ANTIBIOTIC PRESCRIBING PRACTICES OF CLINICAL OFFICERS FOR PATIENTS WITH UPPER RESPIRATORY TRACT INFECTION AT KIAMBU COUNTY, KENYA

BY

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University, or for any other award.

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DEDICATION

I dedicate this study to my family, especially my wife Wanjiru who helped me immensely during the study. I want to remember my daughter Mbula whose joy kept me going.

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ABBREVIATIONS AND ACRONYMS

AMR	Antimicrobial Resistance
ARF	Acute Rheumatic Fever
ASP	Antibiotic Stewardship Program
CDC	Centers for Disease Control and Prevention
DDD	Defined Daily Dosage
ESAC	European Surveillance of Antimicrobial Consumption
ESPAUR	English Surveillance Program for Antimicrobial Utilization & Resistance
EU	European Union
GAS	Group A Streptococci
GLASS	Global Antibiotic Surveillance System
ICU	Intensive Care Unit
KEML	Kenya Essential Medicines List
KU	Kenyatta University
KUERC	Kenyatta University Ethics and Review Committee
LMIC	Lower- and Middle-Income Countries
NSAID	Nonsteroidal Anti-inflammatory Drug

ODK	Open Data Kit
RADT	Rapid Antigen Detection Test
SPSS	Statistical Package for Social Sciences
STGS	Standard Treatment Guidelines
URTI	Upper Respiratory Tract Infections
USA	United States of America
UTI	Urinary Tract Infections
WHA	World Health Assembly
WHO	World Health Organization

DEFINITION OF OPERATIONAL TERMS

Antibiotics - The CDC defines antibiotics as "medicines that treat diseases caused by bacteria in humans and animals by either killing or inhibiting the bacteria's ability to grow and proliferate."

Defined Daily Dosage - Defined by the WHO as the daily average maintenance dose for a medication used in adults for its major indication.

Irrational Use - Defined as overuse, misuse or incorrect use of medication.

Rational Use - Defined as patients receive pharmaceuticals that are appropriate for their clinical needs, in doses that fit their specific needs, for an adequate period, and at the lowest possible cost to them and their community.

ABSTRACT

According to the World Health Organization (WHO), over 50% of all medicines are prescribed, dispensed or sold inadvertently, and more than half of all patients take them incorrectly. Antibiotics are the most routinely prescribed medications. Antibiotics are incorrectly prescribed for viral illnesses and broad-spectrum antibiotics are being used in place of narrow-spectrum antibiotics. Antibiotic resistance has emerged because of incorrect antimicrobial treatment and misuse of antibiotics. Findings from studies have shown an association between prescriber factors, patient factors, institutional factors and antibiotic prescribing. There is scarce data in Kenya about antibiotic prescribing practices, factors affecting antibiotic prescribing, how it varies between different healthcare workers and the mechanism by which interventions are effective. The goal of this study was to figure out antibiotic use among patients with upper respiratory tract infections in Kiambu County. The study design was a cross-sectional hospital-based study. The study area was one public level 5 hospital, five public level 4 hospitals and 14 public health centers within Kiambu County. Data was collected in the form of a modified WHO prescribing indicators checklist and using questionnaires. The WHO prescribing indicators checklist on rational use of medicine was used to collect data from 600 patient encounters. The questionnaire was used to collect data from 36 clinicians working in the outpatients. The data from the checklist included the total number of medications prescribed per encounter, the number of encounters with antibiotics, the proportion of generic antibiotics prescribed, the proportion of antibiotics prescribed from the Kenya Essential Medicines List (KEML), the antibiotic prescribed, its dose, frequency, duration and indication. The data from the questionnaire included prescriber age, gender, level of education, work experience, laboratory availability, availability of antibiotics and availability of guidelines. An Open Data Kit (ODK) was used to collect the WHO data collection checklist. Data was imported into a Microsoft Excel sheet from the ODK server then exported to a Statistical Package for Social Science (SPSS) version 22.0 for further cleaning and analysis. Descriptive statistics of frequencies and percentages were used to summarize categorical variables, and median (interquartile range) was used in case of continuous variables. Logistic regression was employed to find the association between antibiotic prescribing and the prescribing factors. Odds ratio with 95% confidence interval was reported in the logistic regression analysis. All analysis were considered significant when $p < 0.05$. Antibiotics were prescribed in 78% of patient encounters, 96.8% of encounters with an antibiotic had a generic antibiotic, and 96.6% of antibiotics prescribed were from the KEML. Over 91% of antibiotics prescribed were the right dose, 98.3% were the right frequency, 75.2% were the right duration, only 23.8% was the right indication. Availability of antibiotics p=0.026 and availability of hospital guidelines p=0.012 were significantly associated with rational antibiotic prescribing. Patient fever significantly affected rational antibiotic prescribing (OR 4.7, 95% CI 2.49, 8.89, p=<0.001), patient age and gender did not significantly affect antibiotic prescribing. Prescriber gender, p=0.63, age, p=0.92, education level, p=0.99 and work experience, p=0.22 did not significantly affect antibiotic prescribing.

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Antibiotic usage in 76 countries increased by 65% between 2000 and 2015 (Klein et al., 2018). Global antibiotic consumption rate rose from 9·8 (9·2–10·5) DDD per 1000 per day in 2000 to 14·3 (95% uncertainty interval 13·2–15·6) defined daily doses (DDD) per 1000 population per day in 2018 (40·2 [37·2–43·7] billion DDD)(Browne et al., 2021). This rise was occasioned by increased use in low and middle income countries (Richard T. Ellison III, 2018). Antibiotic prescribing was found to be very common in health institutions in Ethiopia (Worku & Tewahido, 2018). A Kenyan study done at Jaramogi Odinga Referral Hospital found antibiotic consumption to be increased(Okoth et al., 2018).

Antibiotics have been in existence for millennia, it is only as recent as 1928 that penicillin was discovered (Society, 2018.) They target and block biological mechanisms that cause cell death and limit growth (Richardson, 2017). Since the inception of mass production of antibiotics in the early 1940s, antimicrobials have been effectively used to treat and cure diseases borne by bacterial infections (Society, 2018). Despite no new discoveries or development of any new classes of antibiotics since 1987 (Hutchings et al., 2019), the antibiotic consumption rates have been on the rise globally with resultant development of antibiotic resistance (CDC, 2018). The CDC linked this resistance to antibiotic overuse and misuse, which promotes the growth of microorganisms resistant to antimicrobials (CDC, 2020).

Antimicrobial resistance (AMR) is a problem that affects all countries, regardless of their money or development level, because resistant organisms do not respect boundaries (W.H.O., 2018). The World Health Organization reported that bacterial AMR was directly responsible for 1.27 million global deaths in 2019 and contributed to 4.95 million deaths (Murray et al., 2022). A study in Europe found that over 33000 deaths occurred yearly due to AMR (Cassini et al., 2019). Immediate and urgent action is required; otherwise, we risk entering a new period in which diseases and simple injuries can kill people again (WHO, 2018a).

According to the WHO, over 50% of all medicines are prescribed, dispensed or sold inadvertently, and more than half of all patients take them incorrectly (WHO, 2004). This inadvertent use was defined as irrational use. Irrational use is further described as overuse, misuse or incorrect use of medication. Antibiotics were the most frequently prescribed medicines in health facilities (Kimang'a, 2012). Outpatient antibiotic use accounted for around 80-90% of all antibiotic use in patients in a study done in England (Public health England, 2018). Antibiotics are mostly prescribed for acute respiratory infections (ARIs) despite these ARIs being viral for which antibiotics have no role in treatment (Havers et al., 2018). The most common indication for antibiotics in the outpatient setting was for treating upper respiratory tract infections despite more than 80% of URTIs being viral in nature (Kunda, 2015).

This inadvertent use of antibiotics can be improved by designing interventions targeting the gaps in prescribers' knowledge and attitudes (Figueiras et al., 2020). Another study showed that improving diagnostic procedure in general practitioners led to marked

reduction in antibiotic prescribing (Bjerrum et al., 2011). Studies have shown that prescribers have poor knowledge and misgivings concerning the use of antibiotics (Rezal, 2015). There is a paucity of knowledge about prescriber related behavior and how it varies between healthcare workers that prescribe or the mechanisms by which interventions can be deemed effective(Parker & Mattick, 2016) even more so in Kenya.

1.2 Problem Statement

Prescribing medication can be described as rational or irrational. Rational use of medication dictates that the right medication be administered, that it be available at the right time, that it be dispensed appropriately, and that it be taken in the right dose (W.H.O., 1985). Antibiotics are indicated in bacterial infections but were irrationally prescribed for viral infections (Imanpour et al., 2017a). Improper administration of antibiotics occurred in over 60% of people with URTI according to the WHO (Kunda et al., 2015a). Approximately 30% of antibiotic prescriptions were found to be inappropriate in a study done in the USA (Fleming-Dutra et al., 2016). According to research done in Tanzania, 67% of patients with URTIs received antibiotics (Mavura et al., 2018).

Antibiotics were amongst the most frequently used medications worldwide (Omudhome Ogbru, 2020). Antibiotic usage increased significantly in 76 countries between 2000 and 2015, owing to a large increase in consumption by low- and middle-income nations (LMIC)(Klein et al., 2018). The high antibiotic use in LMICs was linked to increased prevalence of infectious diseases, poor regulation or implementation in limiting over-the

counter antibiotic sales, insufficient healthcare worker education, and the unavailability of essential diagnostics (Sulis et al., 2020).

In 2019, the WHO named antimicrobial resistance as one of the top ten global dangers (WHO, 2019). Antibiotic use was identified as the primary selective factor generating antibiotic resistance (Goossens et al., 2005). Antibiotic overuse and misuse were identified as major contributors to AMR (Roberts, 2021). There have been efforts to decrease inappropriate prescribing of antibiotics with strong general commitments, however there are differences across health systems worldwide (Roberts, 2021).

Upper respiratory tract infections are common ailments that often lead to antibiotic prescriptions. They are one of the most common illnesses, leading to more primary care provider visits and absence from work and school than any other illness every year (Children's Hospital of Philadelphia, 2024). Inappropriate use of antibiotics contributes to antibiotic resistance. There is limited understanding of the prescribing patterns of clinical officers for URTIs, which may lead to overuse or misuse of antibiotics. Despite the importance of appropriate antibiotic use, there is a lack of comprehensive studies examining how clinical officers prescribe antibiotics for URTIs in Kenya. Understanding these prescribing patterns is essential to develop targeted interventions that can improve antibiotic use and reduce the risk of antibiotic resistance.

This study aims to investigate the prescribing patterns of clinical officers for patients with upper respiratory tract infections in Kiambu County, Kenya. The goal is to assess the appropriateness of antibiotic use for patients with upper respiratory tract infections.

1.3 Justification

Outpatient antibiotic use accounted for around 90% of total antibiotic consumption, with over half of these prescriptions being either unneeded or unsuitable (Dyar, 2016). The number of antibiotic prescriptions given for URTIs was found to be excessive and incorrect in various studies (Gwimile, 2012; Mavura et al., 2018). Despite 80% of URTIs being viral in nature, antibiotics were inappropriately prescribed in 60% of cases (Kunda, 2015). Antibiotics were found to be ineffective in URTIs caused by bacterial infections (Arroll, 2005).

Flu accounted for 35.3% of all hospital visits in Kiambu County, followed by Malaria (18.6%), Respiratory Tract Infections (9.7%), and Ear, Nose, and Throat Infections (3.1%) (Kiambu County Government, 2015). In 2016, Respiratory illnesses were the top cause of morbidity in the county with 1,006,395 hospital cases followed by 190,576 cases of skin disease (Kiambu County Government, 2018). In Kiambu County, health services in the level 5, level 4 and level 3 hospitals are offered in outpatient and in-patient departments. The primary workforce responsible for prescribing and treatment of patients in the Outpatient departments are the clinical officers while doctors are the primary caregivers responsible for treatment and prescribing of medication for patients in the inpatient departments. Nurses act as the primary caregivers in the level 2 (dispensaries) within the county. In Tanzania, a study on antibiotic use for patients with URTI found that irrational antibiotic prescribing was significantly linked to the prescriber's status as a clinical officer (Gwimile, 2012).

Global data indicated antibiotic use as highest in outpatient departments (Public health England, 2018). Antibiotics were found to be prescribed mostly for upper respiratory tract infections in the outpatient department (Kunda et al., 2015b). This study focused on clinical officers because there is scarce information about the antibiotic prescribing practices of clinical officers. Most global studies on antibiotic use among primary care prescribers focus on doctors, medical students and registrars and physician assistants. The goal of this study was to assess the appropriateness of antibiotic use for patients with upper respiratory tract infections. Identification of the prescriber, patient and institutional determinants and improving the antibiotic prescribing practices will help improve health outcomes.

1.4 Research Questions

1. What are the antibiotic prescribing practices of clinical officers for patients with upper respiratory tract infection in Kiambu County?
2. What are the factors that determine antibiotic prescription among clinical officers for patients with upper respiratory tract infection in Kiambu County?
3. What are the types of antibiotics prescribed to patients with upper respiratory tract infection by clinical officers in Kiambu County?
4. What is the association between the clinical officers' antibiotic prescribing practices and the factors that determine antibiotic prescribing for patients with upper respiratory tract infections in Kiambu County?

1.5 Hypothesis

1. Null Hypothesis: There is no association between the clinical officers' antibiotic prescribing practices and the factors that affect antibiotic prescribing for patients with upper respiratory tract infections in Kiambu County.

1.6 Objectives

1.6.1 Main Objective

1. To determine the clinical officers' antibiotic prescribing practices for upper respiratory tract infection in Kiambu County.

1.6.2 Specific Objectives

1 To determine the factors that determine antibiotic prescription among clinical officers for patients with upper respiratory tract infection in Kiambu County.

2 To determine the types of antibiotics prescribed to patients with upper respiratory tract infection by clinical officers in Kiambu County.

3 To determine the association between the clinical officers' antibiotic prescribing practices and the factors that determine antibiotic prescribing for patients with upper respiratory tract infections in Kiambu County.

1.7 Significance and Anticipated Outputs

This study provided valuable information to several stakeholders such as the Kiambu County Health Office, the health facility heads, the health workers as well as the citizens of Kiambu County who seek treatment in the facility. The information attained provided valuable understanding of the factors influencing antibiotic prescribing for patients with upper respiratory tract infection. The goal of this research was to analyze how clinical

officers prescribe antibiotics for patients with upper respiratory tract infection in Kiambu County and by extension, Kenya. The information collected will help improve rational prescribing of antimicrobials in the county, and by extension the country. Ultimately, the study aims to improve patient outcomes and public health by promoting rational antibiotic use.

