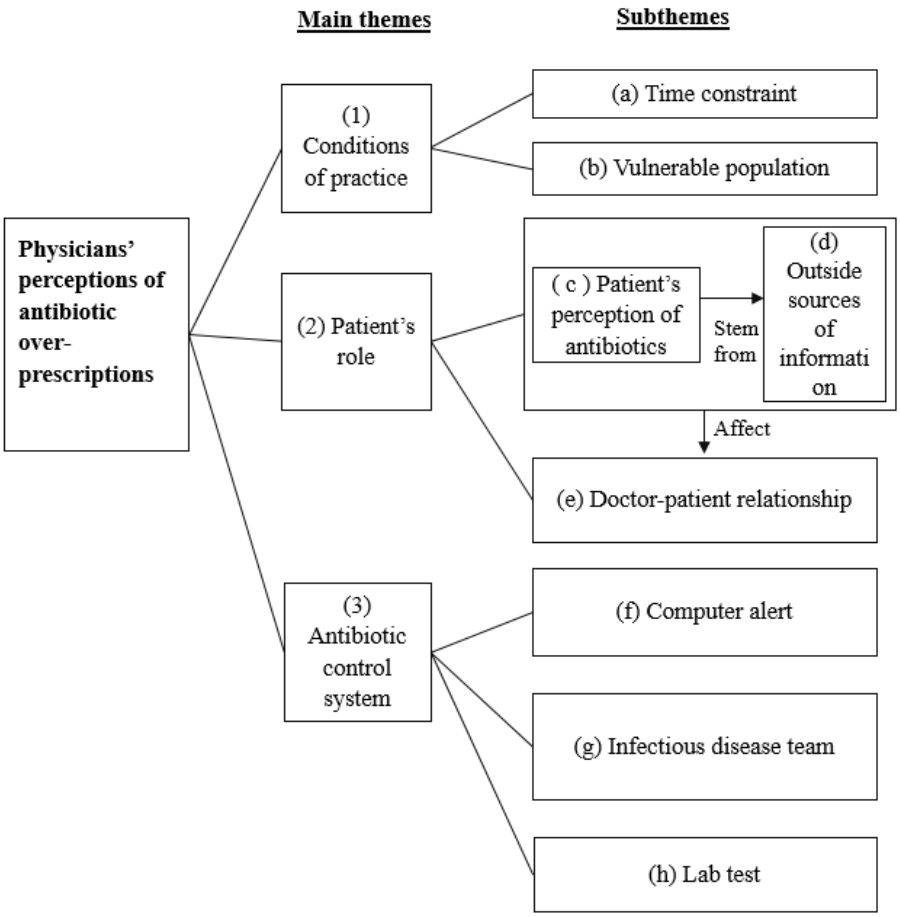

Figure 2—The Relationships Among the Main Themes and Subthemes

The main themes and subthemes are discussed below according to the order of the diagram in Figure 2, and examples from the data are included.

1. **Conditions of practice**. Conditions of practice that residents said predisposed them to antibiotic overuse included having a busy schedule and treating a vulnerable population or a population at risk (risk of developing more severe diseases).

(a) Time Constraints

Almost all participants said that a major factor in over-prescribing antibiotics was the limited time with each patient. They said that in the hospital, residents must perform many

duties in a short period of time; thus, because of time constraints, explaining the cause of the disease in detail and convincing patients to refrain from taking antibiotics is often impractical, so residents tend to go for the quick solution. One participant said, "Sometimes there is no such time to convince the patient that the cause of the disease is more likely a viral infection and there is no need for antibiotics." Another said, "Sometimes doctors know that the disease may not be a bacterial infection, but they may not have time for follow up with the patient, usually because the schedule is overbooked with other patients that have more critical conditions. So, they prescribe antibiotics to be on the safe side."

(b) Populations at Risk

The residents often work with vulnerable populations, including children (under 6 years old), senior citizens (over 65 years old), and other people with increased susceptibility to disease such as cancer and HIV^+ patients. Several participants said that they sometimes prescribe antibiotics as a precaution or to prevent worst-case scenarios. For example, one said:

> Three days ago we had an 87-year-old patient with leukemia and fever, but our team was not able to find the source of infection. We put her on three different types of antibiotics, because we were afraid that her condition may deteriorate. What if she goes to septic shock, which is really life threatening for a patient like her that has defective immune system due to leukemia and chemotherapy.

Another participant stated, "When I am not quite sure whether antibiotic is necessary or not, I go with patients' ages; in elderly population and children I would like to be more cautious."

Analyzing participants' comments regarding the conditions of practice in the over-prescription of antibiotics: The participants mentioned that the conditions under which they work influence their prescribing practices. This finding is consistent with previous research.[62]

Physicians' busy schedules greatly affect antibiotic prescription. Prior research mentioned the lack of adequate time as a main reason for over-prescription.[63-65] The physicians in Butler and colleagues' study [62] said they lacked time to explain the distinction between viral and bacterial sources of infections to the patients, especially those insistent on receiving antibiotics; therefore, they preferred to simply prescribe antibiotics at the outset. Another study found that physicians with a high volume of patients and limited time were more likely to prescribe unnecessary antibiotics for viral respiratory infections.[63] In the present study, participants were residents with tight schedules that left little time for explanations. This situation might differ for physicians in other settings or at other career stages; even so, the results here agree with previous studies. The differences in our results and previous research might stem from utilizing different method of data collection; this study used semi-structured interviews, which allows participants to give information that might not have been collected in other forms of data collection.

Antibiotic prescriptions also increase when a patient belongs to a population at risk. For example, Resi et al. found that in a single year in northern Italy in 52.9% of 211,257 appointments with children aged one to fourteen years, doctors prescribed at least one course of antibiotics for a total of 511,270 antibiotic prescriptions, and the percentage decreased with age.[66] At the other end of the age spectrum, research by Lee and colleagues showed that antibiotic prescriptions increased by 68% for older adults in the United States between 2000 and 2010.[67]

2. **Patient's role.** All participants said that patients' perceptions are a major driver of antibiotic over-prescription; in fact, that patients' demands for antibiotics is the most common reason for prescribing them. Most of these demands stem from outside sources so

that patients come to the doctor with prior knowledge and beliefs that cause them to think they need antibiotics to treat their health problems. The participants explained that these perceptions come from a variety of sources, including online sources and family members (outside sources of information). When the patients' expectations for antibiotics are not met, the doctor-patient relationship is negatively affected.

(c) Patient's Perceptions: Prior Beliefs

All participants indicated that patients' demand for antibiotics is the most common reason for prescribing them. One participant said, "Sometimes it is really hard to convince some patients that it's a viral infection, and you don't need to be on antibiotics. Patients insist on getting one."

Another participant said that as she gained more practice experience, she concluded that discussing patients' health problems in detail was unproductive. Thus, she said she refuses to clarify antibiotic use and overuse to patients: "In the beginning of your medical practice, you explain everything in detail to patients, but at the end of the conversation you will notice that some patients still insist on getting antibiotics. After a while in your busy practice, you may find it more practical to prescribe antibiotics to these kind of patients." Some physicians feel discouraged because patients tend to stick to their own ideas and are reluctant to accept doctors' justifications for their choices.

(d) Outside Sources of Information

Outside sources can be helpful to patients for informing themselves about many medical issues, treatments, and more. Unfortunately, often they do not give patients a full, scientifically correct picture of the situation. The two main outside sources are people the patients know such as family and friends and the media and internet.

Family members' experiences can also affect patients' perceptions about antibiotics. For example, one participant stated, "Sometimes patients come to us and say, 'my sister or brother had the same symptoms, and their doctor prescribed antibiotics, and they feel better now. Why shouldn't you prescribe me any antibiotics?'"

Five participants said the media can play a vital role in increasing people's awareness of antibiotic resistance and thus changing people's attitudes toward antibiotics. One participant said: "[The patient] was sitting in front of me and kept telling me that 'I need antibiotics.' You know, nowadays, patients are more worried to have infections than antibiotic resistance because people learn from media that infections are worrisome. I wonder: does the media teach them anything about antibiotic resistance?"

Another participant said the media can shape people's attitudes toward antibiotic use and raise awareness about the dangers of antibiotic overuse: "Here in America there is not enough learning through media about antibiotic-resistant bacteria, or maybe there is, but I never get a chance to watch TV [laughs]. They have different programs literally for *everything*, but you never see any program that talks about antibiotic-resistant bacteria."

The participants indicated that online information sources and online medical forums that have emerged in recent years have encouraged the overuse of antibiotics, particularly because the increased information leads patients to request new classes of broad spectrum antibiotics more often. These sources of information also can cause trouble in doctor-patient relationships by providing wrong or incomplete information:

> Nowadays, googling has become a rival for our profession. Let me give you an example: The other day a patient, a young lady, came to my office, and according to her symptoms she had a viral URI [upper respiratory infection], and I explained to her the diagnosis. After 10 minutes of explanations, she said, "Doctor, I googled it, and I am sure you have to prescribe me antibiotics."… I really don't think googling has the same effect on any other fields the way it does on medicine. It is just terrible.

Another participant stated, “Now, I got used to it: When they [patients] start asking me some weird questions, I know they have searched their symptoms before coming in.”

Several participants indicated that often patients obtain wrong answers from outside sources of information (e.g. online sources). For example one said: “You know, sometimes they really don’t know which terminology they should use for searching, and they come up with wrong answers.” Another participant said, “Some of these websites provide wrong information to the patients.”

(e) Doctor-Patient Relationships

Participants said that patients’ use of online sources (outside sources of information) to seek treatment information has led to a lack of trust between doctor and patient. They indicated that incomplete and wrong information can make patients unwilling to rely on their doctors. Three participants said that online information poses major problems in contemporary medicine. One stated

> Fifty years ago, when my dad was practicing medicine [the participant put this last word in air quotation marks] when his patients came to visit him, they trusted his diagnosis. Patients wanted to know what their diseases and the available treatments were; but now, when a patient comes to me, he/she has some incomplete knowledge of their diseases. I think [pause] they don’t trust doctors completely. If I don’t prescribe the antibiotic, they may go to another doctor to receive antibiotics, and sometimes the reason is that they got online information that [for example] methicillin is the best treatment for their disease.

Another participant said that

> Overall, people have more knowledge now than before, and they know what their disease is and what are the symptoms and what type of antibiotics could treat them. Most of the time when the patient comes to us, he/she has already searched about the symptom, she/he is just coming to get the antibiotics [laugh].

Moreover, all the participants said that if they do not prescribe antibiotics, the patient will seek a doctor who will do so. One said, “If I don’t prescribe antibiotics to my patients, they

will go and ask another family doctor for antibiotic. [Using antibiotics will cure their problem] is what they believe; I cannot change their beliefs."

Analyzing participants' comments regarding the patient's role in the over-prescription of antibiotics: In the current study, indicated that the physicians feel that patients' perceptions and expectations about doctors and antibiotics stem primarily from online sources, family members' attitudes, and sometimes other patients' opinions (outside sources of information). Such sources can definitely affect patients' beliefs and consequently affect the doctor-patient relationship negatively. MacFarlane et al. find that patients' demands lead doctors to prescribe antibiotics that doctors consider unnecessary.[68] Similarly, Coenen et al. (2006) observe that antibiotics are prescribed significantly more often when patients demanded them.[69] Scott and colleagues patients use a variety of tactics to influence doctors to prescribe antibiotics; for example, they may make direct requests, mention other patients' prescriptions, purposely report specific symptoms that require antibiotics, and note previous use of antibiotics for the same symptoms.[70] Butler et al. find that antibiotic-prescribing decisions often stem from the doctor-patient relationship.[64] These results agree with those of Butler at al.[64] and suggest another point: Patients' unwavering belief in wrong information can change the doctor-patient relationship by creating mutual distrust.

The current findings indicate that patients' perceptions can lead to over-prescription of antibiotics. Stearns at al. found a strong association between patient satisfaction and antibiotic prescription. In their study, when patients requested antibiotics, patient satisfaction increased when doctors prescribed them, regardless of the diagnosis or other factors.[71] The participants' perceptions in the present study seem to corroborate Stearns et al.'s results: The participants perceived that doctor-patient relationships improve if the patient wants an

antibiotic and receives one; they also perceived that if the doctor does not prescribe an antibiotic as desired, the relationship will not evolve as positively, and dissatisfaction could lead the patient to seek another doctor.

Participants in the present study mentioned online sources as a key component influencing patient-doctor interactions. They indicated that the online information affected patients' views of diseases and tended to make them insist on receiving antibiotics. The findings indicate that patients' opinions can affect prescribing behaviors. For example, patients receiving information about a new class of antibiotics from family members, other patients, and online sources (outside sources of information) were perceived as pressuring the participants to prescribe antibiotics.

Relatively little research has been published on the effect of internet sources on patients' beliefs and behaviors. However, Iverson, Howard, and Penney conducted a survey study among patients at three osteopathic primary care medical clinics and found that out of 154 respondents, 58% of patients attending primary care clinics had used internet sources to find information on medical problems or other health-related concerns.[72] The researchers also found that this online information (outside sources of information) affected the patients' attitudes toward their health. They concluded that such information can negatively change patient-doctor relationships.

In the current study, all participants implied that they felt that the patients' use of informational sources beyond themselves indicated a lack of trust in them, their knowledge, and their skills. Perhaps this view was due in part to their relative lack of professional experience and different cultural background (some participants were from countries where antibiotics are sold over the counter). Because all participants had similar levels of

experience, i.e., two or three years of residency, comparing their perceptions with those of more experienced physicians was not possible.

Participants mentioned media as a practical way to change patients' perceptions about antibiotics and raise their awareness of antibiotic resistance. Wutzke et al. studied Australia's National Prescribing Service program, which uses mass media activity, including television, radio, and magazines, to reduce inappropriate use of antibiotics. They concluded it increased patient awareness and decreased the number of antibiotic prescriptions. [73] However, whether the results would be similar in the US is unknown at this point.