1.8 Delimitation and Limitation

The study only targeted public facilities yet some patients obtain treatment from private facilities. Some patients seek care in public facilities but purchase antibiotics from private facilities. The data may not apply to private facilities. The study was conducted over a short period of time, which may not fully capture the effects of the study variables compared to a longer time frame. Laboratory testing was also not assessed in the study, comparisons could have been made between testing for bacterial throat pathogens and whether antibiotics were prescribed. Antibiotic resistance testing was not done. This could have provided vital information on local antibiotic resistance patterns.

1.9 Conceptual Framework

The association between the independent and dependent variables formed the conceptual framework. The independent variables included prescriber factors, patient factors and institutional factors. These prescriber factors were age, gender, level of education, cadre and duration of work. The patient factors were age, gender and temperature. The institutional factors were laboratory support, availability of antibiotics and availability of hospital guidelines. The dependent variable was antibiotic prescribing practice. In this

study, the independent variables influence the outcome. Figure 1.1 further depicts the relationship between the variables (independent and dependent).

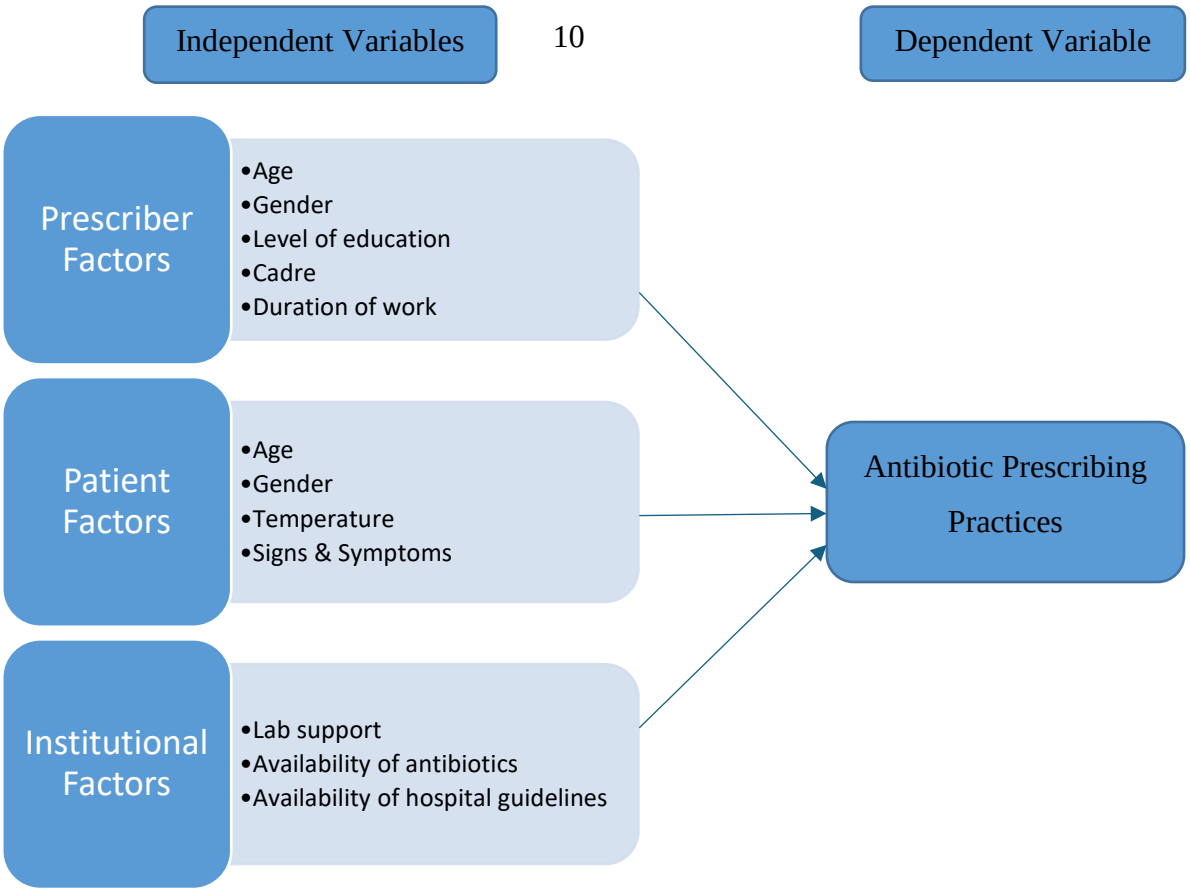

Figure 1.1: Conceptual Framework

Source: Conceptual Framework adapted and modified from the Literature Review

(Choi et al., 2012a; Momanyi et al., 2019; van Buul et al., 2014)

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The consumption of antibiotics is at an all-time high according to studies on global antibiotic consumption. The worldwide antibiotic consumption rose by 65% from 2000 to 2015 (Klein et al., 2018). Global antibiotic consumption rate rose from 9·8 (9·2–10·5) DDD per 1000 per day in 2000 to 14·3 (95% uncertainty interval 13·2–15·6) defined daily doses (DDD) per 1000 population per day in 2018 (40·2 [37·2–43·7] billion DDD (Browne et al., 2021). This rise was attributed to low- and middle-income nations. Increases occurred in all four of the most commonly prescribed antibiotic classes (broad-spectrum penicillins, cephalosporins, quinolones and macrolides) and even in newer classes (carbapenems, glycyclines and oxazolidinones)(Richard T. Ellison III, 2018). The increased usage of last-resort antibiotics, as well as the increased consumption of antibiotics, presents serious public health issues (Van Boeckel et al., 2014). The rise in antimicrobial resistance has been occasioned by incorrect use and misuse of antimicrobials (Hashemi et al., 2013). Antibiotic resistance was linked to poorer health outcomes, longer hospital stays, higher costs for both the patient and the government, and a higher mortality rate (Mboya et al., 2018). Countries should encourage the appropriate use of antibiotics.

Most antibiotic expenditures were linked to the outpatient setting (Public health England, 2018). According to the English surveillance program for antimicrobial utilization and resistance (ESPAUR), approximately 80-90% of antibiotics were prescribed in the outpatient setting (Public health England, 2018). Worldwide, studies showed that use of antimicrobials was inappropriate, ineffective and economically inefficient (Shah, 2008).

According to the CDC, over 30% of antibiotics administered in outpatient were unwarranted (CDC, 2020). It is imperative to examine outpatient prescribing practices and put in place a system to address issues that need to be addressed (Kotwani et al., 2012). Despite the years of overuse and misuse of antibiotics, access to antibiotics remains a major problem worldwide. The impact of antibiotic resistance and how it is affected by primary care prescribing and individual prescribing decisions needs to be emphasized to prescribers (Fletcher-Lartey, 2016).

2.2 Upper Respiratory tract Infections

A study assessing outpatient antibiotic use in the USA found antibiotics were frequently administered for illnesses that did not necessitate their use (Hicks et al., 2015). Upper respiratory tract infection is characterized by self-limited inflammation and edema of the upper airways with cough, with no signs of pneumonia, no other medical explanation for the symptoms, and no history of COPD/emphysema/chronic bronchitis (Thomas & Bomar, 2024). Viruses accounted for 80% of URTIs (Kunda, 2015). Even if the cause was bacterial, antibiotics only had a minor effect on RTIs, particularly in patients with URTIs (Arroll, 2005). Antibiotic misuse included overprescribing and using antibiotics for infections that weren't bacterial and inadequate dosage (Gwimile et al., 2012). Inappropriate use of antibiotics arose from unsureness over the diagnosis, lack of rational antibiotic use guidelines, substandard conformity to antibiotic protocols and existence of complex co-morbidities (Begum et al., 2014; Cusini et al., 2010; Vlahović-Palčevski et al., 2007). Some URTIs can cause serious complications such as myocarditis, otitis media, glomerulonephritis, and pneumonia. These problems raise the expense of healthcare resources and place a significant financial burden on society (Jin et al., 2021).

The main causes of morbidity in underdeveloped nations include respiratory, diarrheal, sexually transmitted, and nosocomial illnesses (Nguyen, 2013). In Tanzania, one study reported that antimicrobials were inadvertently prescribed to 80% of children with acute watery diarrhea and 70% with common cold (Gwimile et al., 2012). Another study in Ethiopia found inappropriate antibiotic prescribing in 86% of prescriptions for children with cough and/or diarrhea (Tekleab, 2017).

There was no evidence that any therapy reduces the length of time a viral URTI lasts (Thomas & Bomar, 2024). Antibiotics are ineffective in the treatment of colds because they destroy bacteria but not viruses. Therefore, antibiotics have no indication in treating common cold as they do not limit the length of the illness or hinder complications like pneumonia (WHO | Cough Remedies, 2001).

The upper respiratory tract accounts for most respiratory illnesses with the majority of them being colds or simple coughs (WHO | Cough Remedies, 2001). There is strong consensus that antibiotics are overprescribed especially for URTIs despite offering limited benefit (Dallas, 2015). An analysis of data in the USA found that colds, URTIs and bronchitis accounted for 21% of all adult antimicrobial prescriptions, and over 50% of antibiotics were prescribed to patients with colds, URTIs and bronchitis (Gonzales et al., 1997). Findings from a study done in Denmark and Iceland revealed most antibiotics were prescribed in primary care, especially for URTIs with a majority of the prescriptions being inappropriate (Sigurðardóttir, 2015). Because antibiotics are routinely recommended in these infections that are primarily viral in nature, URTIs are a significant target for measures to reduce antibiotic use (Harris et al., 2003).

A study in Vietnam found 19% of healthcare professionals possessed knowledge compatible with recommended guidelines when prescribing or dispensing antibiotics for common colds (Hoa et al., 2017). A study on antibiotic prescribing patterns in Cameroon found that antibiotics were inappropriately prescribed at primary care facilities (Chem, 2018). In 2001, a Kenyan study found primary healthcare workers prescribed antibiotic treatment in 67% of patients with acute bronchitis and 48% of patients with common colds (Mitema & Kikuvi, 2004).

Upper respiratory tract infections accounted for a significant amount of outpatient visits with antibiotics regularly prescribed for these illnesses (Kunda, 2015). A study in South Africa found that URTIs led to mild morbidity resulting in unneeded treatment and missed work (Cotton et al., 2008).

Due to erroneous beliefs, URTIs are seldom given serious consideration in medical school curricula (Cotton et al., 2008). The symptoms are usually mild and self-limiting, they include: nasal congestion, fever, vomiting, irritability, inappetance, teary eyes, rhinorrhea, sneezing, cough or sore throat for over 7 to 10 days (Rohilla et al., 2013). A global disease burden study found upper respiratory tract infections accounted for over 45% of illnesses (Jin et al., 2021). Every individual was found to experience about 2.25 episodes of URTI per year, and about 3 episodes per child under the age of five years (Jin et al., 2021).

URTIs affect the sinuses, the nose, pharynx, larynx, and large airways. They arise due to viral, bacterial or fungal infections. URTIs can lead to a variety of disease including:

- Common cold – viral infection of the upper respiratory tract

- Rhinosinusitis – can be allergic, bacterial or viral in nature
- Flu – a virus-borne infection of the nose, throat, and occasionally the lungs.
- Pharyngitis – can be bacterial, fungal or viral inflammation of the throat, with the predominant etiology being viral.
- Laryngitis – this can be attributed to either infective or non-infective causes, with resultant inflammation of the mucus membrane of the larynx.

Identifying most of these illnesses can be challenging due to the overlap of symptoms and similarity in causes. Frequently occurring symptoms of URTIs are cough, throat irritation, runny nose, nasal stuffiness, headache, mild fever, pressure over the face, sneezing, fatigue or muscle pains. Symptoms occur one to three days post exposure and last 7 to 10 days, or up to three weeks (Thomas & Bomar, 2024).

2.3 Treatment of URTIs

Treating upper respiratory tract infections (URTIs) involves several key steps to ensure effective management while minimizing unnecessary antibiotic use. Standard operating procedure guidelines for URTI include:

2.3.1 Common Cold

Runny nose, sore throat, cough, sneezing, and nasal congestion are all symptoms of the common cold, which is a mild, self-limiting viral URTI. It has a significant economic and social burden on society (Thomas & Bomar, 2024). In the United States, individuals were predicted to catch 1 billion colds each year, with around 22 million days of school absences recorded each year (“Overview: Common Colds,” 2023). It is the most frequently occurring disease globally, with approximately 10 million outpatient visits

yearly in the USA alone (Thomas & Bomar, 2024). A study in Canada found that adults had 4 to 6 colds per year on average, whereas children got 6 to 8 colds each year (Worrall, 2011).

The common cold is caused by more than 200 different types of viruses, rhinovirus accounted for 30-50% of cases yearly and 80% of all respiratory infections during peak seasons (Heikkinen & Järvinen, 2003). Other causes included coronaviruses which accounted for 10-15% of cases, influenza viruses 5-15%, respiratory syncytial virus at 5%, parainfluenza viruses at 5%, adenoviruses <5%, enteroviruses <5%, metapneumovirus unknown and approximately 20-30% had no proven viral cause (Heikkinen & Järvinen, 2003). Transmission occurs by hand contact with virus-causing secretions, small-particle aerosols that persist in the air for a long time, or direct contact with large-particle aerosols from an infected person ("Overview: Common Colds," 2023). The symptoms vary from person to person due to the many different causative viruses. Most colds resolve within 7 to 10 days, but some people experience a more prolonged course and others a shorter course. The clinical presentation may include nasal stuffiness or drainage, cough, sneezing, sore throat, hoarseness, watery eyes, headache, fever, body aches or fatigue. The primary symptoms are nasal stuffiness and discharge (Heikkinen & Järvinen, 2003). Because each virus has such a wide range of clinical presentations, it's often hard to determine which virus is causing a problem in a single patient with a common cold based solely on clinical evidence (Thomas & Bomar, 2024).

Viral culture, antigen detection, and Polymerase Chain Reaction (PCR) are all methods for identifying viruses. The gold standard for virus detection is virus isolation in cell

cultures, however due to the slowness of the process, it is of little utility in clinical practice (Heikkinen & Järvinen, 2003). PCR was found to be useful in the diagnosis of viral infections in general, and particularly rhinovirus infections, for which other approaches have been inadequate.

Treatment is largely symptomatic with a variety of different over-the-counter preparations readily available. No cure for the common cold exists ("Overview: Common Colds," 2023). Intranasal or oral decongestants successfully relieved nasal obstruction but there was no evidence for their use in children under 12 years (Taverner, 2007). Zinc was found to be effective in reducing symptoms of cold in adults (Science et al., 2012). Vitamin C had no effect on incidence of colds in the general population (Hemilä & Chalker, 2013). Antibiotics are largely ineffective against viruses but are widely used in treatment (Gonzales, 2001). There was no evidence that antibiotics were effective against the common cold (Kenealy & Arroll, 2013). Traditionally, humidification of the surroundings, plenty of fluids, gargles, nose drops, and bed rest have been used but only steam inhalation has been shown to be slightly effective (Singh, 2004). There was no evidence supporting use of over-the-counter cough suppressants as they had no effect on cough (Malesker et al., 2017).

2.3.2 Flu

Influenza infection is commonly referred to as the Flu. It is an acute viral infection that targets the respiratory tract and presents with systemic symptoms that range from mild fatigue to respiratory failure and death (Gachari et al., 2022).Annual influenza epidemics resulted in approximately 3-5 million cases of severe disease with mortality ranging from

290,000 to 650,000 deaths (WHO, 2018b) with 17% of these deaths having occurred in Sub-Saharan Africa. The overall prevalence in Kenya was 19% (Gachari et al., 2022). It occurs throughout the year in tropical climates, but outbreaks are infrequent.

There are 4 immunologic subtypes, influenza virus A, B, C and D. Type A and B cause seasonal epidemics of disease (WHO, 2018b). A Kenyan study found that influenza A accounted for 76% of influenza cases, influenza B 21% and co-infection with A/B occurred in 3% (Umuhoza et al., 2020). Influenza is transmitted easily by infected respiratory droplets or by touch.

Influenza symptoms can range from mild to severe, depending on the patient's age, comorbidities, vaccination status, and natural immunity to the virus (Boktor & Hafner, 2021). They include cough, high fever, sore throat, myalgia, headache, runny nose and congested eyes. After being exposed to the influenza virus for the first time, symptoms start from 1 to 4 days, with an average of 2 days. The fever and accompanying symptoms normally last 7 to 10 days, although the cough and lethargy might continue up to two weeks**.** The gold standard for making a diagnosis is via a viral culture of nasopharyngeal or throat samples. The rapid tests have high specificity of 98% but 68% sensitivity (Boktor & Hafner, 2021).

In most healthy people who did not have other comorbidities, influenza illness was self-limited and mild. In healthy people, no antiviral medication is required for minor illnesses. Antiviral drugs can be used to treat or prevent influenza infection in healthcare settings such as hospitals and residential institutions, especially during outbreaks (Boktor & Hafner, 2021). Antiviral agents were indicated in patients with confirmed or suspected

influenza who had severe, complicated, or progressing disease, required hospitalization, or were at high risk for influenza complications.

2.3.3 Rhinosinusitis

This is described as inflammation of the sinuses and nasal mucosa. Acute rhinosinusitis lasts less than 4 weeks. In Europe, it affects between 1% and 5% of the adult population each year (Berry, 2018). Global figures indicated that it ranged from 15 to 40 episodes per 1000 patients annually (Worrall, 2011). Sinusitis was found to complicate around 0.5% of all upper respiratory tract illnesses (Worrall, 2011). It was more prevalent in adults than children because their sinuses are not fully developed (Berry, 2018). Females were more likely to develop it, and the peak age for it was 45 to 64 years old (DeBoer & Kwon, 2024). A global study found that antibiotics were prescribed to more than 90% of patients diagnosed with "acute sinusitis" in primary care in Europe and North America (Thomas & Bomar, 2024).

Most rhinosinusitis episodes were due to viral infection (DeBoer & Kwon, 2024). The same viruses that caused the common cold gave rise to sinusitis. Rhinovirus, parainfluenza and influenza viruses accounted for 3-15% of acute sinusitis cases (Ah-See, 2015). Viral sinusitis can progress to bacterial sinusitis in 0.5-2% of cases (Ah-See, 2015). Sinus involvement affects around 90% of patients with viral upper respiratory tract infections, although only 5-10% of these patients develop bacterial superinfection needing antimicrobial treatment (DeBoer & Kwon, 2024).

Acute sinusitis diagnosis is made based on history and examination alone, as investigations have limited value in primary care (Berry, 2018). Signs and symptoms of

acute sinusitis include the following: pain over cheek and radiating to frontal region or teeth, increasing with straining or bending down, redness of nose, cheeks, or eyelids, referred pain to the vertex, temple or occiput, postnasal discharge, blocked nose, persistent coughing or pharyngeal irritation, facial pain and hyposmia. Fever was found to occur in less than 2% of patients with sinusitis (Berry, 2018). Clinical presentations that indicated acute bacterial sinusitis were onset with persistent symptoms, onset with severe symptoms, or onset with worsening symptoms (DeBoer & Kwon, 2024). Cacosmia, pain in the teeth and the overall clinical impression were the best predictors of acute bacterial rhinosinusitis (Ebell et al., 2019).

Antibiotics are largely unnecessary because most sinusitis cases tends to be self-limiting when left untreated (DeBoer & Kwon, 2024). Antibiotics only clear up the purulent mucus but have no influence on the duration or severity of the sickness. Symptomatic relief has not been shown to be effective in clinical trials. According to one study, intranasal steroid sprays were moderately beneficial in reducing the symptoms of acute sinusitis (Zalmanovici & Yaphe, 2013). According to a study conducted in the Netherlands, 91% of patients with acute sinus symptoms improved within one week when they were given a wait-and-see approach (Worrall, 2011). A Cochrane systematic review for acute sinusitis showed that delaying the antibiotic prescription made no difference to outcomes (Lemiengre, 2018).

2.3.4 Pharnyngitis and Tonsilllitis

For adults and children, sore throat and pharyngitis accounted for more than 2% and 5% of all outpatient primary care visits, respectively (Sykes et al., 2020). Acute pharyngitis

accounted for 1.3% of outpatient hospital visits in the USA, and it accounted for approximately 15 million patient visits (Ashurst & Edgerley-Gibb, 2024). Pharyngitis was most common in children under the age of five, adults had lower rates of infection (Wolford et al., 2021). Approximately 70% of children and 90% of adults with pharyngitis had viral infections (Sykes et al., 2020). Streptococcal pharyngeal infection can complicate into post-streptococcal glomerulonephritis, acute rheumatic fever (ARF), peritonsillar abscess and Vincent angina. Rheumatic fever and its complications affected over 2 million people globally (Flores & Caserta, 2015). According to (Wolford et al., 2021), over 20 million individuals were affected by group A streptococci and developed ARF. Children between 5 and 15 years were placed at greatest risk of developing complications of pharyngitis. Studies estimate 1 to 3% of patients with untreated group A streptococcal pharyngitis develop ARF (Weinberg, 2024).

80% of cases are caused by viruses and about 15% of acute onset pharyngitis cases are caused by bacteria, the most common being Streptococcus pyogenes (Group A beta-hemolytic streptococcus) (Thomas & Bomar, 2024). Streptococcus pyogenes accounted for 5-15% of pharyngitis cases in adults and 20-30% of cases in children (Flores & Caserta, 2015). The predominant viral pathogens are rhinovirus, influenza, adenovirus, coronavirus, and parainfluenza. Differentiating viral, bacterial and fungal pharyngitis is difficult due to similar presentation (Sykes et al., 2020). Sore throat, odynophagia and fever were all common presentations, peak within 3-5 days and resolved within 10 days (Wolford et al., 2021). Signs and symptoms suggestive of streptococcal infection are fever, tender cervical adenopathy, tonsillar or pharyngeal swelling or exudate, and absence of cough.

The Centor score is a widely used scoring criteria to diagnose Group A beta-hemolytic streptococcal pharyngitis in adults and children 5-15 years, and to guide testing and treatment (Wolford et al., 2021). It was found to have a 55% specificity and 79% sensitivity (Aalbers et al., 2011). It has four criteria which each score 1 point, namely, tonsillar exudate, and tender anterior cervical left mentoanterior, history of fever and absence of cough. A score of 0-1 indicates no testing or antibiotics are required, 2-3 rapid antigen test and 4 indicates empiric antibiotics to be administered with no need for testing. White blood cell counts are ineffective in distinguishing between viral and bacterial causes of pharyngitis. Rapid antigen detection tests (RADT) are highly specific for Group A beta-hemolytic streptococci, but their sensitivity varies greatly, ranging from 70% to 90%. If the test results are positive, therapy should be started right away. If it's negative, obtain a throat culture to guide treatment, especially in children. Throat culture was established as the gold standard for bacterial pharyngitis diagnosis with 97-100% specificity (Little, 2012) and 90-95% sensitivity (Shulman et al., 2012). However, cultivation of throat samples was found to be challenging and led to delays in antibiotic initiation (Mustafa & Ghaffari, 2020). Antistreptolysin O titre tests (ASOT) are indicated in suspected GAS suppurative complications but are not indicated in acute illness since serologic markers peak 3-8 weeks after onset of symptoms (Shulman et al., 2012).

Management depends on the cause, but adequate hydration is necessary. Treatment of viral pharyngitis is conservative. Lozenges and benzocaine or lidocaine gargles may offer mild pain relief. NSAIDS can reduce pain and fever. In acute GAS pharyngitis, an appropriate antibiotic at an appropriate dose for 10 days duration is preferred. Penicillin or amoxicillin is the recommended 1st line drug (Shulman et al., 2012). Second line

antibiotics approved for pharyngitis were cefalexin and clarithromycin (Zanichelli et al., 2023). Avoid certain antibiotics, tetracycline was associated with increased resistance, sulfonamides and trimethoprim-sulfamethoxazole are not effective, fluoroquinolones are broad-spectrum and not ideal in routine treatment of GAS pharyngitis (Mustafa & Ghaffari, 2020).

2.3.5 Laryngitis

This is characterized by inflammation of the larynx and vocal cords for a period of less than 3 weeks. It is a self-limited infection that is predominantly viral. It is caused by rhinovirus, influenza, parainfluenza, adenovirus, coronavirus, mycoplasma pneumoniae, Chlamydia pneumoniae, GAS and human metapneumovirus in decreasing frequency (Gupta & Mahajan, 2022).

Patients with laryngitis may experience fever, cough, rhinitis, dysphonia or a hoarse voice. They may also experience pain when talking, difficulty swallowing, pain when swallowing, shortness of breath, rhinorrhea, postnasal discharge, sore throat, congestion and fatigue. Vocal symptoms last 7-10 days. The diagnosis is usually made on history alone. Treatment is mostly symptomatic with voice rest, analgesics and humidification. Antibiotics were not recommended for people with normal laryngitis, according to a Cochrane Review (Reveiz & Cardona, 2015).

2.4 Antibiotics

Antibiotics are drugs that fight bacterial infections. They can be classified based on their chemical structures: penicillins, cephalosporins, macrolides and tetracyclines. They can be classified by spectrum of activity, either narrow or broad. They can also be grouped

according to their mode of action, either by killing bacteria (bactericidal) or inhibiting their growth (bacteriostatic). In 2017, a WHO Expert Committee on Selection and Use of Essential Medicines formulated the AWaRe Classification of antibiotics as a method to support antibiotic stewardship programmes at local, national and international levels. Antibiotics were classified into three groups, Access, Watch and Reserve (*WHO Progress*, 2019). This tool was intended for monitoring antibiotic use, setting targets and monitoring effects of stewardship policies that aim to optimize antibiotic consumption and reduce antimicrobial resistance.

Antibiotic therapy is frequently initiated prior to a precise infectious disease diagnosis, and availability of microbiological results (Leekha et al., 2011). This is referred to as empiric therapy. This approach is used to cover for all potential pathological agents. Definitive antibiotic therapy can be administered when antibiotic susceptibilities and results of microbiological testing are known. This entails use of narrow-spectrum antibiotics. Broad spectrum antibiotics target multiple different bacteria, i.e., gram-negative, gram-positive and anaerobic bacteria. Severe bacterial infection warrants for use of empiric broad-spectrum antibiotics (Patel et al., 2024).

The WHO AWaRe tool provides simple guidance for optimal empiric treatment of common bacterial infections in adults and children. The target set by the WHO is at least 60% of overall country-level antibiotic use should be from the Access group by 2023 (*WHO Progress*, 2019). Access antibiotics are antibiotics with a narrow spectrum of activity, a lower potential of antimicrobial resistance and of lower cost. They are recommended for empiric treatment of most common infections and should be widely

available. Watch antibiotics have higher potential for selection of AMR and are more frequently used in sicker patients in the hospital facility setting. Their use should be carefully supervised to prevent misuse. Reserve antibiotics are last-resort antibiotics that should only be used to treat severe infections caused by multi-drug-resistant pathogens. The AWaRe classification has 258 antibiotics, of which 21 are listed on the Access group and WHO Essential Medicines List (Zanichelli et al., 2023).

Table 2.1 Access, Watch and Reserve antibiotics in the 2021 WHO Model List of essential medicines

Access group	Amikacin; amoxicillin; amoxicillin + clavulanic acid; ampicillin; benzathine benzylpenicillin; benzylpenicillin; cefalexin; cefazolin; chloramphenicol; clindamycin; cloxacillin; doxycycline; gentamicin; metronidazole; nitrofurantoin; phenoxymethylpenicillin; procaine benzylpenicillin; spectinomycin; sulfamethoxazole + trimethoprim; and trimethoprim.
Watch group	Azithromycin; cefixime; cefotaxime; ceftazidime; ceftriaxone; cefuroxime; ciprofloxacin; clarithromycin; meropenem; piperacillin + tazobactam; and vancomycin.
Reserve group	Cefiderocol; ceftazidime + avibactam; colistin; fosfomycin; linezolid; meropenem + vaborbactam; plazomicin; and polymyxin B.