3. **Monitoring antibiotic prescriptions: Antibiotic control systems**. Participants in this study were all working in a single integrated health system that uses a system to monitor antibiotic prescription. The health system has a 3-step antibiotic control system (ACS) that involves (1) sending the doctor a computer alert when she/he tries to prescribe an antibiotic, (2) contacting the infectious disease team for approval when prescribing certain classes of broad spectrum antibiotics, and, (3) in most cases, requesting lab tests to verify the diagnosis. This is an internal, proprietary program that belongs to this integrated health system. Participants expressed varied opinions of the system as a practical tool to monitor antibiotic prescription.

(f) Computer Alerts

Computers alerts in the ACS of this organization are used to increase awareness among healthcare providers when they are prescribing antibiotics. The participants explained that when prescribing high dosage antibiotics, they were asked to answer some simple questions that popped up on their computer monitors. These questions remind them about the

duration and proper dosage of the antibiotic they are prescribing. One resident described the alert system:

> […] Here we have a system. When we prescribe antibiotics, when the dose is more than the amount it is supposed to be, or the duration of use is more than usual, the alert pops up in computer screen and asks, "Are you sure you want to prescribe it?" Only thing you have to do is just push the button "yes," and you are done.

The sixteen family medicine residents had mixed feelings about such alerts: They liked the alert system because it helped prevent overuse of antibiotics, but they said that it is not very effective. Nevertheless, they emphasized that the advantages outweighed the disadvantages. As one participant remarked, "Yes, in this health system we have this system that ask [sic] you some simple questions before submitting your prescriptions. It is really good, but sometimes when you need to visit the other patients who are waiting for you, it is mainly time consuming." Another doctor also had reservations about the alert system:

> I think the alert system is a nice way to oversee any type of prescriptions. For instance, in some cases of osteomyelitis [bone infection] patients need to be on antibiotics for about 6 weeks; however, the computer system is designed for maximum duration of 2 weeks, which is a usual duration for that type of antibiotic. So when we prescribe antibiotics for a longer duration, an alert pops up on the computer screen and asks "the maximum duration is 14 days, do you want to proceed?" And all we need to do is hit "yes" button. … I think it is a good reminder; however, [pause] in some cases it takes time.

Only one participant said the antibiotic monitoring system was impinging on his autonomy: "I think doctors are the ones who decide about the dosage and the duration. They don't need any other system to control them. … I think they enjoy making stuff complicated." One participant also said the alert system is disadvantageous because after a while doctors ignore the alerts: "I don't like it; it is not because the alert itself is a bad idea. It's because after three months working with that on a daily basis, you get used to it, and I think you lose the ability to think critically. I don't pay attention to the question anymore,

and I keep hitting the enter button." Thus, some family medicine residents have become insensitive toward the alert system and prescribe antibiotics without paying attention to the questions and warnings.

(g) Infectious Disease Team

The second part of the ACS is consultation with the infectious disease team in cases in which strong classes of antibiotics are requested. Although all the participants said this feature is a practical way to monitor antibiotic prescription, only one seemed to have a sincerely positive view of it; the others seemed to show hesitancy in approving the effectiveness of the system. The enthusiastic participant had worked on the infectious disease team for a year: "We had a portal with different bacteria's names on it and potential resistance that [those bacteria] may cause. The portal was helpful in covering all aspects of antibiotic resistant and how to monitor prescribing resistance antibiotics."

One participant stated:

> We always have ID [infectious disease] specialists who control antibiotic prescriptions. We have an antibiotic which is called meropenem [the participant put this last word in air quotation marks], and it is a strong antibiotic. So we have to call ID and explain them why we decided to prescribe this class of antibiotic, and they go to the chart and check the symptoms and test results, and they suggest us that, for example, the milder class would be better in this case, or they approve the strong class and allow us to prescribe them. Umm, [pause] I think if we have this kind of program nationally, it would be helpful.

Several participants said that getting approval from an ID specialist required an enormous amount of time. "You know, sometimes I am so frustrated, and I want to go and visit my other patient(s??), but these ID people just keep calling me, and I have to answer all the questions. But, [pause] I think it is worth it." This quote shows that the participant viewed the ABS positively; however, this person paused for a few seconds, showing hesitation to

answer the question directly, which might indicate discomfort expressing personal or negative judgments.

One participant said, “Personally, I like this system; they are asking us to do the right thing. But sometimes they are asking too many questions [laughs].”

(h) Lab Tests

Several participants stated that testing to find the cause of the disease is a sound way to oversee antibiotic prescription. However, one participant said that occasionally the cost of the lab testing and imaging for pneumonia may prevent the doctors from ordering a test:

> You know, sometimes the symptoms of the diseases differentiate bacterial or viral infection; but sometimes we need to ensure the source is bacterial. We should ask for lab tests. You know, I need to consider what the cost of testing is? … I don’t agree with testing each patient, do you know what I mean? When somebody comes with runny nose, watery eyes, sneezing, and coughing, I am not gonna ask him to go for test; this is viral; the test is just gonna cost him more, so no need. On the other hand, when the patient comes with a fever and sore throat in aspecific age group, in this situation, it is better to be on the safe side and ask him/her to do some tests.

Another participant stated,

> We have some rapid test kits that give us the results in less than 10 minutes [for example, for a throat infection]. In this situation, testing is reasonable. But let me tell you one thing, sometimes you cannot ask the patient to go for the test; you see that he or she may not be able to afford the cost. In this situation, if the disease is not a complicated one, I trust my judgement based on symptoms and don’t do more work up.

Several participants stated strongly that over-prescription occurs mainly in outpatient settings. They said that having the appropriate diagnostic facilities would help reduce the over-prescription of antibiotics. One stated, “I think the rate of over-prescription is higher in outpatient settings. Children go to doctors with respiratory infections, and doctors prescribe them antibiotics right away. Because the […] office [not in the hospital] is not equipped with imaging to check for the source.”

The analysis of participants' responses regarding the ACS shows that the intended purpose of the monitoring system—to decrease the antibiotic over-prescriptions in the hospital—is not always effective. Pestotnik and colleagues implemented a computerized system to monitor antibiotic prescriptions; they found that the computer system recognized 696 cases of inappropriate prescriptions among 63,759 patients who received antibiotics. They stated that the computer system is a capable tool to ensure the appropriate use of antibiotics.[74] Similarly, Schiff and Rucker found that using a computer to prescribe any type of medicine has a positive impact on selecting the right medicine with right dosage.[75] Although participants said the three parts of the ACS were practical ways to curb over-prescription of antibiotics, Lally and colleagues found that doing a task repeatedly can cause the user to become habituated to the tool.[76] Habituation clearly occurred in at least some of the medical practitioners who participated in this study, which could lead the ACS mechanism to fail to achieve the intended effect. Monthly updating guidelines might help physicians avoid becoming insensitive toward an ACS.

2.6 Conclusions

Previous studies on antibiotic prescriptions have focused mainly on patients' expectations of receiving antibiotics.[77] However, the story of overuse of antibiotics has two sides: that of the doctors who prescribe antibiotics and that of the patients who insist on receiving antibiotics. The present research was conducted to enhance our understanding of the doctors' side of the story, meaning to investigate physician's perceptions of antibiotic prescription.

The conditions of practice allow physicians only limited time with each patient; consequently, physicians are unable to devote ample time to explain the details of the disease. At the same time, some residents indicated that such explanations were not useful anyway. Lowering the work burden of residents' schedules has the potential to lead to a decrease in antibiotic prescriptions since the residents would have more time to explain the disease and situation with the patients and consider all available options. However, such a strategy is difficult to implement since residents need extensive clinical exposure to gain experience, and thus, lowering the workload may hamper proper training of residents. Consequently, hospital CEOs and the American Medical Association need to institute changes in residency and practitioner regulations that encourage physicians to spend more time with each patient.

This study also opens a novel view into understanding patient's perception. Indeed, people are more knowledgeable than before. They have access to more and different sources than ever before and acquire knowledge from them all, e.g., the internet, family members, and even other patients. Some participants in this study indicated a belief that mass media could be used to change people's attitudes toward antibiotics use, eventually decreasing antibiotic over-prescription. Both in Belgium and in Australia informational programs in the mass media have been effective in reducing unnecessary prescriptions and use of antibiotics as well as their misuse.[23,73]

This study's findings suggest that monitoring systems lead to more accurate diagnosis and ultimately contribute to improving physicians' prescription of antibiotics. Implementing such a system nationwide has the potential for a significant positive impact in decreasing antibiotic over-prescription. Although the present study's participants acknowledged that use

of the monitoring system is time consuming, they all said that the benefits of such a system outweigh its drawbacks. Therefore, hospital CEOs need to consider implementing monitoring systems there in order to combat antibiotic over-prescription and the eventual spread of antibiotic resistance.

The present study makes a significant contribution to the understanding of antibiotic over-prescription, but it was limited to one organization in one geographic region. It also was limited to physicians at one career stage (residency) in one specialty (family medicine). The personal interaction between the researcher and the participants during data collection could also have influenced what the participants chose to say and how in the interviews.

Future studies should more broadly explore physicians' perceptions of antibiotic use in order to better limit antibiotic overuse. The relationship between online information (outside sources of information) and patients' perceptions of antibiotics also deserves further research. A similar study not only of family medicine physicians but also including other specialties might shed even more light on the situation and how to avoid antibiotic over-prescription.

CHAPTER III

FACTORS ASSOCIATED WITH ANTIBIOTIC PRESCRIPTIONS FOR THE VIRAL ORIGIN DISEASES IN OFFICE-BASED PRACTICES 2006–2012

3.1 Overview of Study II

Research Question: In case of viral origin disease, does an association between time spent with a doctor during a visit and the prescription of antibiotics exist?

Significance of the Study: The impact of factors such as a patient's age, race, gender, type of insurance, office location, and a physician's specialty on antibiotic prescriptions are discussed in the literature; however, less is known about the relationship between the time a patient spends with a doctor during a visit and the likelihood that the patient will receive an antibiotic prescription. The current study used data on office encounters and prescriptions from the CDC's 2006–2012 National Ambulatory Medical Care Surveys to evaluate possible connections.

Conceptual Framework: This study is associated with changing organizational level behaviors, which is the key assumption of phase two of the ASU model. By emphasizing a decentralized network, phase two focuses on improving doctor-patient relationships. Based on the ASU model and previous studies,[78] I anticipated that the more time a patient spent with a doctor in an office visit, the lower the incidence of inappropriate prescription of antibiotics would be due to increased opportunity for the physician to educate the patient on appropriate antibiotic use, such as explaining the differential effectiveness of antibiotics for bacterial and viral infections. Eventually such information has the potential to influence patients' expectations and behavior, as a result decreasing the number of unnecessary antibiotic prescriptions.

Data Source: The CDC's National Ambulatory Medical Care Survey (NAMCS), 2006–2012

Data Acquisition: The data set is publicly available on the CDC website (ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Datasets/NAMCS/).

3.1.6 Study Setting: The data were extracted from surveys regarding ambulatory care visits in the US. Only visits to the offices of non-federally employed physicians classified by the American Medical Association or the American Osteopathic Association as "office-based patient care" are included in the analysis. The NAMCS collects data using a multistage probability sampling design that involves probability samples of primary sampling units (PSUs), physician practices within PSUs, and patient visits to practices. The first-stage sample includes 112 PSUs. PSUs are defined as geographic segments composed of counties, groups of counties, county equivalents, or towns and townships (for some PSUs in New England) within the 50 States and the District of Columbia.

Study Design: This study analyzed NAMCS data from 2006 to 2012 to identify whether length of time spent during an office visit has an association with the likelihood of antibiotic prescriptions being ordered for the following common viral infections and conditions: the common cold, runny nose, bronchitis, chest colds, the flu, sore throats, and fluid in the middle ear controlling for other influential factors. Evidence-based best practices advise against prescribing antibiotics for these infections and conditions, thus the study model is essentially a model of the relationship between contact time with physicians during office visits and the likelihood of receiving an unwarranted antibiotic prescription.

Study Limitations: Antibiotic prescriptions or changes in prescriptions might occur over the phone or via email, which would not be captured in these datasets. The disease severity and duration were also not captured by the NAMCS data.

Study Approval: IRB approval was obtained through Texas A&M University's Institutional Review Board for Human Subjects in October 2015 (approval number IRB-0651M).

Analysis: This study evaluated the association between spending time with a doctor and the subsequent prescription of antibiotics for viral infections. A multivariate logistic regression model was used to find independent predictors for antibiotic prescriptions in the period of 2006–2012.

Results: The NAMCS sample from 2006 to 2012 included 261,623 patient visits recorded to office-based physicians in the US in the. A multivariate logistic regression analysis revealed five significant predictors of antibiotic prescriptions for suspected viral infections: Length of doctor-patient encounter time, patient gender, the interaction between time and family medicine, type of insurance, and the overall rate of antibiotic prescriptions per physician. The estimated coefficient of the variable "time" was negative and significant (P-value = 0.0327). For every additional minute a patient spent with a physician during a visit, the mean predicted probability of receiving unnecessary antibiotics decreased by 2.4%.

Conclusions: This study provided evidence that physicians continue to prescribe antibiotics in avoidable cases. In the present study, the unnecessary antibiotic prescription was marginally associated with a shorter visit duration for patients with viral origin diseases. The study showed that increased doctor-patient encounter time has the potential to result in decreased antibiotic prescriptions for suspected viral infections.