The WHO AWaRe Book for treatment of common infections listed the common ailments and their preferred first line antibiotic options, these are:

- **Bronchitis:** no antibiotic
- **Acute otitis media:** amoxicillin
- **Pharyngitis:** phenoxymethylpenicillin or amoxicillin
- **Acute sinusitis**: amoxicillin or amoxicillin + clavulanic acid
- **Dental infections:** amoxicillin or phenoxymethylpenicillin
- **Acute localized lymphadenitis:** amoxicillin + clavulanic acid or cefalexin or cloxacillin
- **Mild community-**acquired pneumonia: amoxicillin or phenoxymethylpenicillin
- **COPD exacerbations:** amoxicillin
- **Infectious bloody diarrhea or dysentery:** ciprofloxacin
- **Enteric fever:** ciprofloxacin or azithromycin or ceftriaxone
- **Skin and soft tissue infections:** amoxicillin + clavulanic acid or cefalexin or cloxacillin
- **Burn and wound-related infections**: amoxicillin + clavulanic acid or cefalexin or cloxacillin
- **Lower urinary tract infections:** nitrofurantoin or sulfamethoxazole + trimethoprim or trimethoprim or amoxicillin + clavulanic acid

First line antibiotic agents for treatment of infections commonly encountered in the hospital setting are:

- **Sepsis (adults):** ceftriaxone or cefotaxime combined with gentamicin or amikacin
- **Sepsis (children):** ampicillin or benzylpenicillin combined with gentamicin
- **Bacterial meningitis (adults or children):** ceftriaxone or cefotaxime
- **Bacterial meningitis (neonates):** ampicillin combined with gentamicin
- **Severe community-acquired pneumonia:** ceftriaxone or cefotaxime combined with clarithromycin
- **Community-acquired pneumonia (children):** ampicillin or amoxicillin or benzylpenicillin combined with gentamicin
- **Hospital-acquired pneumonia:** amoxicillin + clavulanic acid or ceftriaxone or cefotaxime or piperacillin + tazobactam
- **Mild intra-abdominal infection:** amoxicillin + clavulanic acid or ceftriaxone or cefotaxime combined with metronidazole
- **Severe intra-abdominal infection:** piperacillin + tazobactam or ceftriaxone or cefotaxime combined with metronidazole
- **Mild upper urinary tract infection**: ciprofloxacin
- **Severe upper urinary tract infection:** ceftriaxone or cefotaxime combined with gentamicin or amikacin

- **Bone and joint infection:** cloxacillin
- **Severe skin and soft tissue infections (necrotizing fasciitis):** piperacillin + tazobactam combined with clindamycin or ceftriaxone combined with metronidazole
- **Severe skin and soft tissue infections (pyomyositis):** amoxicillin + clavulanic acid or cefalexin or cloxacillin
- **Febrile neutropenia (with low risk of serious infection):** amoxicillin + clavulanic acid (A)combined with ciprofloxacin
- **Febrile neutropenia (with high risk of serious infection):** piperacillin + tazobactam
- **Surgical prophylaxis:** cefazolin or cefazolin combined with metronidazole

2.5 Rational Prescribing

Rational medicine use can be a perplexing issue which is often misunderstood by patients, health workers, lawmakers and the general public all of whom should come together to tackle this dilemma (Ofori-Asenso & Agyeman, 2016a). Rational use of medicine was described in 1985 by a panel of experts as, “Patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to them and their community” (WHO, 1985). The World Bank has two defining principles for rational medication use: (1) medicine use according to scientific facts on efficacy, safety, and compliance; and (2) use of medications that are cost-effective within the health system's financial capability (Niëns

et al., 2010). The five rights of medicine administration are intended to decrease patient harm and increase patient safety by administering the right pharmaceuticals in the right doses to the right patient at the right time (W.H.O., 2011). The WHO recommends an antibiotic prescribing rate of 20-25.4% (Isah et al., 2001).

From diagnosis through follow-up, rational prescribing usually follows a logical process (Maxwell, 2009). Rational prescribing can also be viewed from the patients' perspective as what may be medically rational can be considered irrational by the patient (Brahma, 2012). It is important that both patient and medical perspectives are considered to fully understand the rational use of medication.

Irrational prescribing was defined as prescribing without achieving proper quality of therapy (WHO, 1985). Rational prescribers should strive to enhance clinical effectiveness, limit risks, prevent squandering scarce healthcare resources, and respect the wishes of their patients. In an Indonesian study, educating doctors on rational prescribing boosted rational practices (Andrajati et al., 2017). This study also found that work experience beyond 7 years was linked to poorer prescribing practices.

Because antibiotic-resistant microorganisms are becoming more common, research that promotes reasonable drug use is critical.

2.6 Irrational Prescribing of antibiotics

Prescribing has been described as the most beneficial approach to curing illness, relieving symptoms, and preventing disease by physicians (Maxwell, 2016). Irrational prescribing was found to be widespread worldwide, in hospitals and in different healthcare setups (Garg et al., 2014). It was described as "consumption of drugs in a way that decreases or

negates their efficacy or in a situation where they are unlikely to have the desired effects" (Sadaf et al., 2017). It is a significant challenge affecting numerous health systems worldwide (Ofori-Asenso & Agyeman, 2016a). It is exacerbated in low and middle-income nations by inferior health systems, which lack well-structured or non-existent methods for routine monitoring of medicine usage (Ofori-Asenso & Agyeman, 2016a).

Irrational prescribing is common in developing countries (Andrajati et al., 2017). It may be depicted in the following circumstances: incorrect prescribing, multiple prescribing, under-prescribing, and over-prescribing (Ofori-Asenso & Agyeman, 2016a). Antibiotic resistance emerged due to incorrect antimicrobial treatment and inappropriate consumption of antibiotics (Hashemi et al., 2013). According to WHO surveillance statistics, both LMIC had experienced a rise in dangerous bacterial diseases ("WHO | 2018).

Irrational prescribing negatively resulted in increased incidence of adverse effects, drug interactions and emergence of antibiotic resistance (Garg et al., 2014). In Tanzania, antibiotic resistance was linked to poorer health outcomes, longer hospital stays, higher costs for both the patient and the government, and a higher mortality rate (Mboya et al., 2018). Irrational prescribing was found to create a financial burden on patients, families and communities. It depletes resources and amplifies negative effects, necessitating more resources to treat (Kunda et al., 2015a).

Inadequate and poor supply of antibiotics, shortage of staff, an overburdened healthcare setup, misinformation in society and crowded Outpatient Departments were identified as contributors to irrational practices albeit unintentional (Garg et al., 2014). Multiple

studies have indicated poor antibiotic prescribing practices globally. High rates of prescribing antibiotics for URTIs were found in a study comparing antibiotic use for URTIs between Denmark and Iceland (Sigurðardóttir, 2015). A study analyzing antibiotic prescribing practices among primary health care providers in the USA found inappropriate prescribing in 42% of prescriptions (Deb et al., 2022). Another study conducted in the USA that assessed the factors associated with antibiotic misuse in outpatient treatment for upper respiratory tract infections found over 64% of patients were inappropriately treated with antibiotics (Schroeck et al., 2015). In Canada, estimated unnecessary antibiotic prescribing for URTIs stood at 50% (Thompson & McCormack, 2021). In Australia, antibiotics were irrationally prescribed in 36% of patients with URTI (Baillie et al., 2022). An Indian study found over 60% of antibiotic prescriptions had no valid indication and were prescribed for an inadequate duration (Garg et al., 2014). A study evaluating prescribing patterns of antibiotics in Zambia found that antibiotics were prescribed in 72% of patient encounters (Mudenda et al., 2024).

2.7 Factors Affecting Antibiotic Prescribing

2.7.1 Patient Factors

Patient factors that influence antibiotic prescribing include age, certain demographics such as patients' symptoms and results of physical examination, patient expectations (van Buul et al., 2014). The gender of patients has been linked to disparities in drug prescribing in hospitals (Imanpour et al., 2017b). Low socioeconomic status and co-morbidities also influence antibiotic prescription (Hicks et al., 2015). Other factors include perceived demand and expectation from patients.

Age is an important demographic aspect that affects antibiotic prescribing. Antibiotics were prescribed in more than 70% of children outpatient visits for URTIs (Hersh et al., 2011). They are prescribed 1.5 times more frequently in children than in adults (Novan & Primadi, 2020). This contrasts with a Dutch study that found children received antibiotics less frequently than older patients (Akkerman, 2005). In Germany, a study analyzing antibiotic use in primary care found that younger patients were less likely to be prescribed antibiotics (Poss-Doering et al., 2021). A study done in Italy found that children received antibiotics more than any other class of medication (Nicolini et al., 2014).

Patient gender has been linked to disparities in drug prescribing in hospitals (Imanpour et al., 2017a). Antibiotics represent the most significant gender disparity in drug use (Loikas et al., 2013). In the USA, males and older patients were more likely to have an unnecessary antibiotic prescription (Deb et al., 2022). This contrasted the German study that found females were more likely to be prescribed antibiotics (Poss-Doering et al., 2021). In Spain, a study found that females consumed more antibiotics than men (Lallana-Alvarez et al., 2012). A similar study done in Norway found that women used antibiotics more than men (Blix et al., 2007). Researchers in England found that women were not more likely to be treated with antibiotics when presenting with either cough or sore throat (Smith et al., 2018a). This study also found that interaction effects between patient gender and other variables like patient age, clinical setting or medical condition influenced antibiotic prescription. A post-hoc analysis of data across European countries found no gender differences in receiving inappropriate antibiotics in patients with URTI (Bagger, 2015).

Patients symptoms and signs can influence antibiotic prescribing (van Buul et al., 2014). According to a study conducted in Malta, patients with fever are more likely to receive antibiotics (Saliba-Gustafsson et al., 2019a). This study found that other symptoms such as productive cough and ear pain were significantly linked to an antibiotic prescription. A study done in the USA showed that presence of fever was linked to antibiotic prescriptions for URTIs (Manne et al., 2018a). An Australian study found that duration of symptoms exerts influence on antibiotic prescribing by general practitioners (Lum et al., 2018). A study in Germany found that patients with the diagnosis of tonsillitis, sinusitis or bronchitis received more antibiotics than those with the diagnosis of URTI/common cold (Fischer et al., 2005). Research from Cameroon found that general practitioners mostly prescribed antibiotics for patients with respiratory tract symptoms (Chem, 2018a).

The irrational use of antibiotics has raised the number of resistant bacterial strains. Antibiotics are indicated in diarrhea with bloody stools and acute lower respiratory tract infections, but not for non-bloody diarrhea or URTIs (W.H.O., 2005). To ensure that effectiveness of available antibiotics is maintained, rational use interventions are crucial. One study found that many children with common childhood illnesses such as diarrhea and acute respiratory tract infections were treated with antibiotics despite not needing them (Alkaff, 2019).

Antibiotic use trends are also influenced by cultural variables such as strong patient demand (Rogawski, 2017). Antibiotic self-medication is prevalent in the developing nations (Shankar, 2018). It is an example of irrational drug use. In Kenya, it was noted

that pharmacies in low-income communities were more prone to dispensing antimicrobials without a prescription (Mukokinya, 2018). Antibiotic self-medication was found to be linked to age, income, gender, and educational level (Awad & Aboud, 2015). Self-medication was least common among those over 60 years and most common among females, adults between the ages of 40-59 years, lower income and greater level of education. Self-medication with antibiotics can result in antibiotic resistance, treatment failure, drug toxicity and increased morbidity (Sachdev et al., 2022). Patient expectations can be modified by providing them with leaflets and offering educational campaigns during the consultation (Kravitz, 2001). According to the ministry of health, there is misunderstanding among the public about the consequences of antibiotic abuse, as well as poor prescription and illogical use (Ministry of Health, 2019).

2.7.2 Prescriber Factors

A study of antibiotic prescribing rates in Dutch general practices found prescriber factors that influence antibiotic prescription were level of education, work duration, source of updating knowledge and the practice setting (Akkerman, 2005). Systemic review of literature showed other relevant factors were diagnostic ambiguity, influence from medical representatives and lack of expertise (Rezal, 2015). Prescribers were also influenced by patient characteristics such as age, gender, race, treatment history, as well as physicians' experience and product valuation, products' safety, efficacy, side effects and cost and environmental factors such as coworker relationships, access to medicine and the work environment (Sharifnia, 2018). Older primary healthcare providers in Canada were found to prescribe antibiotics more frequently for patients with URTI (Silverman et al., 2017). A study that assessed factors that affect primary care providers'

prescribing decisions found that older prescribers prescribed antibiotics more frequently (O'Connor et al., 2018).

Understanding how healthcare personnel prescribe antibiotics can develop interventions that can improve antibiotic use. Inadequate knowledge of prescribing is rife among healthcare workers (Rezal, 2015). Antibiotic over-prescription can result from the difficulty in differentiating bacterial and viral URTIs based on sign and symptoms (Saliba-Gustafsson et al., 2019a). Prescribers must follow treatment standards and a uniform prescribing process to ensure logical drug prescription (Dyar, 2016). Even when healthcare providers are aware of the proper antibiotic indications, discrepancies between understanding and practice can arise among health workers cognizant of correct antibiotic indications (Dillip, 2015).

Prescriber qualities such as gender, age, work experience, and workload have a significant impact on prescription of antibiotics (Choi et al., 2012b). This is contrast to a study in Australia that found age, years worked as a GP, gender, location of practice and socioeconomic profile of practice population were not significant predictors for prescribing (Fletcher-Lartey et al., 2016).

A study in the USA found that prescriber characteristics associated with higher rates of unnecessary prescribing included working in a rural facility, having more years in practice, and being in higher volume setting such as an urgent care facility (Deb et al., 2022). Antibiotic prescribing was found to be strongly linked with the age and gender of general practitioners in a study conducted in Malta (Saliba-Gustafsson et al., 2019a). This study found that general practitioners over the age of 60 had higher antibiotic prescribing rates, while female general practitioners (GPs) were 2.3 times more likely to write

antibiotic prescriptions. In contrast, female GPs prescribed antibiotics less frequently than male counterparts, according to research from the Netherlands (Eggermont et al., 2018a).

Antibiotics were found to be prescribed most frequently by general practitioners, especially for URTIs (Bagger, 2015). In the United Kingdom, most GPs prescribed antibiotics at higher rates than were clinically warranted to young and middle-aged persons with respiratory illnesses (Gulliford, 2014). A study in Canada found that primary care physicians with long work experience were more likely to prescribe antibiotics in patients with URTI (Silverman et al., 2017). A study conducted in Canada reported that physicians with more experience, who were international medical graduates, with increased workload had less rational antibiotic prescribing (Cadieux, 2007). Similarly, antibiotics were prescribed less often by interns or residents than by senior physicians (Stone, 2000). In Tanzania, a study indicated that incorrect antibiotic prescribing was significantly linked to the prescriber's status as a clinical officer (Gwimile, 2012).

In the event of empirical usage, healthcare practitioners should make every effort to substantiate every antibiotic prescription. A patient’s status is significantly affected by prescribing patterns, and they should be examined on a regular basis to ensure proper drug use (Hicks et al., 2015). Patient demand was the most common reason for primary care practitioners prescribing unwarranted antibiotics (Kohut et al., 2020). According to this study, these clinicians wanted their patients to feel their clinic visits as valuable and believed that an antibiotic prescription demonstrated value, some clinicians felt that some patients could only be satisfied by an antibiotic prescription, and some wanted to avoid possible complications of denying antibiotics. Research by Synovate Kenya showed that

more than 70% of pharmacies dispensed antibiotics without a prescription antibiotic (Momanyi et al., 2019)

2.7.3 Institution Related Factors

Availability of antibiotics, availability of hospital guidelines, laboratory support and antibiotic audit also contribute to antibiotic prescribing patterns (Momanyi et al., 2019). In Kenya, cost-sharing and revolving drug funds are used to finance medicine supply, this can negatively result in overprescribing of antibiotics as an incentive (Bbosa et al., 2014). Hospital administrators rarely implement guidelines to oversee antibiotic prescription. Hospitals are mandated by the government to establish Medicines and Therapeutics Committees (MTC) (George, 2013). The role of the MTC is to evaluate the clinical use of medicines, formulate policies for managing medicines and other health products and technologies use and administration, Pharmacovigilance and safety aspects and managing the formulary system (Ministry of Health, 2020). The African Population and Health Research Center found that about 72% of the health care facilities in Kibera did not have any working guidelines or prescription protocols for guiding their practice (Kariuki, 2011).

The absence of facilities for culture and sensitivity testing, the infrequent reporting time of laboratory investigations, and expensive laboratory tests led to empiric antibiotic prescription and treatment in resource-poor settings (Chem, 2018a). In order to manage antibiotic resistance and controversy, antimicrobial susceptibility testing and surveillance are essential (WHO, 2001). Diagnostic tests were found to reduce resistance by supporting focused and rational antimicrobial use (Okeke, 2016). They can also reduce

drug and healthcare costs by detecting treatment failure due to resistance, revealing the nature and breadth of resistance and preventing its spread (Petti et al., 2006).

Drug availability affects antibiotic prescribing (Erah, 2003). The ability of a prescriber to provide the right treatment was guided by available medication. Drug availability, the patient's socioeconomic level, and prescriber in-service training were revealed to be key factors influencing prescription decisions in a study done in Nigeria (Erah, 2003). The development of an essential medicines list (EML) is a significant achievement in improving rational drug use (Le Doare et al., 2015a). The EMLs are based on local knowledge of illness prevalence and resistance factors and are nation specific. Although evidence suggests that using positive formulary lists reduces prescription rates in the near term, data on their long-term impact is lacking (Le Doare et al., 2015a).

The Kenya Essential Medicines List (KEML) was formulated to promote the correct use of medicines by health professionals, patients and the public. The KEML represents best practice in the choosing of medication for best therapeutic outcomes (Ministry of Health, 2019). It was intended for use by all disciplines of health care workers, it was intended to enhance appropriate medicine use. A new categorization of antibiotics into Access, Watch and Reserve (AWaRe) classes to guide the appropriate use of antibiotics, with specification of the infectious disease conditions to be managed using each medicine (*WHO Progress*, 2019). This classification was meant to integrate antibiotic stewardship. The goal of AWaRe classification was to reduce the use of antibiotics in the Watch and Reserve groups while increasing the use of antibiotics in the Access list in an appropriate manner.

2.8 Strategies to Enhance Antibiotic Prescribing Practices

The Ministry of Health warned that antibiotic abuse and overuse is making common diseases more difficult to treat, and that stronger prescription and use of antibiotics, as well as surveillance measures, are urgently needed to encourage sensible antibiotic use (Ministry of Health, 2019). Antibiotic consumption can be reduced through a mix of patient and provider educational approaches (Harris et al., 2003).

Antibiotic stewardship is defined as a set of actions that encourage appropriate antibiotic use. Antibiotic stewardship initiatives aim to balance the need for antibiotics and the need to preserve their efficacy in the future (Shah, 2008). Antibiotic stewardship is necessary given that there is an antimicrobial worldwide resistance crisis (Dyar, 2016). Integrative strategies including communities, health institutions, and healthcare providers are required to reduce unnecessary antibiotic use (Dillip, 2015). A strong antimicrobial stewardship program should contain suggestions targeting local antimicrobial use and resistance issues, as well as available resources, which are influenced by size of the facility or clinical setting (WHO Stewardship, 2021). Antimicrobial stewardship programs (ASPs) aim to optimize antimicrobial use by promoting the selection of the most appropriate antibiotic therapy based on the patient's clinical presentation, microbiology results, and other relevant factors, while also minimizing the development of antibiotic resistance and other adverse effects associated with antibiotic use. One way that ASPs may promote appropriate antibiotic use is by encouraging the use of narrow-spectrum antibiotics, which are more targeted and effective against specific bacteria and have a lower risk of promoting resistance compared to broad-spectrum antibiotics. In

many cases, generic antibiotics may be available as narrow-spectrum options, making them a preferred choice for ASPs.

In addition to promoting generic prescribing, ASPs may also use other strategies to promote appropriate antibiotic use, such as dose optimization, duration of therapy optimization, de-escalation of therapy, and education and training for prescribers and patients.

In addition, for antimicrobial stewardship programs to thrive, awareness should be increased amongst healthcare workers. To counter rising antibiotic resistance, lowering excessive antibiotic consumption in ambulatory practice is a critical goal. Strategies aimed at targeting acute respiratory infections can help reduce excess antibiotic use (Tonkin-Crine et al., 2017). Estimating the quantity and expense of excess antimicrobial consumption in outpatient settings, as well as recognizing the circumstances leading to surplus use is required for intervention and policy considerations on minimizing excessive antibiotic use (Gonzales et al., 2001).

Patient education is beneficial in decreasing inappropriate antibiotic use in ambulatory settings (Gonzales et al., 1999). It is critical to raise awareness among healthcare staff in order to achieve greater outcomes (Sweileh, 2021). Studies have shown that targeting prescribers is beneficial. A study in a poor rural area in China found that training prescribers in form of review meetings, communication skills training and clinical guidelines led to reductions in irrational antibiotic prescribing (Wei et al., 2019).

In 2015, the US government formulated a policy aimed at changing the trajectory of antibiotic resistance, so that by 2020 inappropriate outpatient antibiotics would decrease

by 50% (CDC, 2020). In Tanzania, an initiative to improve medicine dispensing methods resulted in beneficial increases in dispensing knowledge (Dillip, 2015). Treatment guidelines for acute respiratory infections and diarrhea were appropriately explained to the respondents. In Kenya, the Ministry of Health collaborated with the Ministry of Agriculture to adopt a one health approach and partnered with the WHO to contain antimicrobial resistance and guarantee effective antibiotics would be available now and, in the future (Ministry of Health, 2019). Through this plan, the Kenya Essential Medicines List (KEML) was updated, and the Clinical Guidelines are continuously reviewed to guarantee that antibiotics are used appropriately.

While many developed countries have developed AMR action plans, the situation is different in many developing countries especially in Africa (W.H.O. Surveillance, 2018). The Global Antibiotic Resistance Partnership (GARP) was formed by WHO to provide a platform for low- and middle-income nations to propose meaningful antibiotic resistance policy suggestions, improve surveillance of AMR and lessen inappropriate consumption of antibiotics (Zanichelli et al., 2023). National working groups were established in Kenya and Uganda (Gelband, 2015). Despite not being a member of GARP, the WHO designated Ethiopia as the only country with a national AMR action plan (R. A. Ibrahim et al., 2018).

The WHO identified gaps in high-quality resources for strengthening worldwide prescribing of antibiotics. Formulation of the WHO AWaRe (Access, Watch, Reserve) antibiotic book was undertaken to develop actionable guidance for antibiotic prescribing. The book provides evidence-based guidance on choosing the right antibiotic, route of

administration, and treatment duration for over 30 of the most common clinical infections in both primary health care and hospital setting among adults and children (Zanichelli et al., 2023). The book is guided by recommendations for antibiotic use listed on the WHO Model Lists of Essential Medicines and Essential Medicines Children and the WHO AWaRe classification of antibiotics (*WHO Model List of Essential Medicines for Children - 8th List*, 2021)

Communication training, combined patient/clinician education, and clinical decision support were demonstrated to reduce improper antibiotic prescribing in several trials (Rowe, 2019). Antibiotic stewardship that incorporates modern information technology has the potential to reduce antimicrobial overuse while also enhancing outcomes (WHO Stewardship, 2021). To reduce improper outpatient antimicrobial use, prescribers, health facilities, and health systems must collect antibiotic prescribing data, set appropriate improvement goals, and enact evidence-based interventions (Rowe, 2019). Efforts to enhance appropriate antibiotic consumption in developing countries are inadequate (W.H.O., 2018).

CHAPTER THREE: MATERIALS AND METHODS

3.1 Study Design

The study design was a descriptive cross-sectional public hospital-based study conducted among patients who presented with prescriptions for upper respiratory tract infections within Kiambu County. This design was selected for its efficiency in collecting data from a large sample within a limited timeframe. The study analyzed the antibiotic prescribing practices of clinical officers from September to October 2022. The study followed the methodology recommended by the WHO for investigating drug use in hospitals (WHO, 1993). WHO core prescribing indicators checklist on rational use of medicine was used to assess rational antibiotic drug use, with a particular focus on antibiotic prescribing practices. The core prescribing indicators selected to be measured were mean quantity of medications prescribed per encounter, portion of antibiotics prescribed by generic name, portion of meetings where antimicrobials are prescribed and share of antibiotics ordered from the essential medicine list.

Some limitations encountered were selection bias, response bias and temporal limitations. Temporal limitations were overcome by collecting data prospectively to minimize recall bias from the clinicians. Selection bias was reduced by engaging random sampling method in selecting patient prescriptions for URTI. Response bias was addressed by making the questionnaires anonymous, with the clinicians encouraged to answer honestly and accurately.

The dependent variable was rational or irrational antibiotic prescribing practice. Rationality was assessed based on WHO indicators of rational drug use. These were:

prescribing the right drug, at the right dose, for the right patient in the right duration. The patient antibiotic prescriptions were thus analyzed and checked for the right dose, duration and whether the indication was correct. This was compared against the validated WHO evidence-based AWaRe booklet on antibiotic use (Zanichelli et al., 2023). A rational prescription was determined according to the validated booklet, which indicated the indication should be correct, followed by the right dose and duration. The antibiotic prescribing practice was considered irrational if any of these parameters were not met.

3.2 Variables

The independent variables which were assessed were socio-demographic attributes of the prescriber (age, gender, work experience, and level of education), patient factors (age, gender, temperature) and institutional factors (availability of antibiotics, availability of hospital guidelines, and laboratory support). The age of the clinical officers was categorized into age groups of 5-year intervals starting from under 25 years, 26-30 years, 31-35 years and 36-40 years. The number of years the clinical officers had practiced were grouped into 5-year intervals, starting from under 1 year, 1-5 years, 6-10 years and 11-15 years. The education level was assessed by grouping the clinical officers as having a diploma, higher diploma or bachelor's degree in clinical medicine. The patient factors considered in the analysis were age, gender and temperature. The age of each patient was recorded in years, and patients were categorized into age groups. These were pediatrics (under 12), adolescents from 13 to 18 years, adults from 19-64 years and elderly above 65 years. Gender of each patient was recorded as male or female. Temperature was categorized as normal below 37.4^0C and fever above 37.5^0C. The institutional factors analyzed were availability of antibiotics, availability of hospital guidelines and

availability of laboratory support. These were assessed by use of the Likert scale in the questionnaire ranging from agree, neutral or disagree. The dependent variable was their antibiotic prescribing practices which was either rational or irrational.

3.3 Location of Study

Kiambu County was the study location. It occupies approximately 2,543.5 Km^2 and is situated in central Kenya. As shown on the map below, Kiambu County is bordered by Nairobi and Kajiado counties to the south, Machakos to the east, Murang'a to the north and northeast, Nyandarua to the northwest, and Nakuru to the west. The county is located between latitudes 00 25‘and 10 20‘South of the Equator and Longitude 360 31‘and 370 15‘East.

A total of 120 registered government hospitals, 57 faith-based hospitals and 548 private medical facilities are situated in the county (*Kenya Master Health Facility List*, 2021). The total population according to the 2019 census was 2,417,735 people, of which 1,187,146 were males and 1,230,454 were women and 135 intersex individuals. There were 796,241 households and a population density of 952 people per square kilometer. It is further divided into 12 sub-counties. Kiambu county citizens are served by two level 5 facilities, eleven level 4 facilities, twenty-six health centers and eighty-one dispensaries. The hospitals serve a diverse population, from within and outside the county. The study will focus on level 5 facilities, level 4 facilities, and the health centers.

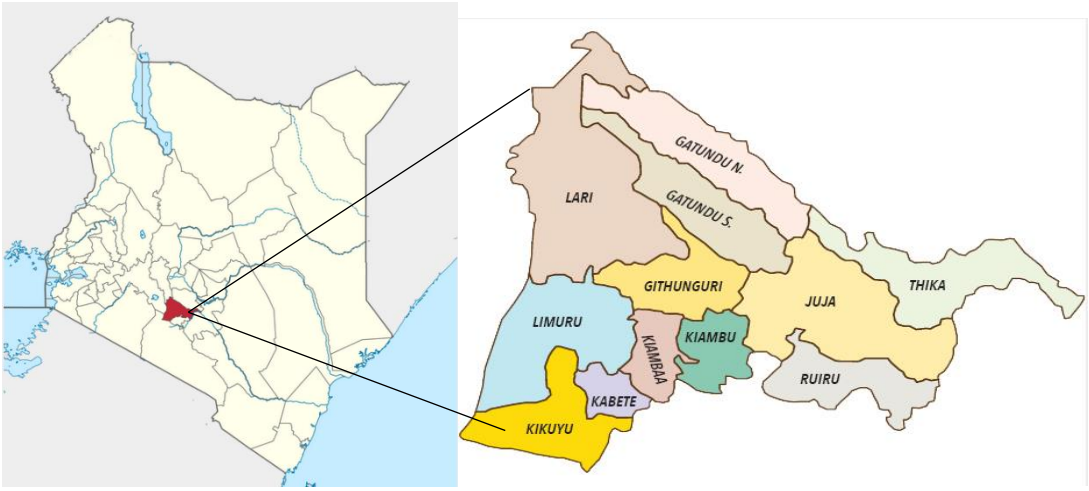

Figure 3.1: Map of Kenya and Map of Kiambu Sub counties

Public hospitals were selected for this study because of their high patient volume and accessibility to various socio-economic groups. These facilities are important in the healthcare system, particularly in the treatment of respiratory illness, which accounted for the majority of hospital visits within the county. The geographical and demographic diversity of Kiambu County provided a broad prospective for antibiotic prescribing practices. This setting ensured that the findings were applicable to a wide range of healthcare contexts and informed policy recommendations effectively.