3.2 Introduction

Antibiotics are intended for diseases with bacterial origins. The best treatment for diseases with viral origins is resting at home and drinking plenty of fluids; seeking help from healthcare providers is not particularly effective for such infections.[35,64] Yet, in the US in 2002 alone, out of 283.1 million doctor visits, an estimated 83.17 million visits were for the common cold, URIs, fluid in the middle ear, sinusitis, and nonspecific URIs, all of which have viral origins.[79] Although antibiotics are not effective against viruses, visiting a doctor in the US for viral diseases may result in antibiotic prescriptions, as physicians tend to prescribe antibiotics for viral diseases such as the common cold, the flu, and chest colds.[80,81] According to the CDC, approximately 50% of antibiotic prescriptions written in the outpatient settings are inappropriate.[9] For example, at least 75% of adults in the US seeking treatment for acute bronchitis--usually caused by a virus--are prescribed antibiotics.[82]. Out of 531 pediatric office visits for colds, URIs, or bronchitis, antibiotics were prescribed to 44% of patients with a common cold, to 46% with URIs, and to 75% with bronchitis.[31]

Different factors influence doctors' decisions to prescribe unnecessary antibiotics. For example, with regard to age, Nyquist and colleagues found that children age 5 to 11 are the main recipients of antibiotics in office-based settings in the case of colds, URIs, and bronchitis.[31] With regards to patients' race, researchers found that the probability of a black patient in the US receiving antibiotics for fluid in the middle ear compared to a white patient was 42% to 52% (p-value less than 0.01).[83] Lallana-Alvarez et al. found that in general women are prescribed antibiotics more than men.[84]

Moreover, several studies reviewed antibiotic prescriptions with a concentration on insurance and the physician's specialty. Some researchers found that privately insured

patients have a higher likelihood of getting broad-spectrum antibiotics than patients with other types of medical coverage.[85] A study focused on specialties demostrated that in that sample pediatricians had a lower rate of prescribing antibiotics compared to other specialties[31] while a study a few years later found that internal medicine physicians had a higher rate of prescribing non-recommended antibiotics than family and general practitioners.[86]

Antibiotic over-prescription may result in the development of antibiotic-resistant bacteria and eventually the spread of antibiotic resistance. Ample evidence supports the fact that antibiotics have no clinical benefits for viral diseases;[87,88] therefore, the CDC implemented several guidelines to control antibiotic prescriptions for viral origin illnesses in healthcare settings. Get Smart, which is an educational package to improve the use of antibiotics, was developed by the CDC in 2009 to stop the prescription of antibiotics for colds, bronchitis, chest colds, the flu, sore throat (except strep), and fluid in the middle ear.[89] The central logic behind developing Get Smart program was to increase the rational use of antibiotics and decrease their irrational, unnecessary use. The Get Smart program has evidenced reductions in unnecessary antibiotic prescription in pediatrics.[90]

Although several studies have reviewed antibiotic prescriptions from various factors including age, sex, race, and insurance type, there is a dearth of studies evaluating the relationship between time spent with a doctor and antibiotic prescriptions. Only a few qualitative studies related to the time spent with the doctor have been conducted in the US;[64,91] the results of these studies indicate that physicians complain about tight schedules, as do the results presented in chapter II of this dissertation, and the authors argue that increasing

the duration of a doctor-patient encounter could reduce the likelihood of an antibiotic prescription for a viral infection.[92,93]

Generally, less is known about the time a patient spends with the doctor during a visit and how that affects the rate of antibiotic prescriptions for illnesses of viral origin. In order to address this deficit in knowledge and understanding, this study uses the NAMCS datasets from 2006–2012 to identify any relationship between the time spent with the doctor and the likelihood of receiving an unnecessary prescription for antibiotics during ambulatory visits, answering the following research question:

2. In case of a viral origin disease, what is the association between time spent with a doctor during a visit and antibiotic prescription?

3.3 Methods

The data used for the analysis are from the NAMCS datasets of 2006–2012, which are probability sample surveys of office-based physicians in the US and include both urgent care and scheduled visits but not any visits to hospitals. The sampling unit for NAMCS is a physician-patient encounter or visit.

The CDC's National Center for Health Statistics conducts the survey. Since 1989, the U.S. Census Bureau has been responsible for NAMCS data collection. NAMCS provides national estimates for reasons people seek medical attention, including clinical services provided during the visit, patient demographic information, physician diagnosis, the reason for the visit (up to three diagnosis codes per visit based on International Classification of Diseases, 9^{th} version), and a list of medications prescribed (maximum of 8 medications per visit).

NAMCS's survey utilizes a multistage probability design.[89] The first stage of sampling is randomly designating 112 geographic primary sampling units (PSUs). The second stage consists of selecting practicing, non-federally employed physicians identified by the American Medical Association and the American Osteopathic Association. The third stage is sampling patients selected during a randomly selected one-week period in the year.

The NAMCS surveys are disseminated annually to physicians who meet the criteria and volunteer to complete the survey. The NAMCS response rate is defined as the number of eligible physicians who completed the survey plus the number of eligible physicians who saw no patients during the study period divided by the sum of the numerator added to the number of eligible physicians who declined to participate.[89]

Ideally, including the years 2000 to 2012 would be more appropriate to identify the impact of different determinants on antibiotic prescriptions. However, 2006 was the first year of the survey when drugs were coded using the Lexicon Plus of Center Multum, Inc. Because the drug coding was different and therefore might cause a bias in the results, the years prior to 2006 are excluded from the study. The survey data from 2006 through 2012 are included, with 2012 being the most recent year of data available at the time of this study. This study obtained approval from the Texas A&M Institutional Review Board.

3.3.1 Study Design

The CDC implemented an awareness program entitled Get Smart to improve the general public's knowledge about antibiotic resistance. The Get Smart program contains information about in which cases prescriptions for antibiotics are unnecessary.[36] Based on the CDC's Get Smart guidelines, the following diseases were characterized as unnecessary

causes for antibiotic prescriptions and are used in this study to assess proper and improper prescription of antibiotics: the common cold (460), runny noses (478.19), bronchitis (490 and 466), chest colds in otherwise healthy children and adults (460), the flu (487), sore throats except strep throat (487.1), and fluid in the middle ear (otitis media with effusion) (385.89). In the present document, for simplicity's sake, the aforementioned diseases are sometimes referred to as viral diseases.

Antibiotics were identified by the National Drug Code Directory Classes. Visits were coded to identify visits during which antibiotics were prescribed; furthermore, all antibiotics were classified as either narrow or broad spectrum. Based on previous studies, penicillin, amoxicillin, ampicillin, erythromycin, tetracycline, doxycycline, trimethoprim, and sulfamethoxazole are classified as narrow spectrum agents, and cephalosporin, macrolides, fluoroquinolones, and amoxicillin-clavulanic acid are classified as broad-spectrum agents.[94,95]

All cases with the International Classification of Diseases (ICD-9) codes of 460, 478.19, 490, 466, 519.8, 487, 487.1, and 38589 were extracted from the combined NAMCS surveys for the years 2006 to 2012. Since these patients might have had other conditions as a second or even third diagnosis that required antibiotic prescriptions, to the next step was to determine the most frequent reasons for visits by patients with a primary diagnosis of the common cold, a runny nose, bronchitis, a chest cold, the flu, a sore throat, or fluid in the middle ear (otitis media with effusion). Subsequently, two tables including a second and third diagnosis for patients with viral source diseases were created. Two family medicine practitioners and the author went through each diagnosis to determine whether the antibiotic prescription was justified or not. As a result, the patients with solely viral diseases defined as

a patient with a first, second, and third diagnosis of viral diseases and the rest of diagnosis as missing or blank were included. Furthermore, patients with primary and/or secondary diagnoses of viral diseases with the remaining diagnoses being conditions that do not benefit from antibiotics, e.g., diabetes, hypertension, allergies, were included in the sample data. For example, a visit in which a patient had a common cold (first diagnosis), diabetes (second diagnosis), and hypertension (third diagnosis) was included in the sample data. However, patients with diseases that might benefit from antibiotics, such as fever and sinusitis, were excluded from the sample data to avoid any potential bias in the results. Extracted data was imported into the SAS® 9.4 software program (SAS Institute Inc., 2014) for analysis.

3.3.2 Variables

The data included the variables of age, sex, ethnicity, race, payment source, the length of a visit with the doctor, geographic region, metropolitan/non-metropolitan location of the physician, the interaction time and physician's specialty, and the rate of antibiotic prescription per doctor. The NAMCS datasets contain a single variable for combined race and ethnicity; therefore, the study uses a combined "race/ethnicity" variable instead of using each one separately. Payment type was contained the following categories: Medicare, Medicaid, self, and private payment. The physicians' specialties were divided into the following categories: family medicine, internal medicine, pediatrics, otolaryngology, and other.

A new variable for the antibiotic prescription rate per physician was created in order to control for the effect of this variable on unnecessary antibiotic prescription. Kumar et al.'s results showed that physicians' experience plays a key role in prescribing antibiotics. Some

experienced physicians often refer to their level of experience to justify their unnecessary prescription of antibiotics. For example, a practitioner might believe that a patient with a sore throat will eventually develop streptococcal septicemia in the absence of antibiotic treatment, and therefore, might prescribe antibiotics for such patients.[96] On the other hand, a 2005 study found that physicians with more than 20 years of experience are less likely to prescribe unnecessary antibiotics.[97] Thus, this variable allows researchers to control for it and isolate the effect of time on unnecessary antibiotic prescription.

The variable "rate of antibiotic prescription" was generated as follow; first, the number of cases of viral diseases that each participating physician treated from 2006 to 2012 was identified; subsequently, the number of antibiotic prescriptions was divided by the number of cases (patients) per physician.

The main independent variable in this study was the time that physicians spent with patients during the patient encounter. This time was defined as the face-to-face time between a patient and a physician. Time spent waiting to see the doctor and receiving care from a nurse was not included in the data. The unit of time was minute. The main dependent variable in this study was antibiotic prescription; whether an antibiotic was prescribed during a visit or not.

3.3.3 Research Question

The research question on which this study is based is, in the case of viral diseases, does an association between time spent with a doctor during a visit and the prescription of antibiotics exist? The researcher theorized that the length of encounter time between the physician and patient would have an association with the prescription of antibiotics as

follows: The more time a patient spends with a doctor, the lower the chance that she/he will receive antibiotics for a viral infection, as increased length of encounter time provides more opportunity for physicians to educate patients on the inappropriateness of antibiotics for viral diseases.

3.3.4 Statistical Analysis

First, a descriptive analysis of the data was conducted using chi-square (Table 2) and t-test (Table 3) measurements. There were no statistically significant differences between groups in patients' gender and race/ethnicity nor in three of the four payment types and office location were present in the sample. However, the results indicated a statistically significant difference among the five types of physician specialties (chi-square with four degrees of freedom = 14.4012, p = 0.0061) as well as a statistically significant difference among patients who have private insurance and patients who do not have insurance (p-value < 0.05).

Table 2—Categorical Variables Associated with Antibiotic Prescriptions for Viral Diseases

Factor	**Percentage of sample**	**P-value**
Overall	21.31	_
Patient gender		
Male	7.87	0.23
Female	13.44	
Patient race/ethnicity		
Non-Hispanic White	16.56	0.71
Non-Hispanic Black	1.64	

Table 2 Continued

Factor	Percentage of sample	P-value
Hispanic	2.3	
Asian	0.66	
American Indian/Alaska Native	0.16	
Type of payment		
Medicare	2.61	0.71
Medicaid	4.08	0.37
Self-pay	0.65	0.28
Private	15.17	0.012*
MSA		
Metropolitan Statistical Area	18.2	0.97
Non-MSA	3.11	
Region		
Northeast	3.11	0.58
Midwest	5.08	
South	9.02	
West	4.1	
Specialty of doctor		
Otolaryngology	4.1	0.0061*
Internal	1.48	
Pediatric	7.05	
Family	7.7	
Other	0.98	

*Shaded boxes indicate a statistically significant p-value.

Table 3—Continuous Variables Associated with Antibiotic Prescriptions for Viral Diseases

Factor	Mean of sample	Standard deviation
Patient age (years)	29.78	25.03
Doctor-patient encounter (minutes)	18.82	12.42
Number of antibiotic prescriptions per doctor per 100 patient visits	11.51	8.98

A multivariate logistic regression was used to test the independent associations of the variables, included in the following model, and antibiotic prescription:

$$\textit{Antibiotic prescription} = b_0 + b_1 X_t \textit{timespent} + b_2 X_t \textit{age} + b_3 X \textit{gender}_t + b_4 X_t \textit{ethnicity/race} + b_5 X_t \textit{Medicare} + b_5 X_t \textit{Medicaid} + b_7 X_t \textit{selfpay} + b_8 X_t \textit{private} + + b_9 X_t \textit{specialty} + b_{10} X_t \textit{specialty*time} + b_{11} X_t \textit{MSA} + b_{12} X_t \textit{region} + b_{13} X_t \textit{rate of antibiotic prescription} + \varepsilon$$

3.4 Results

There were 261,623 patient visits recorded (representing 6,814,501,568 estimated annual visits to office-based physicians in the U.S.) in the NAMCS database from 2006 to 2012. In total, 21.31% of the visits had a primary diagnosis of a common cold, runny nose, bronchitis, chest cold, flu, sore throat, fluid in the middle ear (otitis media with effusion) and secondary and tertiary diagnosis as missing, blank, or a condition that does not require any antibiotics (e.g. hypertension). The remaining 996 visits represented an estimated 29,352,300 national annual visits for the aforementioned diagnosis. Total number of physicians who participated in the survey and saw patients with viral origin diseases were 6,569 (unweighted).

The chi-squared and t-tests gave us an overview of the cases the physicians treated during the periods of data collection. Socio-demographically, the sample records were predominantly from non-Hispanic white patients (16.56%). Non-Hispanic black and Hispanic patients accounted for 1.64% and 2.30%, respectively, of the overall sample. The mean age of patients who visited office-based physicians from 2006 to 2012 was 29 years old. Female patients tended to visit office-based physicians for diseases more than their male counterparts, 13.44% vs. 7.87% of the sample visits. People with private insurance were diagnosed with a common cold, runny nose, bronchitis, chest cold, flu, sore throat, fluid in the middle ear (otitis media with effusion) more often than those with other types of insurances (15.17%). In terms of physicians' specialties, family medicine doctors were more involved in seeing patients with viral diseases (7.70%) than were others. Office-based physicians located in the south region of the US accounted for 9.02% of patients seen with viral diseases. Offices located in metropolitan areas had more patients with viral diseases compared to those in non-metropolitan areas (18.20% vs. 3.11%).

The mean time that patients spent with a physician was calculated for different situations; the mean visit duration for people who were diagnosed with a common cold, runny nose, bronchitis, fluid in the middle ear, the flu, or a sore throat was 18.82 minutes. The mean rate of antibiotic prescriptions for participating physicians was 11.51 prescriptions per 100 patients that a given doctor saw during a survey period.

3.4.1 Multivariate Analyses

Multivariate analysis was used to examine factors that might be associated with antibiotic prescriptions to treat a common cold, runny nose, bronchitis, flu, fluid in the

middle ear, and sore throat. A multivariate logistic regression analysis revealed five significant predictors of antibiotic prescriptions: (1) time spent in an encounter with a doctor, (2) patient gender, (3) the interaction between time and family medicine, (4) having private insurance, and (5) the rate of antibiotic prescriptions made by each physician per 100 patients that a given doctor saw. The results of multivariate regressing were displayed in Table 4. Furthermore, due to existence of an interaction term in the model, the predicted probability for each variable in the model was calculated (Table 5).

Table 4—Results from the Multivariate Regression

Parameter	**Categories**	**Estimate**	**Standard Error**	**P-value**
Time		-0.0247	0.0116	0.0327*
Age		-0.0062	0.00558	0.2664
Gender	Female	0.1992	0.0914	0.0293*
Race ethnicity	White non-Hispanic	0.1395	0.1672	0.404
	Black non-Hispanic	0.0289	0.2596	0.9113
	Hispanic	0.0906	0.2343	0.6988
Physician specialty	Family	-0.0994	0.3566	0.7805
	Internal	-0.238	0.591	0.6872
	Otolaryngologist	0.00796	0.4624	0.9863
	Others	-0.3449	0.6116	0.5728
Time* Physician specialty	Family	0.0369	0.0172	0.0319*
	Internal	0.0132	0.0279	0.6375
	Otolaryngologist	-0.0004	0.0223	0.9843
	Others	0.0011	0.0243	0.9625
Medicare	Yes	0.3587	0.1939	0.0644
Medicaid	Yes	0.195	0.1857	0.2936
Self-payment	Yes	0.0071	0.2632	0.9784

Table 4 Continued

Parameter	Categories	Estimate	Standard Error	P-value
Private-payment	Yes	0.4093	0.1639	0.0125*
Metropolitan Statistical Area	MSA	0.1236	0.1353	0.3609
Region in the U.S.	Midwest	0.2121	0.164	0.196
	Northeast	0.0028	0.1949	0.9885
	South	-0.0817	0.1423	0.5661
Rate of antibiotic prescription		0.077	0.0098	<.0001*

*Shaded boxes indicate a statistically significant p-value.

Table 5—Predicted Probability of Each Variable in the Model

Variable	Mean predicted probability	Standard deviation
Female	0.2	0.14
Male	0.15	0.12
White, non-Hispanic	0.19	0.14
Black, non-Hispanic	0.17	0.15
Hispanic	0.16	0.11
Other race/ethnicity	0.14	0.1
Family medicine specialty	0.23	0.14
Internal specialty	0.16	0.13
Pediatric specialty	0.2	0.13
Otolaryngology specialty	0.12	0.08
Pediatrician	0.09	0.07
Medicare	0.16	0.14
Medicaid	0.16	0.11
Self-pay	0.12	0.1

Table 5 Continued

Variable	Mean predicted probability	Standard deviation
Private insurance	0.24	0.14
Metropolitan area	0.18	0.13
Non-metropolitan area	0.17	0.1
Northeast	0.17	0.11
South	0.19	0.15
West	0.15	0.12
Midwest	0.19	0.12
Time and family medicine	0.15	0.017
Time and pediatrician	0.02	0.12
Time and internal	0.16	0.1
Time and Otolaryngologist	0.12	0.11
Time and other specialties	0.09	0.07

3.4.2 Significant Variables

The estimated coefficient of variable “time” was negative and significant; for every additional minute spent with a physician during a visit, the predicted probability of receiving unnecessary antibiotics will decrease. In addition, the estimated coefficient of the antibiotic prescription rate was positive and significant, which means, for a given physician, the higher the rate of antibiotic prescription means the higher the predicted probability of prescribing unnecessary antibiotic. Female patients had a higher predicted probability of receiving unnecessary antibiotics compared to male patients. The mean predicted probability of receiving unnecessary antibiotics for a female patient was 20%, while the mean predicted probability for male patients was 13%. The effect of time spent with a physician during a visit on decreasing the predicted probability of prescribing unnecessary antibiotics was

reversed whenever a patient had an encounter (spends time) with a family medicine practitioner. The mean predicted probability of receiving unnecessary antibiotics for patients with private insurance was 24%, while the mean predicted probability for patients without private insurance was 15%.

3.4.3 Non-Statistically Significant Variables

1. With every unit increase in a patient's age, the probability of receiving unnecessary antibiotics decreases by 0.6%.
2. The mean predicted probability of receiving inappropriate antibiotics for white, non-Hispanic patients was 19%. The mean predicted probability of receiving inappropriate antibiotics for black, non-Hispanic patients was 17%.
3. The mean predicted probability of receiving inappropriate antibiotics for patients who were covered by Medicare and Medicaid was 16%.
4. When a doctor's office was located in a non-metropolitan area, the mean predicted probability of prescribing unnecessary antibiotics was 18%.
5. The mean predicted probability of prescribing antibiotics in the Midwest was 19%, which was higher than in offices in the Northeast and West.

3.5 Discussion

No definite evidence indicating that antibiotics have a clinical benefit for patients with viral origin diseases, yet evidence suggests that antibiotics continue to be prescribed for diseases of viral etiologies. A survey study in 2003 of 370 primary physicians' visits found

that 54.7% of physicians prescribed antibiotics for a diagnosis of acute bronchitis a disease for which antibiotics are not indicated.[98]

The results of this study align with previous literature on the subject of antibiotic over-prescription by demonstrating that 18.27% of office-based visits for viral diseases resulted in antibiotic prescriptions.

These findings suggest that spending more time at a doctor's office can lead to fewer unnecessary antibiotic prescriptions. The implications of these findings might be that in cases of a common cold, a runny nose, bronchitis, the flu, a sore throat, and fluid in the middle ear, physicians need to spend more time explaining the origin of the disease and ineffectiveness of antibiotics to the patient. Doctors should clarify the reasons for not prescribing antibiotics and the consequences of overuse and misuse of antibiotics.

The findings of this study are in alignment with the Lundkvist et al. study, which was conducted in southeast Sweden, and 6,734 patients along with 41 primary care centers participated in the study. Researchers found that when more time is spent by doctors listening to patients, fewer antibiotic prescriptions result without reducing a patient's level of satisfaction.[99] Similarly, Linder et al.'s found that antibiotic prescriptions were associated with a shorter visit duration. They studied patients between age 18 and 60 with URIs including acute nasopharyngitis, acute bronchitis, sinusitis, a streptococcal sore throat, acute pharyngitis, and acute tonsillitis (or otitis media) from 1995 through 2000.[100] Findings of the current study agree with Linder's conclusions. However, the findings of the current study contradict the 2006 study by Hare et al., which used NAMCS data from 1993 to 2003 for patients under age 18. They found that "not prescribe" antibiotics for children with viral respiratory tract infections does not take any longer than prescribing them falsely.[101] These

differences may stem in part from a different study population and the exclusion of criteria for different diagnoses. The current study includes a first, second, and third diagnosis for each visit and limited the analysis to patients for whom there was no need for antibiotic prescriptions. In contrast, Hare et al. excluded the visits that resulted in a secondary or tertiary diagnosis that could have influenced the duration of the visit or justified the prescription of an antibiotic.

The current findings also showed that women have a higher predicted probability of receiving antibiotics in cases of the common cold, a runny nose, bronchitis, the flu, a sore throat, and fluid in the middle ear compared to men. The reason for such a conclusion could be justified by the study by Vanderweil et al.: They found that out of 16.1 million emergency department visits for acute asthma, 23% of female patients received antibiotics compared to 21% of male patients.[102]

By every additional minute spent with a family practitioner, the mean predicted probability of receiving unnecessary antibiotics was 15% higher. Hicks et al. conducted a study that determined family physicians prescribed the highest overall number of antibiotic courses, followed by pediatricians and internists (24%).[103]

Patients who were covered by private insurance had a mean predicted probability of 24% of receiving antibiotics in cases of viral diseases. The higher rate of antibiotics prescriptions received might be explained in part by the provider's knowledge that most private insurance covers the cost. This finding aligns with the studies by Shapiro et al. and Xu et al.[104,105] The former found that privately insured patients receive a higher percentage of broad spectrum antibiotic prescriptions (11%) compared to people who use public insurance (8%).[106] The later study showed that the odds a person with private insurance will be

prescribed antibiotics for an uncomplicated URI 49% higher than for a person with any other type of insurance or payment.[107]

Physicians with a higher rate of antibiotic prescriptions have a higher predicted probability of prescribing inappropriate antibiotics. This likely has a connection to the physician's general prescribing behavior. Doctors who tend to prescribe more antibiotics have a greater tendency to prescribe more antibiotics even when they are not necessary. A study published in 2016 found that a physician's professional characteristics are one of the main drivers of antibiotic prescriptions, specifically that physicians' knowledge, attitude, workload, and emergency activities impact their prescribing behavior.[108]

The limitations of this study relate primarily to the use of the NAMCS data rather than collecting it personally or using other databases. The NAMCS data does not permit a longitudinal view of individual physicians' antibiotic prescription rates so tracking change over time is not possible. Additional antibiotic prescriptions or changes in prescriptions could have happened outside of regular visits such as over the phone, which would not be captured in NAMCS dataset. The survey did not capture any errors such as misdiagnosis or even miscoding. The duration and the severity of symptoms were not recorded in the dataset; therefore, drawing a broad conclusion regarding the validity of the decision to prescribe antibiotics in a specific case is impossible, forcing researchers to treat the data as if they were completely correct.

3.6 Conclusions and Future Research

To date, efforts to reduce unnecessary antibiotic prescriptions for viral diseases have yielded some modest results. This research extends our knowledge about the over-prescription of antibiotics in the US, showing that physicians frequently prescribe antibiotics

for viral diseases in office-based settings as well as in inpatient settings. Inappropriate antibiotic prescriptions for viral infections appear to be influenced by the complex interaction between circumstances, patients, and physicians.

This study provides evidence that physicians in the US continue to prescribe antibiotics for viral diseases at an unacceptable rate. These findings show that spending more time in an encounter with a doctor may result in fewer antibiotic prescriptions for unnecessary cases, except in the case of family physicians. Perhaps this is because a more contact time gives doctors an opportunity to explain and provide rationales for not prescribing antibiotics. Without enough information and justification, patients may seek unnecessary antibiotics, either from this provider or from another one as discussed in chapter II of this dissertation.

The findings of this study are useful not only for US medical supervisory institutions such as the CDC, the Infectious Diseases Society of America, the American Medical Association, and even the Food and Drug Administration but for medical and public health professionals around the world. They provide a better understanding of the factors that have statistical associations with the prescribing antibiotics in office-based settings, providing insight into doctors' responsibilities toward patients including explaining the reasons behind a prescribed treatment. In order to continue improving antibiotic prescription behavior, future studies are needed to investigate factors that could stop physicians from elaborating more about antibiotics and being more open about the consequences of antibiotic overuse with their patients. Longitudinal studies would be useful to help medical professionals understand factors that influence prescribing behavior over time, particularly to consider what can be done toward eliminating unnecessary antibiotic prescriptions.

CHAPTER IV

TACKLING ANTIBIOTIC RESISTANCE: A QUALITATIVE STUDY OF PEOPLE'S EXPERIENCES AND AWARENESS OF ANTIBIOTIC RESISTANCE

4.1 Overview of Study III

Research Questions: How aware are individuals, from countries with unrestricted access to antibiotics, about antibiotic resistance? What are these individuals' experiences using antibiotics?

Significance of the Study: People from nations with high access to antibiotics may contribute to the global spread of antibiotic resistant bacteria such as methicillin-resistant Staphylococcus aureus (MRSA), Vancomycin-Resistant Enterococci (VRE), and Multidrug-Resistant Neisseria gonorrhoeae. Any intervention or policy that aims to control inappropriate antibiotic use, and thus the spread of antibiotic resistance diseases should target this population. Little is known about people's awareness of antibiotic resistance and experience with antibiotic use in countries with unrestricted access to antibiotics.

Conceptual Framework: The third phase of the Antibiotic Smart Use (ASU) model highlights the importance of changing social norms in improving antibiotic stewardship. Changing people's attitudes toward the rational use of antibiotics is the first milestone in addressing antibiotic resistance worldwide. In order to change norms and attitudes, we need to understand people's awareness level of antibiotic resistance and antibiotic stewardship, which this study aims to achieve. Therefore, this study aligns with phase three of the ASU model.

Data: Four focus groups with five participants each were conducted for a total of twenty individual participants.

Data Acquisition: Purposive sampling was used to reach potential participants. People from countries with high access to antibiotics, and who have recently traveled to the United States were invited to participate in the focus groups.

Study Setting: Tier I Research University in the United States.

Study Design: Research questions dictated using qualitative methodology. Grounded theory designed by Strauss and Corbin (1990) was used to analyze the data.

Study Limitations: The main source of healthcare in the United States for many of the people from countries with unrestricted access to antibiotics who participated in this study was the university's student health center. Therefore, our paradigm model was mainly focused on this singular source of healthcare which prevented us from obtaining a broader perspective of prescription behavior in different healthcare settings such as hospitals, clinics, and office-based physician practices.

Data Privacy: IRB approval was obtained through the Texas A&M University Institutional Review Board for Human Subjects in December 2015 (IRB-0818D).

Data Analysis: Grounded theory was used to analyze the data.