3.4 Study Population

The study population included patients presenting with upper respiratory tract infections in public hospitals in Kiambu County. Clinical officers working in the outpatient departments were included in the study.

Data collected from the patients included demographic data (age, gender) of the patient, temperature, disease diagnosed, type and number of antibiotics prescribed, and the antibiotic dose prescribed.

The target population for this study was all patients presenting with upper respiratory tract infections and all clinical officers working in outpatient departments across Kenya.

3.5 Sampling Techniques

Kiambu County is split into 12 administrative sub-counties. These are Gatundu North and South, Githunguri, Juja, Kabete, Kiambaa, Kiambu, Kikuyu, Lari, Limuru, Ruiru and Thika. The level 5 hospitals are in Kiambu and Thika sub-counties. The level 4 facilities are in all sub-counties except Kiambu, Githunguri and Thika. The health centers are in all sub-counties except Kiambu and Kiambaa. The hospitals were clustered into 3 different levels, namely Level 5, level 4 and health centers. Simple random selection was used to select one level 5. The level 4 hospitals were each assigned a number. A sample size of 5 level 4 hospitals was chosen randomly using a random number generator (*Random Number Generator*, 2023). This random number generator is software that enables one to pick any number of samples within a given frame. The health centers were each assigned a number. Fourteen health centers were chosen at random using the random number generator. Once the facilities were selected, purposive sampling of clinical officers working in the outpatient departments was undertaken.

3.6 Sample Size Determination

Fischer's formula (1998) was used to calculate the number of patient prescriptions to form the sample size that took part in the study.

$$N=Z^2P(1-P)/I^2$$

Where: n=Sample size [where population >10,000]

Z= normal deviation at the desired confidence level. In this case, it was taken at 95% with Z critical value at 95% was 1.96

P= proportion of the population with the desired characteristic was set at 50% since this variable was unknown.

I^2 = Degree of precision, was taken at 4%. Studies indicate an allowed margin of error between 3 and 5%.

Therefore:

$$n=Z^2P(1-P)/I^2$$

$$n=1.96^2 \times 0.5(1-05)/(0.04)^2$$

$$n=3.8416 \times 0.25/0.0016$$

$$n=601$$

WHO's "How to investigate drug use in health facilities" proposes at least 20 facilities to be assessed with at least 30 prescribing encounters per facility in a cross-sectional survey (W.H.O., 1993). Therefore, the sample size of 600 was divided among the 20 health facilities with a target of at least 30 prescriptions per facility.

3.7 Eligibility of study participants

3.7.1 Inclusion Criteria

- Patients of all ages who presented with diagnosis of URTIs at the outpatient departments of public hospitals in Kiambu County, Kenya, during the study period.

- Clinical officers that worked in the outpatient departments of public hospitals in Kiambu County, Kenya, who were involved in diagnosing and prescribing treatment for patients with URTIs.

3.7.2 Exclusion Criteria

- Patients that were on antibiotic therapy for other conditions.
- Clinical officers that declined to participate in the study.

3.8 Construction and research instruments

The World Health Organization's checklist on rational use of medicine was used to assess antibiotic rational usage, with emphasis on antibiotic prescribing practices (WHO, 1993). Data collected from the prescriptions included demographic data (age, gender) of the patient, temperature, disease diagnosed, drugs prescribed, type and number of antibiotics prescribed, antibiotic prescribed by generic or trade name, antibiotic dose prescribed and its duration.

A self-administered questionnaire was employed to gather data from clinical officers working in the outpatient context. The questionnaire had sections that assessed sociodemographic characteristics of the prescriber and institutional factors. The questionnaire was developed according to previous validated questionnaires used in Congo and China (Liu et al., 2019; Thriemer et al., 2013) and adapted to the setting in Kiambu. Prescriber characteristics included age, gender, level of education, years of work experience and current job cadre.

3.9 Validity

The term "validity" refers to a test's ability to accurately measure what it claims to be measuring (Phelan & Wren, 2006). Validity was attained by review of the research instruments by the researcher's supervisors. The validity of the questionnaire was measured among clinical officers pursuing the aim that the content of the questionnaire was easily understood. During the period of data collection, the study researcher maintained objectivity to control bias such as interviewer and recall bias.

3.10 Pre-testing

A small representative sample of patients and clinical officers was selected for pretesting. This sample included 20 patients and 5 clinical officers from public hospitals in Kiambu County, Kenya. The WHO checklist on rational use of drugs was used to collect patient data and the questionnaire was administered to the clinical officers. The clinical officers were requested to complete the questionnaire and provided feedback on the clarity, comprehensiveness, and relevance of the questions. Revisions were made to the questionnaire and WHO data collection tool respectively based on feedback from participants and data analysis from the patient data.

3.11 Reliability

Refers to the extent to which assessments are consistent (Jhangiani et al., 2015). It was attained by ensuring each filled questionnaire was analyzed carefully. The data collection techniques were rigorous coupled with the use of a competent data analyst. Proper coding of data was done during data entry. If any errors were found, it was redone. After

completion of each encounter on the checklist, the researcher checked all patient data for any possible errors and conducted re-entry if found.

3.12 Data collection techniques

Data was collected using medical record review and a structured questionnaire. Medical records were reviewed to extract patient specific factors. WHO prescribing indicators checklist on rational use of medicine was used to collect patient information by extracting the information from the patients' medical charts.

Questionnaires were administered to clinical officers who prescribe antibiotics in the outpatient department. The questionnaire gathered information on clinical officers' demographics, training, work duration and institutional factors.

3.13 Data analysis

An Open Data Kit (*ODK - Collect Data Anywhere*, 2010) was used to collect data by modifying the WHO data collection guideline that was used in a previous study (Kilipamwambu et al., 2021). Data was imported into a Microsoft Excel sheet from the ODK server then exported to a Statistical Package for Social Science (SPSS) version 22.0 for further cleaning and analysis. Descriptive statistics of frequencies and percentages were used to summarize categorical variables, and median (interquartile range) was used in case of continuous variables. The association between antibiotic prescribing and the prescribing factors was assessed using logistic regression. Odds ratio with 95% confidence interval was reported in the logistic regression analysis. Fischer's exact test was used to determine association between prescriber, institutional characteristics and rationality. Pearson's Chi Square test was used to show statistical significance of

relationships between patient factors and rationality. All analysis were considered significant when $p < 0.05$.

3.14 Logistical and ethical considerations

Permission to conduct the study was acquired from Kenyatta University Graduate School. Permission to conduct the research was obtained from the National Commission for Science, Technology and Innovation. Ethical clearance was sought from Kenyatta University Ethics and Research Commission. Permission was obtained from Kiambu County Research Department and the medical superintendent or the in-charge of the sampled hospital. The study posed minimal risks to participants. The primary risk involved the potential inconvenience associated with completing the questionnaire or waiting for details to be captured in the WHO checklist. The potential benefits of the study included contributing to a better understanding of antibiotic prescribing practices within the county, which could inform policy and improve rational antibiotic prescribing. As no direct engagement of patients was carried out, the study received a waiver of consent. The study was discussed in detail with the Clinical officers in the selected health facilities and those who agreed to participate signed the informed consent.

All data collected was anonymized to protect the identities of the participants. Neither patient names nor initials were collected. No personally identifiable information was recorded. Unique codes were assigned to each clinician. Data was securely stored, and only authorized research team members had access to the data. The study ensured minimal potential harm to the participants. Participation was voluntary, withdrawal was permissible at any point in time without any consequence. Participants were informed

they could contact the researcher at any time if they experienced any concerns or apprehensions about the study. Informed consent was obtained from all participants before data collection. Detailed information about the study, including its purpose, procedures, risks and benefits was provided to the participants. Signed consent forms were used to indicate agreement of participants to participate. Contact information for the principal investigator, research supervisors and the ethics committee were provided to the participants in the event they had queries, concerns or apprehensions about the study.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presented the findings on the antibiotic prescribing practices of clinical officers for patients with upper respiratory tract infection among clinical officers in Kiambu County. This is based on the data collected from the patient encounters and respondents.

4.1.1 Return Rate

The study targeted 601 patient encounters and clinical officers from outpatient departments in 1 level 5 hospital, five level 4 hospitals and fourteen health centres. Six hundred patient encounters were recorded, hence achieving a response rate of 99.9%.

4.2 Antibiotic Prescribing Practices

4.2.1 Antibiotic Prescriptions

Table 4.1 indicates that antibiotics were prescribed to 78% of the patients. The most prescribed class of antibiotic was penicillin at over 60% followed by sulphonamide (18%) and macrolide (16%). The least prescribed class was lincosamide at under 1%.

Table 4.1: Total antibiotics prescribed

Antibiotic Class	**n**	**Percentage %**
Cephalosporin	9	1.92
Lincosamide	2	.43
Macrolide	76	16.2
Penicillin	293	62.48
Sulfonamide	89	18.97
Total	469	100

Table 4.2 shows that antibiotics were unnecessarily prescribed in over 84% of the encounters. Only pharyngitis and tonsillitis were rightfully indicated for an antibiotic prescription. Pharyngitis had the least rate of unnecessary prescribing (10%) followed by tonsillitis (50.39%). Nonspecific URTI accounted for majority of antibiotic prescriptions (302), followed by tonsillitis (129) and cough (22).

Table 4.2: Total antibiotics prescribed according to diagnosis

Diagnosis/Signs & Symptoms	Antibiotic class	Received unnecessary antibiotics	Total with condition	Percentage, %
Cold	Penicillin	2	2	100
Cough	Penicillin	16	16	100
	Macrolide	4	4	100
	Sulfonamide	2	2	100
Flu	Penicillin	1	1	100
Pharyngitis	Penicillin	1	7	14.3
	Macrolide	0	3	0
Rhinitis	Macrolide	1	1	100
Sinusitis	Penicillin	1	1	100
Sore throat	Macrolide	1	1	100
Tonsillitis	Penicillin	7	70	10
	Macrolide	29	30	96.7
	Cephalosporin	1	1	100
	Lincosamide	2	2	100
	Sulfonamide	26	26	100
URTI	Penicillin	196	196	100
	Macrolide	37	37	100
	Cephalosporin	8	8	100
	Sulfonamide	61	61	100
Total		398	469	

4.2.2 Generic Antibiotic Prescriptions

Table 4.3 shows there was a high rate of prescribing by generic name, 459 out of 469 prescriptions. Penicillin class was the most prescribed generic at 61%, followed by sulfonamides at 19% and macrolides at 16%. Cephalosporin and lincosamide class were the least prescribed at under 2% of generic prescriptions.

Table 4.3: Total antibiotics prescribed by generic name

Generic antibiotic prescriptions	Total number, n	Percentage, %
Cephalosporin	9	1.96
Lincosamide	2	0.44
Macrolide	76	16.55
Penicillin	283	61.44
Sulfonamide	89	19.61
Total	**459**	**100**

4.2.3 Kenya Essential Medicines List

The antibiotics prescribed were grouped into Access and Watch categories (Table 4.4). Amoxicillin was the most prescribed antibiotic from the Access category. Cotrimoxazole was the most prescribed Watch antibiotic followed by azithromycin and cefixime. Access antibiotics accounted for 62.3% of all antibiotics prescribed while the Watch antibiotics accounted for over 37% of total antibiotics prescribed. The fixed dose combination of ampicillin + cloxacillin (Ampiclox) was prescribed in one patient encounter. This fixed dose combination does not fall in any AWaRe category.

Table 4.4: Total antibiotics prescribed as per AWaRe Classification

Access	**Number prescribed**	**Watch**	**Number prescribed**
Amoxicillin	229	**Azithromycin**	66
Amoxicillin + clavulanic acid	62	**Cefixime**	8
Flucloxacillin	1	**Cefuroxime**	1
		Clarithromycin	4
		Clindamycin	2
		Cotrimoxazole	89
		Erythromycin	6
Total	**292**		**176**

4.3 Rational Antibiotic Prescribing

In table 4.5, macrolide and penicillin were the only rationally prescribed antibiotic classes. Less than 4% of macrolide prescriptions were rationally prescribed. Approximately 24% of penicillin prescriptions were rational. Most antibiotics prescribed had the right dose and duration.

Table 4.5: Total antibiotics prescribed according to rationality

	Rational			**Rationally prescribed, n**	**Total**
Antibiotic class	**Dose, n**	**Duration, n**	**Indication, n**		
Cephalosporin	9	8	0	0	9
Lincosamide	2	0	0	0	2
Macrolide	72	62	3	3	76
Penicillin	262	288	76	71	293
Sulfonamide	89	0	0	0	89
Total	434	358	79	74	469

In table 4.6, adolescents were most likely to receive a rational antibiotic prescription (OR 1.02 CI 95% 0.53 to 1.98, p=0.98) compared to children under 12 years.

Female patients were more likely to be prescribed antibiotics rationally compared to males (OR 1.48 CI 95% 0.86 to 2.55, p=0.16).

Patients with fever were more likely to be prescribed an antibiotic rationally compared to those with normal temperature (OR 4.7 CI 95% 2.49 to 8.89, p=<0.001).

Table 4.6: Rationality of antibiotics prescribed as per patient factors

Variable	Was Antibiotic Prescribed Rationally		Bivariate Analysis Crude Odds Ratio (CI)	*P Value*
	No n (%)	Yes, n (%)		
Age				
0 – 12 years	129(81.7)	29(18.3)	Reference Category	
13 – 18 years	74(81.3)	17(18.7)	1.02(0.53, 1.98)	0.98
19 – 64 years	167(87.9)	23(12.1)	0.61(0.34, 1.11)	0.10
65years and above	25(83.3)	5(16.7)	0.89(0.31, 2.52)	0.82
Gender				0.16
Male	146(87.4)	21(12.6)	Reference Category	
Female	249(82.5)	53(17.5)	1.48(0.86, 2.55)	
Temperature				<0.001
Fever	30(60)	20(40)	4.7(2.49, 8.89)	
Normal	367(87.6)	52(12.4)	Reference Category	

4.4 Factors Determining Antibiotic Prescription

4.4.1 Prescriber Factors

A total of 36 clinicians were included in the study, of whom 21 (58.3%) were females (table 4.7). Most of them were either in the age-group 26-30 years (n=13; 36.1%) or 31-35 years (n=12; 33.3%) of the participants. The majority (n=30; 83.3%) had diploma level of education and had worked for a duration of 6-10 years (n=19; 52.8%). Two prescribers had a bachelor's degree in clinical medicine.

4.4.2 Institutional Factors

In table 4.7, availability of antibiotics (p=0.026) and availability of prescription guidelines (p=0.012) were indicative of higher likelihood of rational prescribing.

Table 4.7: Prescriber & Institutional factors affecting antibiotic prescribing practices

		Prescribing practice		
Variable	**Overall**, N = 36[1]	**irrational**, N = 31[1]	**rational**, N = 5[1]	**p-value**[2]
Gender, n (%)				0.63
Male	15 (41.7)	12 (38.7)	3 (60.0)	
Female	21 (58.3)	19 (61.3)	2 (40.0)	
Prescriber Age, n (%)				0.92
Under 25 years	6 (16.7)	5 (16.1)	1 (20.0)	
26-30 years	13 (36.1)	11 (35.5)	2 (40.0)	
31 - 35 years	12 (33.3)	11 (35.5)	1 (20.0)	
36 - 40 years	5 (13.9)	4 (12.9)	1 (20.0)	
Highest level of Education, n (%)				0.99
Diploma	30 (83.3)	25 (80.6)	5 (100.0)	
Higher diploma	4 (11.1)	4 (12.9)	0 (0.0)	
Bachelor's degree	2 (5.6)	2 (6.5)	0 (0.0)	
Years of Work experience, n (%)				0.22
Under 1 year	6 (16.7)	5 (16.1)	1 (20.0)	
1 - 5 years	8 (22.2)	6 (19.4)	2 (40.0)	
6 - 10 years	19 (52.8)	18 (58.1)	1 (20.0)	
11 - 15 years	3 (8.3)	2 (6.5)	1 (20.0)	
Laboratory guidance, n (%)				0.53
Strongly agree	5 (13.9)	5 (16.1)	0 (0.0)	
Agree	18 (50.0)	16 (51.6)	2 (40.0)	
Neutral	9 (25.0)	7 (22.6)	2 (40.0)	
Disagree	4 (11.1)	3 (9.7)	1 (20.0)	
Availability of antibiotics, n (%)				0.026
Strongly agree	2 (5.6)	1 (3.2)	1 (20.0)	
Agree	20 (55.6)	17 (54.8)	3 (60.0)	
Neutral	13 (36.1)	13 (41.9)	0 (0.0)	
Disagree	1 (2.8)	0 (0.0)	1 (20.0)	
Strongly disagree	0 (0.0)	0 (0.0)	0 (0.0)	
Availability of Prescription Guidelines, n (%)	16 (44.4)	11 (35.5)	5 (100.0)	0.012

[1]Median (IQR) or Frequency (%)
[2]Fisher's exact test

4.4.3 Patient Factors

There was a total of 600 patients that sought medical care in 20 health facilities for URTI (table 4.8). The median age was 17 (IQR: 9-31) years and 388 (64.7%) were females. The median temperature was 36.5 (IQR: 36.4-36.8) degrees Celsius. The most common

presenting condition was nonspecific URTI (n=386; 64.3%), followed by tonsillitis (n=128; 21.3%), cough (n=28; 4.7%), rhinitis (n=23; 3.8%), and cold (n=21; 3.5%). Other presenting conditions included flu, pharyngitis, sinusitis, and sore throat.

Table 4.8: Socio-demographic characteristics of the patients attending health facilities in Kiambu County

Characteristic	N = 600
Age, Median (IQR)	17 (9 – 31)
Gender, n (%)	
Female	388 (64.7)
Male	212 (35.3)
Temperature (^{0}C), Median (IQR)	36.5 (36.4 – 36.8)
Diagnosis, n (%)	
Cold	21 (3.5)
Cough	28 (4.7)
Flu	2 (0.3)
Pharyngitis	8 (1.3)
Rhinitis	23 (3.8)
Sinusitis	1 (0.2)
Sore throat	3 (0.5)
Tonsillitis	128 (21.3)
Nonspecific URTI	386 (64.3)

4.4.3.1 Age

In table 4.9, those above the age of 65 years were most likely to receive an antibiotic prescription (OR 3.19, 95% CI 0.57 to 4.30, p=0.38). Adolescents (13-18 years) were more likely to receive an antibiotic prescription than children (OR 1.31 95% CI 0.75 to 2.29, p=0.35). Adults were more likely to receive an antibiotic prescription than children (OR 1.12 95% CI 0.72 to 1.73, p=0.62). However, these results were not statistically significant.

4.4.3.2 Gender

In table 4.9, female patients were significantly less likely to be prescribed an antibiotic than their male counterparts (OR 0.52, 95% CI 0.34 to 0.80, p = 0.002).

4.4.3.3 Temperature

There was a significant association with fever (table 4.9). Patients with fever were more likely to be prescribed an antibiotic (OR 2.67, 95% CI 1.04 to 6.88, p=0.03).

Table 4.9: Patients' predictors of antibiotic prescribing

Variable	**Was Antibiotic Prescribed**		**Bivariate Analysis Crude Odds Ratio (CI)**	***P Value***
	No n (%)	**Yes, n (%)**		
Age				
0 – 12 years	51(23.8)	163 (76.2)	Reference Category	
13 – 18 years	22(19.3)	92(80.7)	1.31(0.75, 2.29)	0.35
19 – 64 years	53(28.0)	189(72)	1.12 (0.72, 1.73)	0.62
65years and above	5(16.7)	25(83.3)	3.19 (0.57, 4.30)	0.38
Gender				0.002
Male	45(21.23)	167(78.77)	Reference Category	
Female	86(22.2)	302(77.8)	0.52(0.34, 0.80)	
Temperature				0.03
Fever	5(15.15)	45(84.85)	2.67(1.04, 6.88)	
Normal	126(22.2)	424(77.8)	Reference Category	

4.5 Other Medications

In table 4.10, the most common prescribed medication either as single drug or as a combination with other drugs were Paracetamol (n=219; 29.6 %), Cetirizine® (n=309;

41.8 %), Piriton® (n=35; 4.7 %), and Brufen® (n=84; 11.4 %). The most common classes of medication prescribed were antihistamines and analgesics.

Table 4.10: Medication prescribed at health facilities in Kiambu County

Class	Specific Medicine	n	%
Analgesics	Paracetamol	219	29.6
	Cipladon®	1	0.1
	Babymol®	1	0.1
Decongestant	Benacold®	1	0.1
	Solvin®	1	0.1
Antihistamines	Cetirizine	309	41.8
	Cetin®	3	0.4
	Zyncet®	2	0.3
	Elmont®	1	0.1
	Lmontas®	1	0.1
	Piriton®	35	4.7
	Chlorpheniramine	1	0.1
	Levocetirizine	1	0.1
	Promethazine	2	0.3
Bronchodilators	Salbutamol	2	0.3
Corticosteroids	PDL (prednisone)	17	2.3
Nasal solution Crystalloid Fluid	Normal saline	17	2.3
Expectorants	Ascoril®	4	0.5
Leukotriene receptor antagonists (LTRAs)	Montelukast	1	0.1
Mucolytics	Rhinothiol®	4	0.5
NSAID	Ibuprofen	12	1.6
NSAID	Brufen®	84	11.4
NSAID	Brustan®	5	0.7
Nasal solution	Probeta-N®	6	0.8
Mouthwash	Andolex-C®	2	0.3
Other	Multivitamin	4	0.5
Mouthwash	Betadine	3	0.4

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

The study investigated the antibiotic prescribing practices of clinical officers for patients with upper respiratory tract infections (URTIs) in public hospitals in Kiambu County, Kenya. The World Health Organization (WHO) recommended antibiotic prescribing rate is between 20-27% (Isah et al., 2001). There is strong consensus that antibiotics are overprescribed especially for URTIs despite offering limited benefit (Dallas, 2015). This study found a high rate of overprescribing antibiotics for patients with URTI. This was supported by a study that analyzed antibiotic prescribing globally. It found that the high antibiotic use in LMICs was linked to increased prevalence of infectious diseases, poor regulation or implementation in limiting over-the counter antibiotic sales, insufficient healthcare worker education, and the unavailability of essential diagnostics (Sulis et al., 2020).

A study conducted in the USA that assessed the factors associated with antibiotic misuse in outpatient treatment for upper respiratory tract infections found over 64% of patients were inappropriately treated with antibiotics (Schroeck et al., 2015). This was similar to a study done in Denmark and Iceland that revealed a majority of antibiotics were prescribed in primary care, especially for URTIs with most prescriptions being inappropriate (Sigurðardóttir, 2015). A similar study in India found that more than 60% of antibiotic prescriptions were inappropriate (Garg et al., 2014). A similar study on antibiotic prescribing patterns in Cameroon found that antibiotics were inappropriately prescribed at primary care facilities (Chem, 2018). A study in Ethiopia found

inappropriate antibiotic prescribing in 86% of prescriptions for children with cough (Tekleab, 2017). A study in Tanzania found antibiotics irregularly prescribed to 70% of children with common cold (Gwimile et al., 2012).

This increased use of antibiotics may have been due to several reasons. Diagnostic uncertainty and difficulty differentiating between bacterial and viral infections may have contributed to the inappropriate use. Patient expectations and pressure for antibiotics may have contributed as prescribers may have felt compelled to meet patient demands to ensure their satisfaction and compliance. Inconsistent adherence to clinical guidelines and inadequate training on antibiotic stewardship may have contributed to inappropriate prescribing. Additionally, healthcare system pressures such as high patient loads, and time constraints could have led to faster consultations and more frequent prescriptions. Another possible reason was perceived high infectious disease burden in the community which may have contributed to higher antibiotic prescriptions.

The World Health Organization (WHO) recommended use of generic antibiotics whenever possible (Ofori-Asenso & Agyeman, 2016b). There was a high rate of generic antibiotic prescription. This was similar to a study done in Cameroon that found high generic antibiotic prescription of 98% (Chem, 2018b). Generic antibiotics are preferred due to their cost-effectiveness and widespread availability. Antibiotic stewardship initiatives favor generic antibiotics as they are more readily available as narrow-spectrum antibiotics. Narrow spectrum antibiotics are preferred due to less predisposition to antimicrobial resistance (*WHO Progress*, 2019).

The Kenya Essential Medicines List (KEML) was designed to promote access to essential medicines and ensure their rational use. The Ministry of Health recommends prescription of antibiotics from the KEML to guarantee that antibiotics are used appropriately (Gitaka, 2020). Over 99% of the antibiotics prescribed were from the Kenya Essential Medicines List. The high adherence to the KEML in this study suggests the clinical officers followed national guidelines, which was a positive finding. Studies indicate that use of an Essential Medicine List improves rational drug use (Le Doare et al., 2015b). Access group antibiotics accounted for 62.3% of all antibiotics prescribed while the Watch group accounted for 37% of antibiotics prescribed. This accomplished the target set by WHO of at least 60% of overall antibiotic use from the Access group (*WHO Progress*, 2019). The Access antibiotics were preferred due to their narrow spectrum of action, lower cost and lower potential for antimicrobial resistance. The Watch group contains broad-spectrum antibiotics. Antibiotics from the Watch category increase the likelihood of antimicrobial resistance and are indicated in sicker patients in the hospital setting for conditions that are not URTIs. There was irrational use of antibiotics from the Watch group among the patients encountered in this study. No antibiotics were prescribed from the Reserve category.

Only macrolide and penicillin were rationally prescribed. Rationality was assessed based on WHO indicators of rational drug use. These were prescribing the right drug, at the right dose, for the right patient in the right duration. The patient antibiotic prescriptions were thus analysed and checked for the right dose, frequency, duration and whether the indicaiton was correct. This was compared against the WHO AWaRe booklet on antibiotic use. Based on this, macrolides were correctly indicated in treatment of

pharyngitis while penicillins were correctly indicated in treatment of tonsillitis and pharyngitis. Ampiclox was prescribed in one patient encounter. The WHO doesn't recommend use of the fixed-dose combinations of multiple broad-spectrum antibiotics such as ampicillin + cloxacillin as it is not evidence-based, nor recommended in high-quality international guidelines (WHO Stewardship, 2021).

Male prescribers were more rational than their female counterparts. This is backed by a similar study in Malta that found female general practitioners were two times more likely to prescribe antibiotics (Saliba-Gustafsson et al., 2019b).This is in contrast to a study done in rural China that found male prescribers to be more irrational than females(Chang et al., 2019). A similar study in the Netherlands found female general practitioners prescribed antibiotics more rationally than male GPs (Eggermont et al., 2018b). This difference could be attributed to different reasons. There could be interaction effects between gender and other variables like patient age, gender, clinical setting or medical condition (Smith et al., 2018a).

Prescriber age had no implication on prescribing. This is in contrast to a study done in the USA that found older prescribers were more likely to prescribe antibiotics irrationally (Deb et al., 2022). Older primary healthcare providers in Canada were found to prescribe antibioitcs more frequently for patients with URTI (Silverman et al., 2017). This was similar to a study conducted in Malta (Saliba-Gustafsson et al., 2019a). This study found that general practitioners over the age of 60 had the highest antibiotic prescribing rates. A study that assessed factors that affect primary care providers' prescribing decisions

found that older prescribers prescribed antibiotics more frequently (O'Connor et al., 2018).

The level of education were either diploma, higher diploma or bachelor's degree in clinical medicine. Those with diploma were the most rational in their prescriptions. This was not significant. A study done in Tanzania assessing antimicrobial prescribing practice for URTI identified clinical officers as the most irrational prescribers (Gwimile et al., 2012). General practitioners were found to prescribe antibiotics more than other practioners (Bagger, 2015).

Prescriber working experience did not affect antibiotic use. This is in contrast to a study done in Canada that found primary care physicians with longer work experience were more likely to prescribe antibiotics for URTI (Silverman et al., 2017). A study in Australia found that age, work experience, gender, location of practice and socioeconomic profile of healthcare practitioners were not significant predictors for prescribing (Fletcher-Lartey et al., 2016). A study assessing antibiotic prescribing among Canadian general practitioners found that inappropriate antibiotic prescribing increased with time in practice (Cadieux et al., 2007).