Results: In total, six main categories arose from the data. Participants in this study had: (1) Perceptions of, and (2) experience with, antibiotic use in their country of origin, which were all countries with unrestricted access to antibiotics. They also observed that there is (3) restricted access to antibiotics in the U.S. Participants (4) evaluated the available options and strategies for reducing their symptoms of illness. Subsequently, they went through a (5) decision-making process and either avoided taking antibiotics, or practicing self-medication. All of these categories were connected to a (6) lack of knowledge on antibiotic resistance and antibiotic stewardship.

Conclusion: Participants in this study were from countries with high access to antibiotics, and reported a paucity of knowledge and awareness about antibiotic resistance and antibiotic stewardship, both in their country of origin and since arrival in the United States. The theoretical model that this research proposes is the fact that providing the right information at the right time will enable people to make right decisions to avoid unnecessary antibiotic use (i.e. in case of common cold and flu). The findings of this study will open a new path toward better understanding the consequences of the lack of information on antibiotic overuse. The results of this research have implications for physicians as well as healthcare organizations and agencies around the world. Nurses, physicians, and other healthcare providers can take the first step in educating people about the consequences of antibiotic overuse. Without increasing awareness and knowledge about the rational use of antibiotics, stopping the spread of antibiotic resistance seems an impossible goal.

4.2 Introduction

Every month, more than 2 million people enter the US as refugees, asylum seekers, visitors, tourists, or students.[109] Many of these people come from countries in which antibiotics are sold as over-the-counter (OTC) medicines, meaning without a prescription.[110,111] in 2014, the World Health Organization (WHO) released a report in which national surveillance data were used to identify countries with inadequate regulation of the distribution and sale of antibiotics.[112] This unrestricted access is usually attributed to weak legislations and regulations.[113] According to this report, people in Egypt, Pakistan, and India have the easiest access to retail antibiotics,[114] which reported that 41% of Iranians and 94% of Pakistanis had used third-generation of cephalosporin without a prescription.[112] Out of 2,953 legal drug sale transactions in India (2,083 urban and 870 rural), 50% of urban and 28% of rural area consumers requested antibiotics without a prescription.[115] In Abu Dhabi, out of 510 pharmacy transactions, 68.4% of the observed antibiotic sales were without a prescription.[116]

Thus, people with different experiences may have different expectations regarding antibiotic use. These expectations can lead to improper behavior regarding antibiotic use, such as demanding antibiotics in situations where antibiotics are not warranted as for diseases of viral origin or self-medicating with leftover antibiotics from previous prescriptions.

Keeping leftover medication for future use is the main source of antibiotic misuse as these antibiotics are potentially used later without a medical prescription.[117] A survey of 1,363 emergency department patients in the U.S. found that 43% of patients had used antibiotics in the previous year, and 17% had consumed leftover antibiotics without

consulting a healthcare provider.[118] Interestingly, some of the misuses documented among U.S. children occurred with drugs purchased in Mexico.[119] This agrees with a focus group study that found that Latino participants reported using imported antibiotics for self-medication.[120] In addition, a study in Israel showed that out of 467 Israeli adults, 114 stored leftover antibiotics at home, and 81 would consider practicing self-medication with antibiotics without a medical consultation.[121]

Given the differential behaviors observed among clusters and populations of people regarding antibiotic use, it is essential to target high- and inappropriate- use groups for behavioral change. The first step in targeting a population for behavioral change is understanding the foundations of the behavior. Any intervention or policy that aims to reduce antibiotic overuse doomed to be ineffective if it does not target populations from countries in which antibiotics are available without prescriptions.

After significant review of the literature, no studies investigating antibiotic overuse/misuse behavior among people from high access countries were found. Therefore, in the third study, the following research questions regarding the level of knowledge about antibiotics and awareness of antibiotic resistance were explored in dialogs with people from such countries:

3. How aware are individuals (from countries with high access to antibiotics) about antibiotic resistance?

4. What are individuals' (from countries with high access to antibiotics) experiences of using antibiotics?

The primary purpose of this study is to seek insight into people's experiences and knowledge of antibiotic use and antibiotic resistance from high access countries. By

collecting data about these two research questions, this study attempts to demonstrate how experiences shape attitudes toward antibiotics and in what ways knowledge of antibiotic resistance and antibiotic stewardship can be increased in order to change people's attitudes, beliefs, and behavior.

Hesse-Biber defines an epistemological orientation in research as a philosophical belief system about how the relationship between the researcher and research participant is understood.[52] This research is founded on social constructivism, which argues that the only way to perceive social reality is from the perspective of the people who are enmeshed within it.[122] Consequently, it promotes understanding of the social meaning of interactions between the researcher and the participants in a study. Social constructivism has guided the researcher in the role of an active participator throughout the data collection and data analysis processes. No one reality exists in the world; but rather, each person has an individual reality and each interaction creates a new reality for each participator in the interaction. Thus, as is necessary in all research, during this study, the researcher endeavored to put aside personal beliefs and assumptions to be open to other ideas. One tool employed to aid in this process was writing; writing journal entries and memos, which helped the researcher recognize pre-existing beliefs, assumptions, and ideas. By writing memos the researcher ensured that personal feelings and values did not interfere with the research process.

4.3 Methods

4.3.1 Theoretical Approach

In the proposed study, the qualitative methodology of GT dictated the processes for collecting and analyzing data.[123] Qualitative research methodology is defined as a process of

naturalistic investigation that attempts to explain human experiences and behaviors in natural settings in order to understand reality.[124] According to Strauss and Corbin (1990), qualitative methods can be used to understand "what lies behind any phenomenon about which little is yet known."[123]

As part of the body of qualitative research methodology, GT allows the researcher to generate a theory of a phenomenon that is grounded in participants' comments regarding that phenomenon.[123]. Birks and Mills (2011) specified that one indicator that guides the researcher to use GT is not having much information in that particular area.[61] By and large, little is known about how people from high access countries experiences using antibiotics or their awareness of antibiotic resistance; therefore, using GT allowed the generation new data and understanding regarding the participants' experiences and awareness of antibiotic resistance.

Strauss and Corbin's GT[123] aligns with my epistemological approach as a social constructivist. They developed GT processes for analyzing and coding data, identifying categories, and acknowledging the researcher's theoretical sensitivities from a social constructivist viewpoint.

4.3.2 Study Design

Krueger and Casey purport that focus groups instead of interviews need to be considered when at least one of the following conditions is met: (1) the goal of the research is to look for the range of ideas or feelings that people have about a topic; (2) the researcher wants to understand differences in perspectives between groups of people; and (3) the purpose of the study is to uncover factors that influence behavior. In the current study, all

three conditions are met, which makes focus groups an ideal technique for data collection in this study.[125]

Focus groups rely on interactions between people to generate data. Ideally, people in focus groups feel supported by other members of the group and, thus, willingly share their feelings and thoughts.[126] Conducting a focus group has additional advantages: It generates more data in a shorter period of time; it enables the researcher to interact with participants; and it gives the participants opportunities to use their own words to respond to the topic and prompts.[127]

4.3.3 Participants

Graduate students at tier I Research University in the US who were originally from high access countries were invited to participate in the study. The inclusion criteria, purpose of the project, and timeframe were explicitly stated in a recruitment email sent through the university email list-serve for international graduate students. A total of twenty graduate students from high access countries participated (Table 6).

Table 6—Characteristics of the 20 Participants

Major	Degree program enrolled in	Nationality	Number of years in the US
Industrial engineering	Ph.D.	India	<1
Applied economics	Ph.D.	Peru	3
English	Masters	Iran	2

Table 6 Continued

Major	Degree program enrolled in	Nationality	Number of years in the US
Education	Ph.D.	China	4
Transportation engineering	Masters	Iran	1
Mechanical engineering	Masters	Panama	1
Public Health	Ph.D.	China	3
Public Health	Ph.D.	Pakistan	2
Economics	Ph.D.	Iran	3
Public Health	Ph.D.	Nigeria	3
Agriculture	Ph.D.	China	2
Physics	Masters	Iran	3
Agriculture	Ph.D.	Pakistan	3
Civil engineering	Ph.D.	Iran	4
Human resource development	Masters	Azerbaijan	1
Health policy	Masters	India	3
Chemical engineering	Ph.D.	India	1
Civil engineering	PhD	Iran	3
Civil engineering	Masters	India	2
Agriculture	Ph.D.	Mexico	3

Graduate students from countries with high access to antibiotics were selected as a subset of the target population. There were two reasons for selecting international students as

a sample data: (1) Per US law, all international students are required to be covered by health insurance prior to registering for classes[128] giving the students greater chances of interacting with healthcare in the US for various conditions, including common viral infections such as cold or flu that are typically associated with inappropriate antibiotic use. (2) All international students need to pass the Test of English as a Foreign Language (TOEFL) before being admitted to a university in the U.S., ensuring that participants have a reasonable level of proficiency in speaking the English language, thereby eliminating most potential language barriers in the focus group discussions. A purposive sampling was used to reach out to the participants.[59] The inclusion criteria for participants were as follows:

1. They must have arrived in the United States between 1 month and 4 years ago. The reason behind choosing individuals who had recently arrived in the U.S. was to ensure that they could recall their experiences in their home countries. According to Wagenaar and Cognit (1986) 60% of critical details selected at the time of occurrence to be remembered were irretrievable after 5 years.[129]
2. Each needed to be a native born citizen of and have spent at least their initial 18 years in a country with high access to antibiotics.
3. Participants should not have a background in biology, medicine, or pharmacy. Students in these fields are required or more likely to know about antibiotic resistance. Therefore, they were excluded from the study.

4.3.4 The Focus Groups

Four focus groups with five participants in each group were conducted in February 2015. Each focus group followed the same general outline: The focus group discussion began

with a welcome statement followed by an overview of the topic and some rules to help the discussion flow smoothly. As the researcher reminded participants that there were no right or wrong answers, that the reason for taping the audio was only for the transcription of data, and that participants needed to respect each other's opinions. The researcher then began the conversation by stating the opening question and then moved to other questions (Table 7). Additional probes were also used to elicit further explanation as appropriate.

Table 7—Focus Group Questions

Type of question	**Focus group guiding questions**
Opening	When was the last time you took an antibiotic?
Introductory	What are pros/cons of taking antibiotics?[a]
Transition	What do you do when you have the flu or a common cold?[b] *Probes: Have you ever asked your doctor to prescribe you an antibiotic? Have you ever gotten antibiotics from a pharmacy to treat your flu/common cold?*
Key question 1	How would you describe access to antibiotics in your country? *Or* What is your perception of selling antibiotics without a prescription?[b]
Key question 2	After you start feeling better, what do you do with the rest of the antibiotics you have?[a]
Key question 3	What do you know about antibiotic-resistant bacteria?[a] *Note: Before asking the question, the moderator will say "Antibiotic overuse and misuse can lead to antibiotic resistance, which stops antibiotics' functionality."*
Ending question	Suppose you have one minute to educate other people in your home country about antibiotic resistance, what would you say?

[a]Questions that target research question3: How aware are individuals (people from high access countries) about antibiotic resistance?

[b]Questions that target research question 4: What are individuals' (people from high access countries) experiences of using antibiotics?

The opening and introductory questions introduced the topic of discussion and prompted the participants to begin thinking about their connection to the topic. The transitional question served as a logical link between the introductory and the key questions.[125] A qualitative study to explore patients' ideas about medication was published in 1994; the transition question in this protocol comes directly from that study.[130] The key questions drove the study and played the most important role in data analysis. Finally, the final question allowed participants to reflect on their previous comments, and each person was asked to respond to the final question.

After the focus group ended, the researcher made field notes of the focus group including details about participants' visible feelings and emotions as well as their body language during the focus group. This aided in recalling the events in detail during the data analysis phase.

4.3.5 Data Analysis

In the GT approach, data analysis begins with listening to the data, transcribing it, and reading it repeatedly to identify the main categories. The 367 minutes of audio recorded during the 4 focus group sessions became a 250-page transcript. Each line was coded. The categories emerged, and analysis continued throughout the transcripts to define and refine the subcategories, which were grounded in the main categories. [131]

4.3.6 Open Coding

Strauss and Corbin (2008) defined the coding process as an active process that raises raw data to the conceptual level.[132] Each focus group transcript was analyzed using open

coding; an analytical process of breaking down the data.[123] In the open coding process, events or actions are compared to other events to find the similarities and differences. Labeling (coding) was used to identify the concept or idea that participants have discussed. Meaningful, small units that best describe each sentence or line was assigned to each line. Once the subcategories were identified, they were grouped together to create tentative categories (themes). The open coding of transcripts resulted in ~650 initial concepts. For example, the statement, "usually as soon as I start feeling flu there was the syrup [antibiotic] … I will just buy it, and you don't need any prescription to buy any anything from a pharmacy in Pakistan no matter what medicine it is" was given the open code of "no prescription" and "buy from pharmacy". I proceeded with open coding until the last line of the transcript.

4.3.7 Axial Coding

After the conceptual labels were obtained from open coding, I compared the emerging codes and similar concepts and collapsed them together under the same category. This was part of the axial coding. If a category was consistently present and noted by the researcher, it was included in the main model. Then a core category, or central idea that explains the main phenomenon was defined [123]. Other categories are always connected with a core category. Strauss and Corbin (1990) describe axial coding as "a set of procedures whereby data are put back together in new ways after open coding by making connections between and within categories."[133] Therefore, in this stage, I attempted to bring data back together into a coherent whole. I sorted the categories according to the pattern, ideas and relationship in the data. In some cases, I had to redefine the category names to contain the

units under them (some units had a connection with each other that required a new name for that category). If a category was consistently present and noted, it was included in the main model. In this step, I also identified properties and dimensions for each category. The properties create a more comprehensive view of the categories and show the connection to the larger data set [123]. An Excel file was used to organize emerged categories, subcategories, and their dimensions.

4.3.8 Constant Comparison

With GT, the constant comparison method was used to analyze the data from the focus groups. Birks and Milles (2012) describe constant comparison as an analytical process in which incidents are compared with existing codes, and codes are compared with codes, which together leads to the development of the main catagories.[61] These date were grouped using a color coding method in which different colors signified different categories or ideas. Using different colors simplified the comparison of new codes with existing codes. For instance, red was used for all codes related to "pharmacy sell." After the open coding was complete, the coded transcript was reviewed and categories and statements related to the category "pharmacy sell" were circled in red. In addition, all of the emerged categories were diagramed on a large sheet of paper. Using different colors and the large sized paper helped create an overall picture of the categories and then accurately collapse them. Using the constant comparison method, eventually all categories were compared with each other, which led to the selection of a core category.

4.3.9 Selective Coding

The third step of data analysis was selective coding. In this stage, the search is for a core category to build a model that represents the whole idea of the research results. To identify the core category, researchers answer the following two questions: What do all of these categories point out? What is the concept that holds all of the categories together?[133]

For this study, knowledge gap was the core category in the data.[123]All data were related to the lack of awareness of antibiotic resistance. In response to each question posed to the participants, they demonstrated unawareness. When answering, participants discussed their opinions in the context of uncertainty. For example, “I know it had some problem in the liver. It makes some problems in your liver. But I am not sure [what it is];” “I usually go through the whole period of taking them all. I think it’s six days; I'm not sure;” and “I might have heard [about it] from my family or a doctor, but I did not [know] what is it exactly until you explained.”

4.3.10 Memoing and Drawing Diagrams

According to Lincoln and Guba (1985), a qualitative researcher is responsible for establishing a trustworthy study.[134] Different methods of keeping qualitative research trustworthy include “triangulation, keeping a reflexive journal, prolonged engagement, and peer debriefing.”[134] This researcher used memoing as a tool in reflexive journaling in this study. Memoing, in both written and audio formats, started at the time that the analysis began.

Different diagrams showing potential logical relationships among the categories were drawn. In the end, over 10 diagrams and 9 memos were created. Explaining each diagram to

a colleague helped organize the ideas and thoughts to develop a paradigm model of the data (Figure 3).

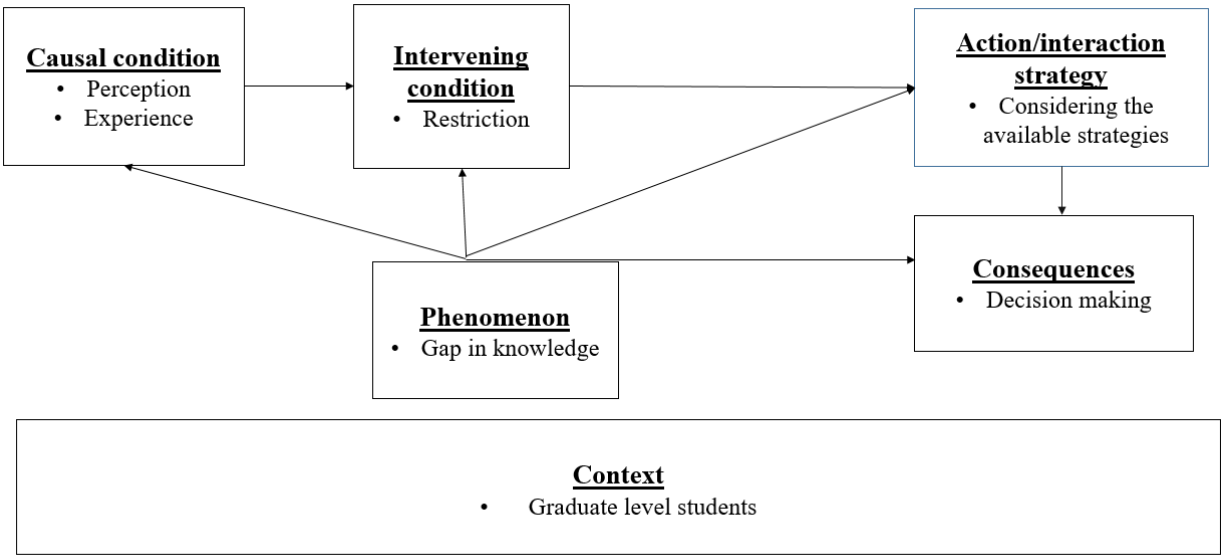

Figure 3—Basic Paradigm

Next, the defined categories were placed in the paradigm model suggested by Strauss and Corbin by identifying them as (1) causal conditions, (2) context, (3) action/interaction strategies, (4) intervening conditions, (5) consequences, and (6) phenomenon.[123] Their paradigm assists researchers in thinking systematically about data and making and perceiving complex connections among categories. Strauss and Corbin argue that unless "you make use of this model, your grounded theory analysis will lack density and precision".[123] The main purpose of using the paradigm model was to display the main categories, subcategories, and the relationships that emerged from the data. All of this is elaborate on in the Results. For

example, the category considering the available options was classified as a strategy whereas experience and perception was categorized as a causal condition.

4.4 Results

The participants from high access countries revealed their levels of awareness regarding antibiotic use and antibiotic resistance in the focus groups. The participants' opinions about antibiotics were organized into 14 subcategories within 6 main categories (Figure 4). In the following section, I will use quotes from the data to provide an in-depth description of each component of the paradigm model. Because the participants were all international students, most of them were non-native speakers of English. Thus, there were a significant number of mistakes and oddities in their statements. In order to simplify the usage of the quotes from them, the term "sic" will be omitted in most cases, and very difficult sections will be revised and included in square brackets.

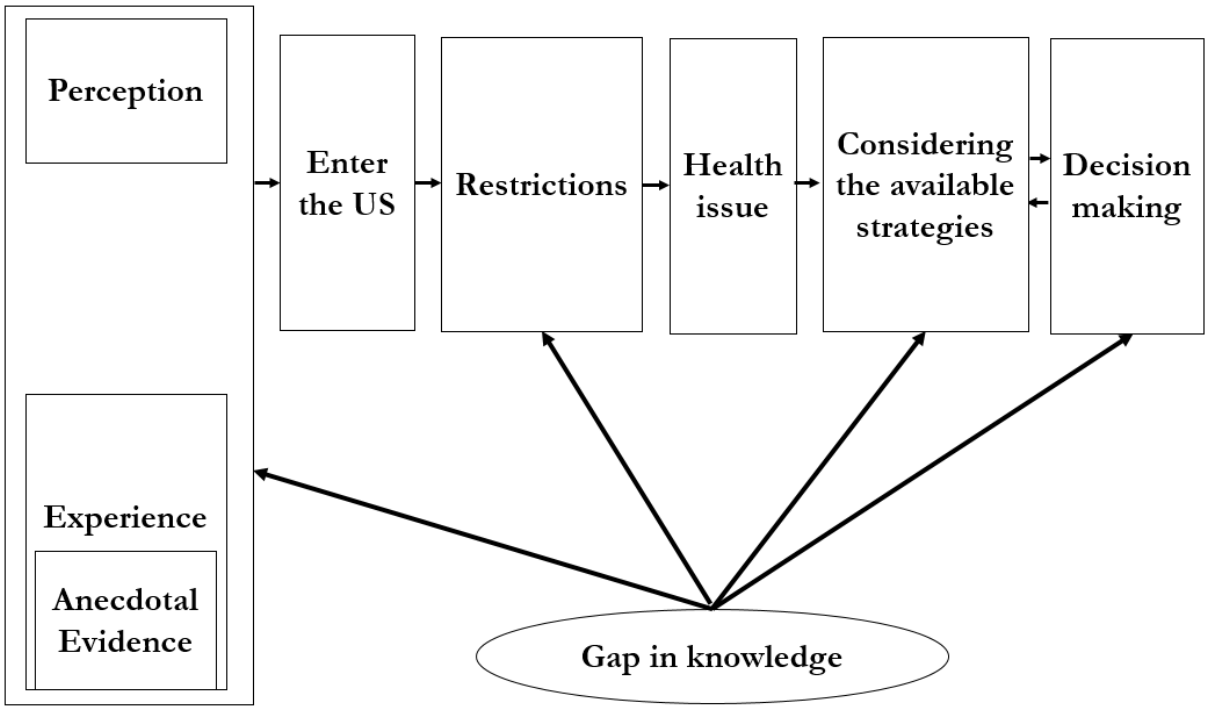

Figure 4—Major Conceptual Categories Derived from the Data Analysis

1. **Causal conditions**

Strauss and Corbin define causal conditions as "the events or incidents that lead to the occurrence or development of a phenomenon."[123] Causal conditions are often indicated in the data by terms such as "when", "while", "since", and "because."[123] Therefore, I used these words to identify causal conditions. In this study, participants' (a) perception and (b) experience were categorized as causal conditions. Two dimensions were also defined within perception: complete awareness and incomplete awareness. Two sub-categories that were revealed from the data went under perception as the main category: antibiotic functionality and antibiotic side effects. Participants' experiences were also defined as other causal conditions. There were two dimensions within participant experience, namely personal

experiences and indirect experiences, referring to stories they had heard. Two sub-categories were under experience: personal experience and anecdotal evidence.

(a) Perception

Participants in this study were familiar with the basic role of antibiotics in the body. They all knew that antibiotics are designed to kill infections. One said, "When you take antibiotics you slow down the progress of infection, and that is usually helpful." Another participant illustrated the functionality of antibiotics by saying "Sometimes … the body is not capable of defending itself so you have to help the body with [an] external weapon." One participant described the functionality of antibiotics in general terms by stating that "As far as I know, it helps the patients heal faster."

People in this study had inadequate knowledge of the side effects of antibiotics. They all believed antibiotics had inevitable adverse effects, but no one was able to name any. One described the side effects of antibiotics: "I know it had some problem in the liver; it makes some problems in your liver, but I am not sure." Another participant in the focus group said that "If you use it for several times it will not work as good as a first time."

(b) Experience

Participants discussed their personal experiences in their home countries. Most of them referred to their childhoods to describe their own experiences with the overuse of antibiotics. One said, "[the] doctor suggest[ed] the medicine, and my parents were OK with that because as long as I was getting well soon, quickly, and I was not missing school, I was not [going to be] absent and all that." Another participant spoke about how the doctors in his country prescribe antibiotics to keep their patients satisfied. He said, "[The doctor] was writing [prescribing] some antibiotics, and my dad told him, [are] all these medicines

actually necessary? And the doctor actually told him no. If you don't want to take them, throw them out. People won't be happy if I don't write them antibiotics, but if you don't need, don't take them. Just go home and rest."

The participants also told some stories about antibiotic over-prescription that they had heard but not experienced personally. For example, one said:

> My friend who … worked with the army for his compulsory duty for a year, he worked in a city in [the] south and small town and people, a lot of under-educated people and he would tell me the stories. People [come] in all the time, and they don't start with describing what's wrong with them. They would start with "hey doctor, write this penicillin [laugh]. Write me this and this and this." They would just tell you what to prescribe; they wouldn't tell you what is wrong. And he would not argue with them that much because he did not want to be beat with stick or something [laughs]. I guess he would try to, but he would not push it because those people were not really happy with the doctor. But yeah, I've heard a lot of anecdote[s] about other people trying, asking a doctor to prescribe antibiotics.

Another participant explained the overuse of antibiotics by pharmacies in her home country. She said:

> The parents of little kids, of little children: The child has the flu, or the child has a fever, or the time [he] has diarrhea or just common childhood diseases, they would just go to the next shop or anyone who is in healthcare, usually a nurse or pharmacist or a mother who already had older kids who [had] the experience of younger kids. So they just get ideas from people:"What do you think I should do?" And go to the pharmacy and tell them give you ampliflac and this and that, but yeah, it's always on demand.

One described this easy access to all kind of antibiotics by highlighting the fact that pharmacies sell the antibiotics as over the counter medicine in his home country. He said: "So back in our country you just go to pharmacy and say I want this [antibiotic], …, like yeah, you can find any antibiotic over the counter."

2. **Phenomenon**

Phenomenon is the concept that holds all categories together. It is the central point of GT and integrates all of the theory's various dimensions. I identified the main phenomenon for

the current study by answering the following questions: What is this data referring to? And what are the action and interaction all about? Answering these two questions helped me determine that a knowledge gap was a core category for the paradigm. Every component of the paradigm was in response to unawareness of or lack of knowledge about antibiotic resistance. I defined two sub-categories under the knowledge gap as (a) knowledge of antibiotic resistance and (b) the urge to be informed. There were two dimensions for this category: The status quo and expected situations. The knowledge gap impacts every step of the process of making a decision about whether to use or to avoid antibiotics.

(a) Knowledge of Antibiotic Resistance

Participants in this study described little to no knowledge of antibiotic resistance. More than half of the participants in this study had not heard of antibiotic resistance before the focus group session. One participant said, "Before [the moderator's explanation of antibiotic resistance], I've never heard of anything about antibiotic resistance and all that." Five of the participants had heard the term "antibiotic resistance," but they did not know what it meant. After hearing an explaination ofing the consequences of antibiotic overuse and misuse and the appearance of antibiotic resistance, one participant described his lack of knowledge by saying "I had a vague idea about [antibiotic resistance] but did not know what it is exactly." One participant who had heard of antibiotic resistance before the focus group believed that other people do not know about antibiotic resistance. He described the ignorance of his friends as follows:

> I believe most of [my friends] think that's science fiction and think of it as a zombie movie …. You know, there is no such thing [as] a supremely resistant bacteria or diseases and curable ones most of them [sic]. I believe my friends, they don't grasp how fast bacteria reproduce and how easy it is to have a million of them in 20 minutes, so they don't really grasp how fast this happens. When I heard about it, it blows my mind.

(B) The Urge to Be Informed

The participants in this study were interested in learning about antibiotic resistance. They took the conversation beyond the original discussion questions by proposing some methods of educating people about the consequences of antibiotic resistance. Participants in this study were all seeking accurate information that would help them make the right decisions.

Many of the participants believed that physicians should educate people about the significance of antibiotic overuse. One said, “I agree with [another participant]: The physicians and the doctors should play a bigger role in this, like [by] educating people.” Another participant said that doctors, nurses, and other healthcare providers should teach people about antibiotic resistance. She said, “I would say the first place to start [educating people] is the point of service, so right from the doctor, the doctor who is prescribing; it’s not hard for doctors [to explain].”

In this study, people were interested in receiving reliable information through media such as TV programs. One participant stated that TV news is an effective way to make a point to the general population. She said, “Advertising from news and media is [a] pretty good way, ‘cause I read news in a newspaper that a girl got sick, and doctors couldn't help her because she already got resistant to all antibiotics and she died. I think the media should show this kind of news and highlight it instead of showing all about wars. In news, we need to see this information that might be worse than war.” Another participant believed that most people watch TV, and thus, they could receive information about antibiotic resistance faster through television than any other medium. He said “[The] media. Yes, that is the way of reaching to people from a different approach. You know, when they watch an advertisement,

and you [could] show someone who took antibiotics and say, 'It's not working. Why?' So that the messages get around very quickly."

3. **Intervening conditions**

For this study, intervening conditions are defined as the broader structural context related to a phenomenon. Restrictions is defined as an intervening condition. Three sub-categories were defined as restrictions: (a) The cost of healthcare, (b) restricted access, and (c) reluctance of doctors. Two dimensions in this category included personal and policy level limitations.

Participants in this study perceived several restrictions on access to antibiotics in the US compared to their home countries. They all had a similar understanding of the strict regulations to access to any kind of antibiotic in the US.

(A) The Cost of Healthcare

The cost of healthcare is extremely high in the U.S., which impacts their decisions to visit doctors with a common cold or flu. One said, "In China, it is very cheap to see a doctor; it is not as expensive as the US. I think in [the] US if you want to see [a] pretty general doctor, it is gonna be expensive. I think maybe around $30." One participant believed that the high cost of visiting a doctor might prompt him to use one of his old medications. He said, "Oh my god. No, it's too much cost. I am an economist, so for each cost I maximize my profit. That's how we [think]. So, basically by knowing that I had this [medication] last time, this was the prescription, and this is what I took, [and] it went away. In this time, it must converge to a true distribution." Another participant wished that antibiotics were OTC in the US because the cost of visiting doctors is so high. She said, "As a general rule, yes, if antibiotics were OTC in the United States, oh, definitely [I would buy them]. It's too

expensive to go pay a doctor make an appointment and [take] time out of your day then wait in the waiting room until they see you and have to [fill] in two forms and insurance."

(B) Restricted Access

All of the participants believed that access to antibiotics is very restricted in the US compared to their home countries, where there are virtually no laws controlling the sale and use of antibiotics. One participant said, "Now compared to the United States … where even penicillin you have to get the prescription to get that. I actually found that really shocking when I came." Another participant compared access to antibiotics in his country and the US by stating, "Generally I know that access to medication here is a lot more difficult [than] in my country."

(C) Reluctance of Doctors

In addition, some participants believed that not only is there a strict policy overseeing the sale and use of antibiotics in the US, but also healthcare providers are reluctant to prescribe antibiotics even when prescriptions are necessary. They described this reluctance as a barrier to access any type of medication in the US. One participant recalled an incident that required her to go to the university's health center for an emergency operation on her toenail. She described the doctors' reluctance to prescribe an antibiotic after her surgery:

> They took my nail off, and it was like a surface of blood, and then they told me here is a surface of blood, and you cannot put your toe in a shoe 'cause it will get infected. Be careful not to get infected. And I was like, okay, now if you are taking off my toenail you should give me antibiotics because it is a blood[y] surface. How I should keep my toe clean all day long for a week? And they were like no, you cannot have antibiotics; it is not that serious. And I was in pain, and I was putting my toe on a chair all day long for a week in class 'cause they did not give me antibiotics, and I didn't have [any] at home. I asked them a lot; I showed them a Google page, you should [speaker's emphasis]. If you take off my nail, you should should [speaker's emphasis] give me antibiotics. I asked [a] dermatologist in Iran, and [the] toe is dirtiest part in your body. [What] do you expect?

Another participant remembered an accident in which he felt an antibiotic was needed, but doctors refused to prescribe one. He said:

> Because I had a bike accident and I scraped like half of my knees, and they just told me [to] keep it clean and put some antibiotic ointment [that] you can buy OTC and just keep it clean, wash it, and put that on top. And I was like, dude, there was a piece of my leg that's gone. A car hit me, there was piece of my leg that is not there anymore. And they were like, "no, no, no, it is ok; you are fine, just keep it clean wash it and put [on] the cream. Put it [on] several times a day, and keep it covered." And I am like okay. I guess. I am another kind of doctor, and I am not that kind of doctor [medical doctor]. But it is common sense that I should get antibiotics.

4. **Action/interactional strategies**

Intervening strategies that facilitate the action/interaction process always exist. Strauss and Corbin (1990) argue that GT is an action/interaction-oriented method of theory building.[123] In this study, considering the available strategies with regard to common health issues was represented as strategies that facilitated the occurrence of the main outcome (decision making). Two dimensions of this category were defined as a traditional approach and modern approach. People used (a) home remedies, (b) leftover antibiotics, and (c) antibiotics from their home countries as traditional approaches and (d) searching for online sources as a modern strategy to deal with the common cold or the flu.

(A) Home Remedies

All participants in this study said that home remedies would be the first option of treatment when they have a minor cold or flu. For example, one participant suggested his uncle's miracle home remedies for the cold: "My uncle would say the best recipe for the common cold is the seven mix; 7 lemons and 7 tequilas, either you forget it, or you get better [laughs]. Either you get better because of the 7 lemons, or you forget it because of the 7 tequilas." Another participant said, "When I feel I am getting [a] cold or [the] flu, I start with natural stuff like soup and tea."

(B) Leftover Antibiotics

Without exception all of the participants in this study said they would keep leftover antibiotics for future use. One participant said:

> So you keep them [antibiotics] around next time when you have an infection, just as you were saying, next time when you have an infection you will be like, hey wait I have some antibiotics. Let's see, are they expired yet? aahh, they will work. How much did I take last time? If you were lucky, then they still have the label that says take three a day. If you are lucky, take 3 for 5 days, and you are like, hmm, okay, cool. Let's count if I have enough. If I don't, let's see how far I can get with them. That's what happens.

Another participant referred to the reason for keeping the leftover antibiotics as her "backup plan:" "I keep my antibiotics as a backup plan [laughs]. If I ever get that again, to avoid going back to the health center, that's basically why." Another participant explained his reason for keeping the leftover antibiotics, stating, "I will keep all my antibiotics because either myself or my family will need them in the future, if I get [a] disease that doctors would prescribe the same antibiotics [for], so I won't [have to] buy it again."

(C) Antibiotics from Their Home Countries

Several participants brought antibiotics to the US to use without consulting a doctor. One participant said, "When a doctor does not prescribe me antibiotics, I use the ones I brought from Iran."

(D) Searching for Online Sources

In this study, students talked about googling as an approach to find the best treatment for their diseases. One of them said:

> I have a back pain, so I have a lot of bottles of prescription painkillers at home, and with Google as our friend, you go and you Google it. I am going to find out what are the other uses of this medicine. Oh yes, there you go. The pain I have right now is on the list, I'll take one of [these]. So, something similar would have happened [with] antibiotics if I had them available as OTC. So, for example, last time I had the flu infection, last time they prescribed me these antibiotics [for] this amount of days; let's

> google the antibiotic. … Selin, let's go to the pharmacy, buy, and take it. I would definitely do it. I would do that in my home country, or other countries [where] antibiotics are available. I definitely would have done that because it's much more efficient.

Another participant reinforced that googling needs to be done through trustworthy sources. She said, "I definitely google it, and I ask relative doctors that I have, the one[s] that I trust. …but if I google, I will google through [trustworthy] sources, not just [anything that] pops up."

5. **Consequences**

Action/interaction is a response to a phenomenon with a certain outcome or consequence. In this study using the focus group data, decision-making as the main outcome of the study. The dimensions of this category were to avoid taking unnecessary antibiotics and seek for antibiotics. Two sub-categories were (a) avoiding unnecessary antibiotics and (b) practicing self-medication.

(A) Avoiding Unnecessary Antibiotics

Several participants in this study shared that they do not take antibiotics for the flu or common cold. One participant said, "… I actually am against taking medicines." Another participant pointed out that he is reluctant to take any kind of medications in the case of the flu or a cold: "…now I completely avoid medicine, for the most part, to be honest." One participant said that he takes antibiotics only in serious cases: "I had an accident. I fell off on my bicycle—that kind of thing. Other than that I usually don't take antibiotics at all." One said he goes for antibiotics only in a situation where he cannot catch up with his studies or work: "Usually, I am like him, I don't take antibiotics unless I have a very high fever or a headache which is not allowing [me] to focus and get the job done. So until that time, I don't

take antibiotics." Interestingly, although many of these students mentioned that they avoid taking antibiotics, they all said that they would keep their leftover antibiotics for future use. This seeming inconsistency will be revisited in the discussion section.

(B) Practicing Self-Medication

On the other hand, several students reinforced taking unnecessary antibiotics and practicing self-medication. One student said, "When I came to the US, I realized that it was not easy to get antibiotics. You have to go to the doctor, and you have to pay a co-pay to receive [an] antibiotic. To be honest, I had [my] parents [send] me some antibiotics from Nigeria. So if I had strep or a sore throat, something that I knew I needed antibiotics [for] and I really didn't want to go and do a co-pay and office visit, I could just use it." Another student explained that she insists on receiving antibiotics from her healthcare provider, "So I tried to push them [doctors] last time to prescribe me antibiotics. I had to push my doctor because they are obsessed with it, so I usually push them to prescribe." Another student said that she practices self-medication using antibiotics she brought from her home country. She said, "I got [a] cold in June, when I came back from Iran in [the] airplane, and then I went to [the] health center, they did not give me antibiotics, but I had [it] myself so I took it."

6. **Context**

Context defines the set of properties that give rise to the main phenomenon to which people respond by means of action/interactions. In this study, graduate students studying at a tier I Research University are defined as a context in the paradigm. All action/interactions of this research occurred in the context of being an international graduate student in the US.

Moderator effect. The moderator eases the process that leads to the emergence of the main outcome. The moderator of the paradigm was determined as dealing with a common health

issue. Since the focus group questions centered on the common cold and flu, only one sub-category was defined as a common cold/flu under the moderator. The participants in this study usually encountered a health issue such as a cold or the flu in their everyday lives. Their discussion throughout the focus groups concentrated on stories of themselves or family members getting a cold. One said, "When I was in college I got [a] cold, and I had to lay on the bed…." Another participant started his conversation by recalling "I remember my mom got [a] cold, and they prescribed her amoxicillin, but it did not work." One participant answered the question by talking about his child being sick. He said, "It is hard to see your child suffering from [a] cold or any other disease."

4.4.1 Storyline

The main purpose of this study is to describe the awareness and knowledge of individuals from high access countries about antibiotic use and resistance. Using GT designed by Strauss and Corbin (1990) to analyze the data from four focus groups, a basic model demonstrating the different components involved in experience of antibiotic use and awarness of antibiotic resistance was developed.

The people from countries with unrestricted access to antibiotics who participated in this study had a *perception* of the performance of antibiotics, but very little understanding of the side effects of antibiotic use. Their perceptions and understanding were shaped by their *experiences* involving unregulated access to antibiotics in their home countries. They witnessed the sale of antibiotics as OTC medication; they experienced the over-prescription of antibiotics by their physicians; and they had heard anecdotes regarding the overuse of antibiotics. Now living in the US, many of the participants had experienced or observed

strictly regulated and *restricted access* to antibiotics in the US. They also noticed that the cost of healthcare is enormously high, and pharmacies do not sell antibiotics OTC. They might have experienced a situation in which a doctor was reluctant to prescribe antibiotics, even when the participant felt they were necessary.

In the case of the flu or common cold, they use these background perceptions and experiences to explore the available options to come up with *strategies*. The available strategies might be employing traditional home remedies, using leftover antibiotics from a previous illness, bringing antibiotics to the US from their home countries, and using online sources to diagnose their illnesses. After assessing the available strategies, they go through a *decision-making* process. Some decide to avoid taking any antibiotics and visiting doctors, and some not only seek antibiotics but practice self-medication with them.

The whole process happens within the context of being graduate level students in a tier I Research University. The entire process, from the starting point of living in a high access country and being exposed to antibiotic overuse to the end point at which they make a decision regarding the illness is influenced by a *knowledge gap*. Lack of adequate education on antibiotic use, complaints about restricted access to antibiotics without knowing the specific reason behind such regulations, evaluating available treatment options without any knowledge of the consequences, and finally, making a decision without being properly informed all illustrate that people are not aware of the spread of antibiotic resistance and the significance of such a public health crisis.

4.5 Discussion

This study sought to create a theoretical model that reflects the knowledge of and experiences with antibiotic use and antibiotic resistance among people from countries with unrestricted access to antibiotics.

What was particularly salient about participants' common experiences was the struggle they experienced when facing the US healthcare system, which required them to go through an evaluation process before any critical health decision. The main findings of the study appeared consistent with results from previous research. In the current study, participants had basic knowledge of the function of antibiotics, and incomplete knowledge of the side effects of antibiotic use. They all perceived that an antibiotic is a useful medication for fighting infections or disease in general; yet they were unware of the consequences of antibiotic overuse and misuse. One study found that out of 1,002 participants in a survey, 70% of the group showed appropriate knowledge of antibiotics.[135] A population-based survey conducted in 1998—1999 in Connecticut, Minnesota, and Oregon, and selected counties in California, Georgia, Maryland, and New York found that 58% of patients were not aware of the possible dangers and side effects of antibiotics.[136]

Participants were faced with the restricted access to medications in the US immediately after arrival. For most of the participants in this study, controlled access to medications, including antibiotics, was a novel experience. Despite admiration for the healthcare services in the US, participants perceived the relatively high cost of healthcare, physicians' reluctance to prescribe necessary antibiotics, limited access to antibiotics, and rigid policies that oversee the sale of medicine as inconvenient barriers that negatively impacted their experience with the US healthcare system. The lack of adequate knowledge

about antibiotic resistance might be one reason the participants interpreted such policies as barriers rather than as something positive such as safeguards. These participants had never been educated about the use of antibiotics nor been informed about the reasons behind such restrictive policies.

The high cost of healthcare and the restrictive policies regulating the sale of antibiotics as well as other medications are two features of the US healthcare system that are very well documented in the literature.[137,138] Many studies highlight the fact that physicians tend to over-prescribe antibiotics, but the best of our knowledge, not many studies showing that physicians are reluctant to prescribe antibiotics in the US are available. Presumably, the participants in this study avail themselves of the healthcare services at the university health center which might justify the physicians' reluctance to prescribe necessary antibiotics. There is not ranking system (five stars ranking on performance) available for physicians who practice in the university's health center, which can rationalized the reason of being reluctant to give out antibiotics (physicians do not face a pressure from ranking system). More research needs to be done to investigate a physician's tendency to prescribe antibiotics, especially in university health centers.

In line with previous studies, our results suggest that many will consider using antibiotics left over from a previous illness in the case of a common cold or the flu. Ceaser and Wurtz (2000) interviewed 101 randomly selected adults on a city street to determine how many would keep leftover antibiotics for later use; they asked select people several questions, and one of the questions was related to leftover antibiotics: "Would you take the leftover antibiotic if you were sick without first consulting a health care provider?" They found that approximately 26% of people had saved antibiotics from a prescription that was not

completed. Half of the interviewees took or had taken the remaining antibiotics without consulting a health care provider.[139]

However, when are confronted with mild illnesses, e.g., a runny nose, the participants indicated they would rely on home remedies as a first step in treatment. A cross-sectional descriptive study with children visiting a pediatric outpatient clinic was conducted in which researchers found that 52% of those children were using a prescription medication at the time of the survey; 36% used natural products such as herbal remedies; and 19% used both simultaneously for a total of 69% of the children sampled using some medication at the time of the survey.[140] Further investigation is needed to form a comprehensive picture of the nature and process of how international students evaluate available options when they have common health issues.

Based on the focus group findings, individuals use their knowledge and experiences along while considering available treatment options to make a decision about how to take care of their health in the case of a common cold or flu. Knowledge and experience can lead them in opposite direction when it comes to making a logical decision: avoiding unnecessary antibiotics or seeking (unnecessary) antibiotics out. This finding echoed that of an earlier study in which researchers found that subjective knowledge, objective knowledge, and usage experience play a vital role in the decision-making process in real situations.[141] Similarly, 90 randomly selected participants were interviewed and the effect of prior knowledge and experience on decision-making was consistent among the majority of participants.[142] Educating people about antibiotic resistance will aid them in making the right decision.

The majority of the participants in this study stated that they completely avoid taking antibiotics whenever possible, but when asked what they do with their leftover antibiotics,

every one of them admitted to keeping them for future use. Presumably, social desirability bias plays a role in this inconsistency. In answering a question that directly targeted antibiotic use, the participants claimed that they would not take any antibiotics. However, in response to the question indirectly targeting the misuse of antibiotics, they all agreed that they would save antibiotics for future use. This could be rationalized by lack of knowledge about the consequences of antibiotic overuse and misuse. Although most participants in this study had heard the term antibiotic resistance before participating in this study, they did not know its meaning nor understand the potential danger this poses for themselves, their families, and their communities through the possibility of becoming infected with antibiotic-resistant bacteria. These results are consistent with a 2007 study in 12 European countries that found out of 1,101 respondents in the study, half of them were not aware of antibiotic resistance.[143]

In the current research, participants said receiving accurate information through reliable sources aids them in making a sound decision. All believed they lacked information on the appropriate use of antibiotics. Evidence-based information can help people make reasonable decisions that result in a better outcome.[144] However, not enough educational information and opportunities are available to assist people in making good decisions regarding antibiotic use, in particular the importance of avoiding unnecessary use of antibiotics. To the best of our knowledge, there has not been a study in which an intervention was used to educate people on the consequences of antibiotic overuse/misuse, and specifically among people from high access countries.

4.6 Limitations

This study was developed and implemented carefully to ensure that the results would accurately represent the views and opinions expressed by the participants during data collection. As with any social science research, some limitations exist. First, the focus groups were conducted in the context of international students in graduate school; therefore, significant differences might well exist between the sample and the general population. Such differences might provide insights into understanding the reasons behind individuals' choices and their robust opinions about antibiotic use against viral diseases. Similar research in the general populations of the US and other countries would provide much information from a much broader sample. A broad cross-section sample from the general population would provide needed information on how to go about changing the social norms regarding antibiotic use.

Furthermore, the main source of healthcare in the US for many of the participant in this study was the university's student health center. Therefore, the paradigm model was focused primarily on this single source of healthcare experiences, which inhibited access to a broader experience with prescription behavior in different healthcare settings such as hospitals, office-based physician practices, and other clinics.

4.7 Conclusions

In summary, one of the most notable and frequent themes throughout all stages of the data analysis was the lack of adequate knowledge regarding antibiotics. The path toward increasing awareness about antibiotic resistance is complex; policy makers need to consider that the overuse of antibiotics stems from the population's strong attitudes toward antibiotics.

Thus, investing in educating people would be an effective way to change such beliefs. Additionally, policies need to be translated into appropriate regulations in order to change people's behaviors. Zamir (2014) argues that legal regulation can achieve its goals directly through creating fear of sanctions or desire for rewards. However, it can also accomplish its goal indirectly by changing mindset about the regulated behaviors.[145] Interestingly enough, Zamir (2014) discusses that this indirect path has the potential to be the most effective one. Such indirect regulation could be encouraging people to get flu shots to avoid getting a flu or cold.[145]

The theoretical model that this research proposes is the fact that providing the right information at the right time will enable people to make sound decisions to avoid unnecessary antibiotic use. The findings of this study will open a new path toward understanding the consequences of the lack of information and antibiotic overuse.

The participants in this study were all graduate-level students at a tier I Research University in the United States; these people with new information on a daily basis. Even so, many of them had not heard of antibiotic resistance before participating in a focus group session for this study. This brings us to the question that needs further investigation: How can we expect the general population, a less educated population than the participants, to be aware of such dangers and avoid unnecessary use of antibiotics when even the most educated part of the population, with high access to information, is not aware of them.

4.8 Implications of the Study

These results have implications for healthcare providers as well as healthcare organizations and agencies around the world. Nurses, physicians, and other healthcare

providers can see that many people are eager to know and learn, and perhaps this will encourage them to take the first step in educating people about the consequences of antibiotic overuse and misuse. Health care providers need to spent time with a patient and explain on how to use the antibiotics appropriately. The WHO needs to take action to encourage the stricter regulation of access to and use of antibiotics in high access countries. Without taking a global action tackling antibiotic resistance locally is unachievable. Using mass media and social media to share information with the general public could ease this process. The results of this study suggested that CDC needs to address the educational need of people from other countries in any stewardship programs (such as Get Smart) that implemented in the US in order to oversee antibiotic use and prescription.

CHAPTER V

CONCLUSIONS

The purpose of this dissertation was to better understand the human and social causes of antibiotic resistance. As part of this, one goal was to propose possible means to change people's use of and physicians' prescription behaviors regarding antibiotics. This dissertation achieved these goals by answering the following research questions:

1. How do family medicine residents in an integrated health system describe antibiotic over-prescription?
2. In case of a viral origin disease, what is the association between time spent with a doctor during a visit and antibiotic prescription?
3. How aware are individuals about antibiotic resistance?
4. What are individuals' experiences of using antibiotics?

5.1 Summary of the Three Studies

The first paper, "Toward Better Understanding Physicians' Perspectives on Antibiotic Over-Prescription: A Qualitative Study of Family Medicine Residents in an Integrated Health System in South Texas," explained the reasons for antibiotic over-prescriptions from the point of view of family medicine residents. Three main themes (using the grounded theory methodology) arose from 16 interviews with family medicine residents working under an integrated health system. The results of this study showed that working hurried schedules with a vulnerable patient panel could lead physicians to over-prescribe antibiotics based on a 'better safe than sorry' practice of medicine. Patients' perceptions of when they should receive antibiotics, which stem largely from online sources and interpersonal relationships

(outside sources of information), can play a vital role in the over-prescribing of antibiotics. However, an antibiotic control system (the integrated health system utilized to oversee antibiotic prescription) could moderate these impacts and lead to the more appropriate prescription of antibiotics.

The second paper, "Factors Associated with Antibiotic Prescriptions for Viral Origin Diseases by Office-Based Physicians from 2006–2012," measured the effects of several determinants on the prescription of antibiotics in office-based settings. The main variable of interest was "duration of visit". I determined whether prolonged visits/encounters would lead to better explanations about disease mechanisms from the doctors to the patients, and consequently, fewer unnecessary antibiotic prescriptions. I found that for every additional minute spent with a physician during a visit, the predicted probability of receiving antibiotics for the common cold, runny nose, bronchitis, flu, fluid in the middle ear, and sore throat will decrease. Moreover, there was a statistically significant association between unnecessary antibiotic prescription and patients' gender, being privately insured, the rate of antibiotic prescriptions for each physician, and the interaction of time and family medicine specialty.

The third paper, entitled "Tackling Antibiotic Resistance: A Qualitative Study of People's Experiences and Awareness of Antibiotic Resistance," explained individuals' knowledge of antibiotic use and resistance. In total, 20 international students from countries with high access to antibiotics that were studying in a tier I Research University participated in the study and revealed their level of knowledge about antibiotic use and resistance. I found that people who came from countries with high access to antibiotics had limited knowledge of antibiotic resistance. Faced with the restrictive policies governing access to antibiotics in the U.S., they failed to appreciate the reasons for such limitations. Subsequently, when met

with a viral origin disease, they engaged in a decision making process to explore and choose from various different options to cope with their disease. The participants in this study all felt that they had little or no knowledge of antibiotic resistance, which impacted their decision-making process. Participants in this study reported a paucity of knowledge and awareness about antibiotic stewardship, both in their country of origin and since arriving in the United States.

5.2 Placing the Papers in the Context of the Literature

This body of work adds to the literature exploring the causes of antibiotic resistance, and serves to highlight the need for immediate implementation of antibiotic stewardship in the U.S. This new contribution goes beyond a single cause of antibiotic resistance; it describes the phenomenon of over-prescribing, overuse, and misuse of antibiotics through three related studies.

The results of this dissertation are echoed by previous literature. In terms of antibiotic over-prescription, Welschen et al. (2004) argued that approximately 30–70% of patients with upper respiratory tract infections expect to be prescribed antibiotics, and physicians assume that prescribing antibiotics will increase patient satisfaction.[146] This result aligns with the findings of this dissertation, which concludes that physicians over-prescribe antibiotics due to their busy schedules and the pressure to meet patients' expectations, which lead physicians to often overlook or bypass the monitoring system.

With regards to visit duration and unnecessary antibiotic prescription, Lundkvist et al. (2002) found that spending more time in a doctor's office will lead to fewer antibiotic prescriptions, [99] which aligns with the results of this dissertation, which finds that every

additional minute spent in doctor's office will lead to a 2.4% decrease in the likelihood of unnecessary antibiotic prescriptions.

With regards to people's awareness of antibiotic resistance, Vanden Eng et al. (2003) found that the majority of people who participated in a telephone survey were not aware of antibiotic resistance.[136] The third paper of this dissertation found that people who came from countries with high access to antibiotics demonstrated a paucity of knowledge and awareness about antibiotic resistance.

5.3 Limitations

The body of work presented here should be viewed in light of several limitations. Prescribing is a dynamic process. It involves different factors, such as a patient's comorbid conditions, illness severity, duration of diseases, doctors' levels of experience, etc. Although I controlled for many different factors in our quantitative work, the aforementioned factors, which might substantially impact the prescribing of antibiotics, were absent in the NAMCS dataset, and were therefore unaccounted for.

Despite the fact that I reached the saturation level during the data collection in our qualitative studies, conducting more interviews with physicians from different specialties will enable us to have a more in-depth and comprehensive understanding of the reasons for antibiotic over-prescription, and will allow us to build a paradigm model that explains the over-prescription phenomenon from physicians' point of view. In addition, conducting focus groups among less educated people will allow us to have a broader picture of the general populations' behavior of antibiotic use and knowledge of antibiotic resistance.

5.4 Conclusions

In short, encouraging people to make healthy choices has become an essential component of public health policy.[147] However, as healthcare professionals, we cannot expect individuals to take responsibility for their lifestyle choices and personal wellness, which impact their own health and in the case of antibiotic resistance, the health of the society as a whole, if we do not ensure the availability of appropriate information.[148] Unfortunately, very few resources are available to educate people on avoiding the irrational use of medication, especially antibiotics. However, educating patients alone is not enough. More needs to be done to control the prescription of antibiotics from the physicians' side, including the implementation of more stewardship programs across the US and around the world. To that end, policymakers need to find ways to institute policies that both promote patient education and regulate prescription behaviors.

5.5 Future Studies

Without a doubt, social science disciplines have never enjoyed the vast resources of the natural/life sciences, which have largely focused on producing novel drugs and diagnostics tools; however, far fewer resources have ever been allocated toward the education of people on how to appropriately use the existing drugs and tools. The social sciences need theoretically founded, practical guidelines on how to make significant progress with limited resources.[149] Society has an immediate need to identify the factors associated with high rates of antibiotic resistance and their relationships. Comprehensive data containing behavioral information will be useful in designing and implementing interventions to oversee the rampant spread of antibiotic resistance.

The studies in this dissertation will be continued to further increase our knowledge and understanding of antibiotic resistance while seeking useful techniques to counteract the spread of antibiotic resistance. The first study will be expanded by conducting further interviews with physicians from different specialties working in different healthcare systems. The second will continue by analyzing the effect of physicians' medical education, specifically whether physicians are graduates of US or foreign medical school, on unnecessary antibiotic prescription. The third study in this project will seek to extend its findings by conducting additional focus groups with people from more diverse backgrounds to attain a more complete understanding of people's lack of knowledge of antibiotic resistance.

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