Antibiotics were prescribed more rationally to female patients despite males receiving more antibiotics. This contrasted a study done in the USA that found males and older patients were more likely to be prescribed antibiotics rationally (Deb et al., 2022). (Imanpour et al., 2017b) found that patient gender was linked to disparities in antibiotic prescribing in hospitals. This study found that females had a higher probabiility of receiving unneccessary antibioitics compared to men. In England, a study found that

women were less likely to be treated with antibiotics when presenting with either cough or sore throat (Smith et al., 2018b). A German study found that females were prescribed antibiotics more than men (Poss-Doering et al., 2021). This contrasts a post-hoc analysis of data across European countries which found no gender differences in receiving inappropriate antibiotics in patients with URTI (Bagger, 2015).

Patients above the age of 65 years had a higher rate of antibiotic prescriptions, however, adolescents were most likely to be prescribed antibiotics rationally. This contrasts a study in Indonesia that found antibioitcs were prescribed more in children than adults (Novan & Primadi, 2020). In Germany, a study analyzing antibiotic use in primary care found that younger patients were less likely to be prescribed antibiotics (Poss-Doering et al., 2021). A study analysing drug use in Italy found antibiotics were the most prescribed class of drugs in children(Nicolini et al., 2014).

This discrepancy in prescribing across the age groups could have been due to several factors. Older adults are often perceived as more vulnerable to complications from infections due to age-related decline in immunity and presence of comorbidities. This could have led to a more cautious approach by the clinical officers, resulting in higher rates of antibiotic prescriptions. Older patients may have stronger demands for antibiotics, which could have been influenced by previous experiences or a notion that antibiotics are necessary for recovery. This in turn could have pressured the clinical officers to prescribe more antibiotics to them. Daignostic uncertainty could have led to more liberal use of antibiotics as a precaution due to the assumption from the prescriber that diagnosing

infections in the older population is harder due to atypical presentaitons and prsence of overlapping symptoms with other chronic conditions.

Presence of fever increased antibiotic prescribing. Those with fever were significantly associated with a rational antibiotic prescription. Patient signs and symtoms were found to influence antibiotic prescribing (van Buul et al., 2014). A similar study in Malta found that presence of fever increased the likelihood of an antibiotic prescription (Saliba-Gustafsson et al., 2019b). A similar study in the USA found fever was linked to antibiotic prescriptions (Manne et al., 2018b). this Patient demand was the most common reason for primary care practitioners prescribed unwarranted antibiotics (Kohut et al., 2020). According to this study, these clinicians wanted their patients to feel their clinic visits as valuable and believed that an antibiotic prescription demonstrated value, some clinicians felt that some patients could only be satisfied by an antibiotic prescription, and some wanted to avoid possible complications of denying antibiotics.

Increased rates of prescribing antibiotics for patients with fever could have been due to several reasons. Prescribers often consider fever as a sign of a more serious infection, which could be bacterial rather than viral. This can prompt the clinician to prescribe antibiotics more. Diagnostic uncertainty in differentiating between a viral and bacterial URTI is mostly difficult, so the clinicians may have empirically treated the patients to cover for any potential bacterial infection.

Availability of antibiotics and availability of prescription guidelines was associated with rational antibiotic prescribing. This was similar to a study done in Kenya that found availability of antibiotics, availability of hospital guidelines, laboratory support and

antibiotic audit contributed to rational antibiotic prescribing patterns (Momanyi et al., 2019). The ability of a prescriber to provide the right treatment is guided by available medication. A study done in Nigeria also concluded that drug availability positively affected antibiotic prescribing (Erah, 2003). The use an essential medicines list (EML) in prescribing was found to be a significant achievement in improving rational drug use (Le Doare et al., 2015a). In Kenya, the Kenya Essential Medicines List (KEML) was formulated to promote the correct use of medicines by health professionals, patients and the public. The KEML represents best practice in the choosing of medication for best therapeutic outcomes (Ministry of Health, 2019).

5.2 Conclusions

The study showed that there was a high antibiotic prescribing rate, which deviated from the WHO standard. This study demonstrated that most antibiotic prescriptions were irrational. The null hypothesis that there was no association between the clinical officers' antibiotic prescribing practices and the factors that affect antibiotic prescribing for upper respiratory tract infections was partially rejected. The institutional factors: availability of drugs and availability of hospital prescribing guidelines were significantly associated with rational antibiotic prescribing. Patients with fever were significantly more likely to be prescribed antibiotics rationally. Prescriber factors were not significantly associated with rational prescribing of antibiotics.

5.3 Recommendations

5.3.1 Recommendations from the study

Antibiotic prescribing needs to be addressed within the county. This can be done in the form of educating the healthcare workers on rational prescribing and by monitoring antibiotic use in the facilities. Increasing awareness among healthcare workers leads to greater outcomes.

Regular monitoring of antibiotic use and feedback to prescribers should be done. This can help address the high rates of antibiotic consumption within the county.

Encouraging facilities to adopt hospital formulary and healthcare workers to use prescription guidelines can help improve rational antibiotic prescribing of antibiotics.

5.3.2 Recommendations for further research

More research is needed to better understand the factors associated with antibiotic prescribing. Some factors such as patient waiting time, workload and expectations were not assessed but have been found to influence antibiotic prescribing among prescribers. Further research looking at these confounding variables should be done.

A similar study assessing private facilities within the county should be done. The study only targeted public facilities yet some patients obtain treatment from private facilities. Some patients seek care in public facilities but purchase antibiotics from private facilities.

The study was conducted over a short period of time, which may not fully capture the effects of the study variables over a longer time frame. A study done over a longer period

of time may provide more valuable information on antibiotic prescribing practices within the county.

Laboratory testing was also not assessed in the study, comparisons could have been made between testing for bacterial throat pathogens and whether antibiotics were prescribed rationally.

Antibiotic resistance testing was not done. This could have provided vital information on local antibiotic resistance patterns. Further studies on local antibiotic resistance and how it compares to country resistance patterns can be done.

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APPENDICES

Appendix I: Questionnaires

Part 1: Sociodemographic Information

1. Gender	☐Male ☐Female
2. Age	☐Under 25 years ☐26-30 years ☐31-35 years ☐36-40 years ☐41-45 years ☐Over 45 years
3. What is your highest level of education?	☐Diploma ☐Higher diploma ☐Bachelors degree ☐Post-graduate degree
4. How long have you been working as a prescriber, including internship?	☐Under 1 year ☐1-5 years ☐6-10 years ☐11-15 years ☐16-20 years ☐Over 20 years

Part 2: Institutional Factors

To what extent do you agree with the following statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
5. Laboratory guidance (culture and sensitivity) is useful before prescribing antibiotics	☐	☐	☐	☐	☐
6. My choice for prescribing antibiotics is influenced by availability of antibiotics	☐	☐	☐	☐	☐

7. There are hospital guidelines available on which antibiotics to prescribe	☐Yes ☐No
8. I use hospital antibiotic guidelines before prescribing antibiotics	☐Yes ☐No

Appendix II: WHO Prescribing Indicators Checklist

PRESCRIBING INDICATOR FORM

Location: _____

Investigator:_____Date:_____

Sequence Number	Date	Age	Gender	Temp	# Drugs	Antib. (0/1)	Antib. Name	Generic (0/1)	Dose	Duration (days)	No. on EDL	Diagnosis
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
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Appendix III: Graduate School Approval

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Dean, Graduate School

DATE: 20th May, 2022

TO: Mr. Kevin Wambua Murigi
C/o Department of Obstetrics & Gynecology

REF: P151/37655/2016

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

We acknowledge receipt of your Research Proposal after fulfilling recommendations raised by the Graduate School Board of 31st March, 2022.

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The forms are available at the University's Website under Graduate School webpage downloads.

KENYATTA UNIVERSITY OFFICE OF DEAN 31 MAY 2022 GRADUATE SCHOOL P.O. Box 43844-00100 NAIROBI

Thank you.

REUBEN MURIUKI
FOR: DEAN, GRADUATE SCHOOL

CC. Chairman, Department of Obstetrics & Gynecology

Supervisors:

1. Dr. Joseph Thigiti
   C/o Department of Obstetrics & Gynecology
   Kenyatta University
2. Dr. Muiruri King'ang'a
   C/o Department of Medical Physiology
   Kenyatta University

Appendix IV: KUERC approval

KENYATTA UNIVERSITY
CENTRE FOR RESEARCH ETHICS AND SAFETY

Fax: 8711242/8711575
Email: chairman.kuerc@ku.ac.ke
Nairobi, 00100

P. O. Box 43844,

Tel: 8710901/12

Website: www.ku.ac.ke
Our Ref: **KU/ERC/APPROVAL/VOL.1**

Date: 22nd /08/2022

Kevin W. Murigi
P.O Box 43844, 00100
Nairobi.

Dear Mr. Murigi,

APPLICATION NUMBER: PKU/2538/I1665- ANTIBIOTIC PRESCRIBING PRACTICES FOR UPPER RESPIRATORY TRACT INFECTION AMONG CLINICAL OFFICERS AT KIAMBU COUNTY, KENYA

This is to inform you that ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** has reviewed and approved your above research proposal. Your application approval number is **PKU/2538/I1665.** The approval period is **22nd /*08/2022 to 22nd/08/2023***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.

vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.

vii. Submission of an executive summary report within 90 days upon completion of the study to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

To serve you better, researchers are kindly requested to access and complete a customer feedback form and sent it back online as you continue with research and upon completion of data collection found on the following website link; ;(https://docs.google.com/forms/d/1ytWefDwvyz5h1oz_VIn0xbxg3uGdlDzMXFWNDsMrRPQ/edit?usp=sharing

Yours sincerely

KENYATTA UNIVERSITY
OFFICE OF THE DIRECTOR
22 AUG 2022
ETHICS REVIEW COMMITTEE
P.O. BOX 43844 - 00100 NAIROBI

Prof. Judith Kimiywe

Director: Centre for Research Ethics and Safety

Appendix V: NACOSTI Approval

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **481429**

Date of Issue: **13/October/2022**

RESEARCH LICENSE

This is to Certify that Dr.. Kevin Murigi of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kiambu on the topic: ANTIBIOTIC PRESCRIBING PRACTICES FOR UPPER RESPIRATORY TRACT INFECTION AMONG CLINICAL OFFICERS AT KIAMBU COUNTY, KENYA for the period ending : 13/October/2023.

License No: **NACOSTI/P/22/20424**

481429

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Appendix VI: Kiambu County Permission

COUNTY GOVERNMENT OF KIAMBU
DEPARTMENT OF HEALTH SERVICES

All correspondence should be addressed to HEAD
HRDU – HEALTH DEPARTMENT
Email address: mndiritu@gmail.com
mkwasa@live.com
Tel. Nos: 0721641516
0721974633

HEALTH RESEARCH AND DEVELOPMENT
UNIT
P. O. BOX 2344 – 00900
KIAMBU

Ref. No.: KIAMBU/HRDU/22/08/23/RA_MURIGI Date: 23rd August 2022

TO WHOM IT MAY CONCERN

RE: CLEARANCE TO CONDUCT RESEARCH IN KIAMBU COUNTY

Kindly note that we have received a request by Dr. Kevin Murigi of Kenyatta University to carry out research in Kiambu County, the research topic being on **"Antibiotic Prescribing Practices For Upper Respiratory Tract Infection Among Clinical Officers In Kiambu County, Kenya"**

We have duly inspected his documents and found that he has been cleared by Kenyatta University Ethics Review Committee to carry out the research for a period ending **22nd August 2023**. As he has received approval from a NACOSTI licenced ERC, we hereby give him a provisional clearance to begin collecting his data immediately to avoid any delays in the research process. However, he is required to submit the license within 2 months of receiving this letter.

It is incumbent upon the institution where he is carrying out research to ensure that he receives adequate supervision during the process of conducting the research. This note also accords him the duty to provide a feedback on his research to the county at the conclusion of his research.

DR. MWANCHA KWASA
COUNTY CLINICAL RESEARCH OFFICER
KIAMBU COUNTY

Appendix VII: Informed Consent

INFORMED CONSENT

Participant Information Sheet (To be kept by participant)

Research Title: Antibiotic prescribing practices for upper respiratory tract infection among clinical officers at Kiambu County, Kenya

Dear fellow healthcare worker:

We are conducting a survey regarding antibiotic prescribing practices of healthcare workers for upper respiratory tract infections. Rational prescribing of antibiotics delays onset of antibiotic resistance, improves clinical outcomes and is cost-effective. This study aims to assess and check if antibiotics are prescribed rationally. If you are willing to participate in this study, we will analyze your patient prescriptions (average number of medications prescribed per encounter, percentage of antibiotics prescribed by generic name, percentage of encounters where antibiotics are prescribed, and percentage of antibiotics prescribed from the essential medicine list) and offer you a questionnaire.

Voluntary Study

The study is voluntary, you have the right to refuse participation in this study. If you accept to participate in the study, you are free to change your mind any time. If you do not participate in the study, your care will not be affected in any way. You may ask questions related to the study at any time.

Discomforts and Risks

Some of the questions you will be asked are personal and may make you uncomfortable. If it occurs, you can refuse to answer any questions if you so choose. There are no risks anticipated with participating in this study.

Benefits

If you participate in this study your responses will help us understand healthcare workers' antibiotic prescribing practices and help improve antibiotic prescribing.

Reward

There are no rewards or any payment to you if you participate.

Confidentiality

Your personal information will be confidential, and the responses will be used for academic research only. Your details will be entered only in coded form and your name will not be included.

Researcher contact details: Kevin Wambua Tel No: 0721755094

If you have questions about the study, call the Principal Investigator or Supervisor

1. **Dr. Joseph Thigiti Tel No: 0711920700**
2. **Dr. Muiruri King'ang'a Tel No: 0722511000**

However, if you have questions about your rights as a study participant: You may contact Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke, secretary.kuerc@ku.ac.ke

Consent Form

I confirm that I have understood the information I have been given about the study. I agree to participate in the study. I confirm that I am joining the study out of my free will and that I can withdraw at any time. I understand that my information will be kept private.

I understand what will be required of me.

Name:……

Signature…….

Date:……

Investigators Statement

I confirm that I have explained the information fully to the volunteer in a language s/he understands, the procedures to be followed in the study and the benefits and risks involved

Name of Interviewer …….. Signature …….

Date ……

Date: