AN ASSESSMENT OF ANTIMICROBIAL STEWARDSHIP STATUS IN KAPSABET COUNTY REFERRAL HOSPITAL, NANDI COUNTY, KENYA

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DECLARATION AND APPROVAL

Declaration

This thesis/project is my original work and has never been presented for any academic award in any institution.

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DEDICATION

I dedicate my research study to my children, Taita Lellin and Kibichii Yego for their immense love and inspiration.

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ABSTRACT

The pertinent need for antimicrobial stewardship (AMS) has been orchestrated by the rising rates of antimicrobial resistance (AMR). Antimicrobial stewardship programs play a pivotal part in encouraging the rational usage of antimicrobials within hospital settings. Assessing the key indicators of Antimicrobial Stewardship Program (ASP) in healthcare facility settings is a practical way of identifying the drivers and barriers of AMS. This study assessed the status of antimicrobial stewardship in Kapsabet County Referral Hospital in Nandi County. Objectively, it assessed health care workers awareness; drivers as well as barriers for effective antimicrobial stewardship program at Kapsabet County Referral Hospital in Nandi County. By use of a descriptive, cross-sectional study design, the study employed stratified random sampling, targeting medical officers, pharmacists and clinical officers. Study approvals were secured from National Commission for Science, Technology and Innovation, MKU research committee and Kapsabet County Referral Hospital. A total of 63 respondents filed the structured questionnaires and checklist that were distributed to the sampled population. Quantitative and qualitative data was collected and analyzed. It was determined that the antimicrobial stewardship status at Kapsabet County Referral Hospital was not well developed, with 54% of the respondents rating the AMS program as below average. The core interventions that drive AMS program were partially implemented with an average of 1.86 and a standard deviation of 0.63, despite health care workers demonstrating awareness and an understanding of antimicrobial stewardship with an average of 2.59 and a standard deviation of 0.49. Poor communication on antimicrobial resistance, poor leadership and insufficient resources were cited as the most common barriers for effective implementation of antimicrobial stewardship. The study concluded that even though the antimicrobial stewardship is not well-developed, the health care workers demonstrated awareness, with optimal antimicrobial usage through documentation of drug dosage, duration and indication as the main driver of AMS program at the facility. This study recommends the strengthening of the AMS program at Kapsabet County Referral Hospital through the enhancement of AMS awareness; strengthening antimicrobial optimization usage; and leadership commitment to promote sustainability of the antimicrobial stewardship program in a health facility setting.

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LIST OF ABBREVIATIONS AND ACCRONYMS

AMR	Antimicrobial Resistance
AM	Antimicrobial
AMS	Antimicrobial Stewardship
AMU	Antimicrobial Use
AWaRe	Access, Watch, Reserve
ASP	Antimicrobial Stewardship Program
DOI	Diffusion of Innovations
GAP	Global Action Plan
GLASS	Global Antimicrobial resistance and use Surveillance System
HCW	Health Care Worker
KAP	Knowledge Attitude and Practices
NAP	National Action Plan
SDG	Sustainable Development Goals
TDF	Theoretical Domains Framework
UHC	Universal Health Coverage
W.H.O	World Health Organization

CHAPTER ONE

INTRODUCTION

1.0 Introduction

Chapter one outlines the study's background information; it presents the problem, aims and questions the study sought to answer. Further it provides the study scope, its expected significance, limitations with delimitations and assumptions made.

1.1 Background to the study

The alarming burden of antimicrobial resistance (AMR) in regards to the key bacterial strains listed among the WHO's 2017 priority pathogens, foreshadows the health status of persons in developing nations (Wangai et al, 2019). This threat is heightened by the reduction in the production of antimicrobial (AM) drugs that are either not easily accessible or highly-priced (Mbugua et al, 2020). However, even with a dwindling pipeline, the continuous evolution of resistant bacteria will not spare the new antibiotics (Wangai et al, 2019).

In 2019, the total global death toll attributed to AMR was about 1.3 million deaths. This is projected to take on an upward trajectory with an estimated 10 million deaths in 2050 (Simon K et al, 2024) with a disproportionately high burden to low resource settings. This rising trend is already evident; with the Global Antimicrobial resistance and use Surveillance System (GLASS) report (2022) indicating an increase by more than 15% in the AMR rates in 2020 in comparison with 2017. The report further highlighted worrying rates of AMR among common bacterial pathogens, particularly for Escherichia coli resistant to third-generation cephalosporin and the methicillin-resistant Staphylococcus aureus (MRSA) at 42% and 35% median resistance rate respectively spanning across 76 countries. Data from 2020 revealed that about 20% of urinary tract infections etiologically linked to E. coli showed low sensitivity to routinely prescribed

antibiotics such as ampicillin, co-trimoxazole, and fluoroquinolones, making routine infection management more challenging and diminishing the effectiveness of standard treatments (WHO, 2022).

In Africa, AMR has surpassed pathologies such as malaria, HIV, and TB to emerge as a main contributor of mortality within the region (Africa Centers for Disease Control and Prevention, 2024). A survey on the worldwide magnitude of antimicrobial resistance published in 2022 revealed that the African continent shoulders the greatest burden, with an estimated 27 mortality cases per 100,000 being directly related to AMR while 114 per 100,000 mortality cases indirectly linked to it (WHO, 2022). The total deaths related to AMR were approximately 255,000, corresponding to 22% of the global AMR burden in 2019 (Africa Centers for Disease Control and Prevention, 2024). This situation is anticipated to deteriorate further, with projections suggesting that by 2050, Africa's population will have doubled and deaths linked to antimicrobial resistance could rise fourfold, reaching 4.1 million annually. The Africa Centers for Disease Control and Prevention landmark report (2024) further notes that despite such glaring threat, the uptake and implementation of AMR interventions in Africa remains sub-optimal, mainly due to priorities misalignment, inadequate resources, and poor coordination. For instance, only 57% of African countries have stewardship programs, specifically on AWaRe antibiotic classification on their National Essential Medicine Lists (NEMLs).

In Sub-Saharan Africa (SSA), reports indicate that the region carries the heaviest burden of AMR at 23.5 deaths per 100,000 (GLASS, 2022). Kariuki et al (2022) attributes these prevailing high levels to the regional impoverish status culminating in a high infectious diseases burden, sub-optimal management of antimicrobial drug consumption, and a lack of substitutes to antimicrobials rendered powerless. Collaborators A. R (2019) noted that the leading pathogens

associated with AMR deaths in the region are *Streptococcus pneumoniae, Klebsiella pneumoniae, Escherichia coli, Staphylococcus aureus, Pseudomonas aureus, and Acinetobacter baumannii.*

In Kenya, although the exact national landscape on AMR is unknown, studies and surveys conducted in health facilities across the country has shown the rampant use of antibiotics; non-judicious treatment sheets particularly to extended-spectrum penicillins and third-generation cephalosporins in wards; coupled with the infrequent usage of microbiology laboratory tests to inform treatment (GOK, 2020). The Institute for Health Metrics and Evaluation (IHME), (2023) gave an estimate of eight thousand, five hundred directly attributable deaths to AMR, with thirty seven thousand, three hundred AMR associated deaths. These numbers have been reported to be greater than the mortality rates from cancers, gastro-intestinal infections, and even neonatal and maternal disorders. With the commonly identified pathogens being; *Klebsiella pneumoniae, Escherichia coli, Streptococcus pneumoniae, Staphylococcus aureus, and Salmonella Typhi.* Ogutu (2024) notes that the irrational usage of antimicrobials continues to be the key contributor of AMR which results in resistant microbes that is difficult and costly to treat. This affirms the certainty of the correlation between AM use and AMR (Mbugua et al, 2020) heralding calls for acute measures in the optimization of antimicrobial use in order to safeguard patients from harms inflicted by irrational antibiotic use (CDC, 2019).

According to WHO/EMP/IAU (2018), the term stewardship denotes the act of responsive and prudent management of something delegated to one's watch. For antimicrobials, it is the rational use geared towards patient recovery with minimal evolution and risk of spreading resistance. Antimicrobial stewardship (AMS) entails the optimum choice, dose, and time interval of AM therapy that yields best clinical results with less adverse effects to the patients and a decline in

resistance development (Shrestha et al, 2022). Simply put, AMS is a logical framework designed to enhance accountability in AM use.

AMS programs primarily aims to improve patient outcomes through infection rates reduction and subsequent reduction of morbidity and mortality; it improves patient's safety as it minimizes unintentional outcomes of AM use; it reduces AMR through rational use of AM; and it reduces medical treatment costs without altering health care quality (GOK, 2020). As such, AMS, together with disease prevention frameworks and care quality assuarance, have been designated as building blocks of establishing a solid strategy aimed at strengthening the healthcare delivery system (Shrestha et al, 2022).

Growing evidence advocates that AMS programs should be undertaken as it has sufficient capacity to tackle prudent use of AM and AMR (GOK, 2020). CDC (2019) further notes that these programs aids in improving antibiotic prescription thus enabling physicians improve clinical outcomes and harm reduction. The end result of successful implementation being a reduction in illnesses, deaths, and medical expenditures related to infections (GOK, 2020). Even with such glaring benefits, CDC (2019) notes that there is no single model design for the program in health facilities. Instead, hospitals have been entrusted with the responsibility of implementing and coordination of AMS activities at the facility level (WHO, 2022). These activities call for flexibility due to the intricacy of clinical therapy decision-making in regards to AM use and the variability (CDC, 2019).

South Africa, Taiwan and South Korea have been able to successfully implement AMS programs (GOK, 2020). In Kenya, AMS programs are neither implemented nor well established as evidenced by the nonexistence of mandatory AMS supporting activities in medical facilities

(Mbugua et al, 2020). Further, Gitaka et al. (2020) notes that these programs are yet to be set up at county health facilities, with main indicators and practices lacking in their roll out. In their study, exploring perspectives on AMS among health managers in Kenya, Mbugua et al. (2020) reports that AMS initiatives remain in a nascent stage, coinciding with excessive antibiotic utilization in medical facilities; an absence of comprehensive system-wide surveillance for IPC practices, and insufficient awareness among healthcare personnel. This is despite health care managers' cognizance of the paramount significance of AMS programs and the extensive advantages they bring to hospitals and their patients. Nevertheless, the Kenyan private health establishments have exhibited exceptional skill and competence in advancing and executing AMS programs. According to the GOK (2020), the health care private sector has noted a drop in multiple drug resistance (MDR) infections and candidemia by diligently following AM guidelines for surgical prophylaxis and limiting the use of carbapenem and other reserved antibiotics.

Even with scarce data on AM use and consumption within our setup (WHO, 2022), studies have discovered compelling evidence indicating that antibiotic utilization might not be optimal within the health care facilities (Omulo et al. 2022). It is therefore crucial to ensure that the AM available are used rationally (Shrestha et al, 2022) in order to preserve our current stock of antibiotics in use (Wangai et al, 2019). This has increased the fundamental priority of AMS program within the landscape of AMR burden (Mbugua et al, 2020).

Moreover, the fact that the development of microorganisms resistant to AM supersedes the development of new counter drugs is worrisome for governments striving to implement the health for all initiative in alignment with the Universal Health Coverage (UHC) for sustainable development. The Kenyan government is no exception, and as such has instituted a national blue

print framework on containment and prevention of AMR as a stepping stone in curbing the detrimental effects of AMR. It has also published a set of national guidelines on how AMS should be implemented in hospital facilities. These documents intend to lessen the impact of AMR by encouraging the judicious usage of drugs against microbes so as to safeguard the efficacy of accessible antimicrobials in the management and prevention of microbial diseases (WHO, 2022; GOK, 2017). Nevertheless, there has been a lack of organized implementation or systematic tracking and measurement of ASP programs and initiatives in government health institutions. Further, the degree to which AMS activities have been executed within health facilities remains largely unknown (WHO, 2022). It is therefore important to assess ASP in hospital settings as a practical approach of pointing out the drivers and challenges encountered while implementing AMS programs. This study therefore assessed AMS in a public hospital in Kenya.

1.2 Problem Statement

Resistance to antimicrobials has been highlighted among the ten foremost public health menace confronting mankind globally (WHO, 2021), with current estimates directly attributing about one million, two hundred seventy thousand deaths yearly to it (WHO, 2022). Murray et al. (2022), notes that Sub-Saharan Africa shoulders the biggest load, with 255,000 AMR related deaths in a year. This accounted for 22% of the AMR burden globally in 2019. These figures are expected to worsen by 2050, with estimates suggesting a quadruple of AMR associated deaths yearly to 4.1 million as the population doubles (Africa Centers for Disease Control and Prevention, 2024). In Kenya, the exact burden of AMR is unknown; however, sentinel studies have revealed development of significant levels of resistance to primary medications used in the management

of common life threating pathogens (GOK, 2020). According to the IHME (2023), an estimated eight thousand, five hundred deaths in 2019 were directly caused by antimicrobial resistance, while an additional thirty seven thousand, three hundred deaths, were linked to AMR-related infections. This has been attributed to the poor utilization of AMR knowledge by HCWs in clinical practice in spite of them being cognizant of AMR and its ramifications on the community (GOK, 2017).

Countrywide surveys undertaken in hospitals have depicted cases of significant occurrence of antibiotic utilization. Additionally, the prescription of antibiotics was found to be irrational in various hospital wards, particularly concerning third-generation cephalosporins and extended-spectrum penicillins. Furthermore, the utilization of culture and sensitivity tests to inform treatment was either limited or nonexistent (GOK, 2020). Consequently, we are facing resistance to the significant bacterial species featured on the WHO's 2017 list of priority pathogens which present significant danger to human well-being (Wangai et al, 2019).

Although the exact burden of AMR in Nandi County is not known, Nandi County is already facing multiple resistances to antimicrobials of *Campylobacter jejuni* and *Shigella* species. These are common causative organisms of diarrhea in pediatric population, particularly those under the age of five years, associated with a greater likelihood of mortality and morbidity. This is concerning as reports indicate one in five of AMR deaths occur among under five pediatric population (IHME, 2023). In an assessment carried out by Zachariah et al. (2021) at Kapsabet County Referral Hospital, it was noted that there is lack of efficacious of the commonly used first-line AM agents such as cotrimoxazole, erythromycin and ampicillin to the pathogens, narrowing down the therapeutic options to secondary medications such as ciprofloxacin and norfloxacin. This findings are worrisome as it over shadows Kenya's aim of achieving the global

SDG target for under five mortality rate of 25 per 1000 lives birth (UN, 2015), further hindering the likelihood of attaining Vision 2030 and universal health coverage.

With evidence showing sub-optimal use of antibiotics within public hospitals in our set up, (Omulo et al, 2022), there is need to advocate for the rational use of AM agents that are currently available by preserving their effectiveness. While antibiotic stewardship shows promise as a viable approach to ensure the proper utilization of antimicrobials and combating the AMR menace (GOK, 2020), it remains largely unimplemented in the majority of level 4 and 5 hospitals across sub-Saharan countries (Gitaka J et al, 2020) as evidenced by the lack of core AMS supporting interventions (Mbugua et al, 2020). For this reason, this study aimed to assess the antimicrobial stewardship status in Kapsabet County Referral Hospital, a level 5 government hospital in Nandi County.

1.3 Purpose of the Study

The main intent of this research was to assess the status of antimicrobial stewardship in Kapsabet County Referral Hospital, Nandi County, Kenya.

1.4 Objectives of the Study

1.4.1 General objective

To assess the status of antimicrobial stewardship in Kapsabet County Referral Hospital

1.4.2 Specific Objectives

1. To assess the level of awareness of antimicrobial stewardship by health care workers in Kapsabet County Referral Hospital
2. To identify drivers of antimicrobial stewardship program in Kapsabet County Referral Hospital
3. To assess barriers for effective implementation of antimicrobial stewardship activities in Kapsabet County Referral Hospital.

1.5 Research Questions

1. What is the current status of AMS in Kapsabet County Referral Hospital?
2. How aware are HCWs' in Kapsabet County Referral Hospital of AMS?
3. What drives the implementation of the ASP in Kapsabet County Referral Hospital?
4. What barriers hinder the effective implementation of AMS activities in Kapsabet County Referral Hospital?

1.6 Justification of the Study

AMR is emerging as a non-border concern posing existential threats for the realization of the SDGs and UHC. Globally, AMR has replaced common killing pathogens in mortality rates, with the World Bank estimating that by 2050, we are likely to face a 1.1% reduction in global GDP annually, hitting the low-income countries hardest with a potential of losing over 5% of their GDP (Africa Centers for Disease Control and Prevention, 2024). As such, AMR could drive millions into extreme poverty and overwhelm an already fragile health system.

Despite the glaring projections, the African continent continues to lag behind in achieving key AMR control indicators. The rolling out of the AMR National Action Plans (NAPs) endorsed by African Union (AU) Member States and developed in tandem with the WHO AMR Global Action Plan (GAP), has been deemed slow, fragmented, with heavy reliance on donor funds that often is misaligned with the set country's goals. Further, challenges such as limited technical capacity, low awareness levels, weak stewardship structures, and insufficient financial investment persist.

Like other LMICs, Kenya developed its AMR NAP; however, it continues to grapple with implementation barriers. Public health facilities remain at the fore front displaying irrational usage of drugs against various microbes, accelerating the development of antimicrobial inefficiencies. Further, HCWs bequeathed with the vital responsibility of antimicrobial prescribing and stewardship, lack consistent access to AMR training, updates, or diagnostic support tools requisite for rational usage of these antimicrobials. This study assessed the status of AMS program at Kapsabet County Referral Hospital, focusing on HCWs' awareness, drivers of AMS, and existing barriers.

By focusing on key local drivers and barriers influencing AMS in the context of a health facility level, the study aligns with national, regional and global efforts such as the AU Continental Framework for AMR Control (2020–2025), the AMR GAP, and the International Health Regulations (IHR). Further, it offers some contribution to the broader objective of strengthening health system resilience and containment of AMR through the One Health approach, ultimately feeding into SDG 3 (Good Health and Well-being) and the national health security goals.

1.7 Significance of the Study

The importance of assessing antimicrobial stewardship at Kapsabet County Referral Hospital is pegged on the benefits yielded to various stakeholders.

To researchers and academicians, the study results may serve as a reference point on AMS in healthcare settings across Kenya. By contributing valuable insights into AMS and antimicrobial resistance (AMR), this survey aims to enrich available literature. Additionally, it identifies potential gaps and loopholes for future studies, which may provide guidance and direction for upcoming scholars and researchers interested in this field.

To policymakers, the study findings could enhance the knowledge base on AMS, by painting a clear picture of the probable hiccups likely to be encountered while implementing AMS programs at healthcare facility levels. This knowledge may support information guided decisions as well as the development of policy briefs.

For the Ministry of Health, county health departments, and healthcare leaders at the facility level, this study's findings may prove beneficial in strengthening AMS program implementation. By shedding light on current gaps and opportunities, the research could inform strategies to optimize AMS practices, improve healthcare outcomes, and mitigate the growing threat of AMR.

1.8 Scope of the Study

This assessment was centered on determining the current AMS status in health care settings in Kenya. Kapsabet County Referral Hospital was used as a case assessment site. This study objectively assessed the level of awareness of AMS among health care workers, factors that

driver AMS program and barriers for effective implementation of AMS at Kapsabet County Referral Hospital. This study was carried out in February-March 2024.

1.9 Limitation and Delimitation

The research study was undertaken in Kapsabet County Referral Hospital. Health care workers to be contacted were not readily available owing to the demands of their professional duties. It took substantial amount of time for adequate data to be collected. To make certain that the majority of the population of interest was contacted; the investigator sought help from a research assistant to assist in data collection process. Additionally, to minimize disruption to clinical duties and enhance participation, point contact persons among the target population were contacted in advance to confirm availability prior to the scheduled data collection dates. The study therefore included participants who were available and consented to take part in the research study.

1.10 Assumption of the Study

This research proceeded with the presumption that the target population was presently available, open to participating, with the ability to provide an accurate representation of the research problem. It was also assumed that the participants possessed solid knowledge of the research subject; AMS in public health care facility setting in Kenya.

1.11 Conceptual Framework

This research study assessed the status of AMS program at Kapsabet County Referral Hospital by examining three key independent variables: healthcare workers' awareness of AMR, health facility drivers of AMS program, and the barriers to implementing AMS. The relationship among these variables was assessed in relation to the overall status of AMS program, which served as the dependent variable. Further, health system factors were considered as intervening variable that may influence the association between these predicting variables and the outcome of interest.

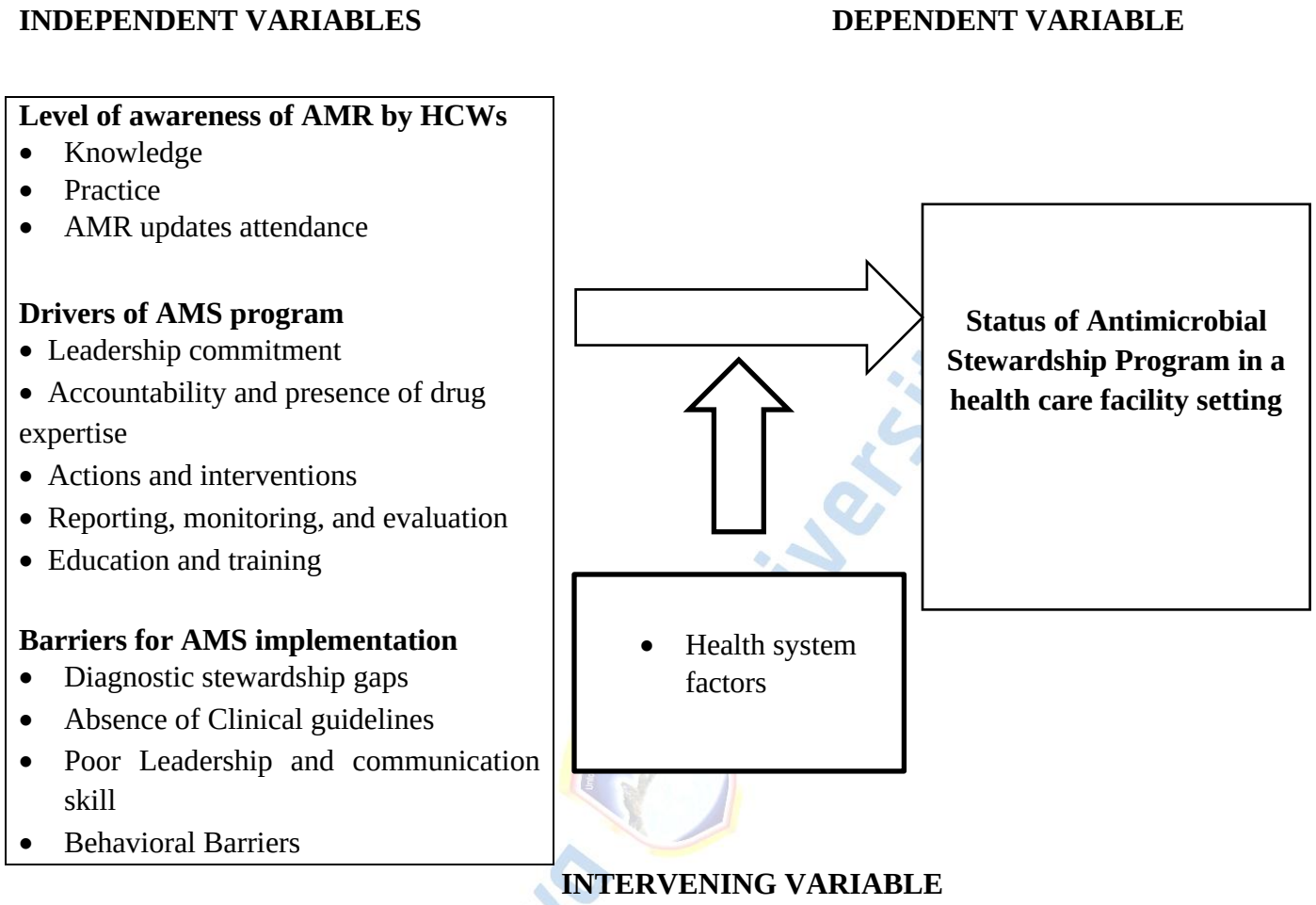

Figure 1. 1 Conceptual Framework

Source: Researcher (2023).

1.11.1 Independent Variables

Level of AMR awareness among healthcare workers can considerably affects the adoption and sustainability of AMS practices within a health facility setting. This includes HCWs' knowledge of antimicrobial resistance, prescribing practices, and participation in AMR-related training or updates. According to Shrestha et al. (2022), insufficient knowledge in antimicrobials can result in its irrational use, accelerating resistance. This study assessed the awareness levels of HCWs

and how these contribute to the successful implementation of AMS activities within a health facility.

The study also looked at the drivers that support AMS implementation. As documented by the WHO (2019) and Kenya's national AMS guidelines (GOK, 2020), effective AMS programs are driven by strong institutional leadership; dedicated AMS teams, AMS strategies such as prescription audits; continuous assessment of AMS outcomes and continuous professional development on AMR and AMS best practices. These drivers form the structural basis of a functional AMS program and were assessed in the study to identify their presence and influence within the health facility setting.

The implementation of AMS programs may be bombarded with varied systemic and contextual challenges ranging from limitation of diagnostic infrastructure, outdated of unavailability of clinical guidelines, poor leadership and communication capacity, and behavioral resistance among HCWs (Gitaka et al., 2020; WHO, 2019). Such barriers carry the potential of hindering the integration of stewardship practices into routine clinical decisions. This study assessed the challenges affecting the AMS implementation efforts in Kapsabet County Referral Hospital.

1.11.2 Intervening Variable

The study considered health system factors as an intervening variable that has the potential of influencing the association between the explanatory variables and the outcome of interest. Health facility factors such as resource availability, policies, infrastructure, and organizational culture can drive or obstruct the successful operationalization of AMS programs.

1.11.3 Dependent Variable

The status of AMS program was the measured variable in the study. This was measured by evaluating adherence to recommended AMS practices, rational antimicrobial prescribing behaviors, and institutional support for stewardship activities. As emphasized by Mbugua et al. (2020), well-executed AMS programs contribute to cost-effective patient care and help mitigate the progression of antimicrobial resistance.

1.12 Operational definition of key terms

Antimicrobial agent: According to GOK (2017), an AM agent is any substance which interacts with a specified target killing or inhibiting the growth of a microorganism. The same meaning shall be retained in this research project.

Antimicrobial resistance: According to GOK (2020), AMR is a microorganism's capability of preventing or stopping the effectiveness of an antimicrobial activity. The same meaning shall be retained in this research project.

Antimicrobial use: According to GOK (2020) AM use denotes an assessment of AM quantities together with their indication in a target group of patients or population over a specific time period. The same meaning shall be retained in this research project.

Antimicrobial stewardship: This is a logical sequence of activities promoting accountability in the use of antimicrobials (WHO, 2019). The same meaning shall be retained in this research project.

AMS program: AMS program is a strategy adopted by health-care facilities with the objective of enhancing the rational usage of antimicrobials by executing interventions that are evidence-based (WHO, 2019). The same meaning shall be retained in this research project.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter introduces details on the general literature on AMS; AMS in a health care facility level; level of AMS awareness by HCWs; drivers and barriers of AMS in health care facilities; the study's theoretical and conceptual framework.

2.1 General Literature Review

AMR can be regarded as an international health menace affecting all nations, regardless of their economic status. The World Health Organization (WHO, 2018) emphasizes that resistance to antimicrobials exists everywhere, having the potential to impact anyone, regardless of age or location. However, the burden of AMR disproportionately affects developing countries because of the large numbers of persons with infectious illnesses and scarce healthcare resources (WHO, FAO & OIE, 2018). Alarmingly, estimates project that by 2050, AMR-related causes can contribute to approximately 10 million mortality cases yearly, with an approximated 4.5 million of the deaths projected to occur in Sub-Saharan Africa. The economic ramifications are equally dire, with potential Gross Domestic Product (GDP) losses exceeding 1%, and indirect societal costs estimated to be three times higher than direct healthcare expenses (GOK, 2017).

Kenya, like many developing nations, is witnessing an upward trajectory in the levels of AMR. However, the precise burden remains unknown due to a lack of systematic surveillance (GOK, 2017). However, available sentinel site data indicate high resistance rates for respiratory, enteric, and hospital-acquired infections, rendering many first-line antimicrobials such as penicillins and cotrimoxazole ineffective against common infections. This growing resistance trend has

underscored the urgent need for improved data collection mechanisms to enable evidence-based policymaking.

Responding to the directive by the WHO to affiliated nations to formulate National Action Plans (NAPs) by 2017 as an indication of a political commitment to AMR containment (WHO, FAO & OIE, 2018), Kenya introduced its first national blue print on AMR Prevention and Containment in June 2017. This document was further reviewed in 2022 and revised to align it with WHO blue print on Global Action Plan (GAP), ensuring a structured approach to AMR containment (WHO, 2022). Despite these efforts, many nations, including Kenya, continue to face challenges in effectively implementing their AMR policies, largely due to difficulties in regulating antimicrobial overuse (Rogers et al., 2019).

In 2019, Kenya recorded 8,500 mortality cases that had direct links to AMR, with 37,300 deaths were indirectly connected to AMR through related infections. The country was ranked 28th internationally in terms of age-standardized death rates due to AMR across 204 nations. Notably, five key pathogens were flagged as major contributors to AMR-associated deaths in Kenya. These are *Staphylococcus aureus, Klebsiella pneumoniae, Streptococcus pneumoniae, Salmonella Typhi* and *Escherichia coli*. These pathogens have been linked to severe infections of the bloodstream, lower respiratory tract and intra-abdominal.

The optimization of antimicrobial use (AMU) is among the strategic goals delineated in Kenya's NAP blue print. This involves the development and implementation of antimicrobial use guidelines, strengthening regulatory frameworks, improving human resource capital, enhancing accessibility to essential antimicrobials, and bolstering laboratory diagnostic capabilities (GOK, 2017). In March 2020, the national Antimicrobial Stewardship (AMS) guidelines was launched by the Ministry of Health (MoH), specifically designed for healthcare facilities. These guidelines

set forth action plans and investment priorities aimed at curbing AMR through implementing and coordinating of AMS initiatives at the health facility level, with efforts focusing on ensuring rational AMU and improved patient outcomes.

Despite commendable strides in AMS policy development, the challenge lies in implementation effectiveness. The disparity between well-documented policies and their practical execution presents a critical concern. Nevertheless, commendable effort has been seen in the establishment of AMR stewardship committees, enhancement of laboratory capacity, and introduction of community awareness programs which have yielded positive outcomes (Sohaili et al., 2024).

2.2 AMS in a healthcare Settings

The setting up of antimicrobial stewardship programs (ASP) in health institutions is one of the most fundamental steps in addressing the emergence of AMR (Yoon et al, 2021). According to WHO (2022), the implementation and coordination of AMS activities is based at the health care facility level as facilities possess the requisite capacity to perform and attain stewardship (Yoon et al, 2021). The rolling out of AMS activities is however pegged on facility setting (Gitaka et al, 2020). This is because of the inadequacy of data on the best model for ASP (Yoon et al, 2021). Regardless of the model, ASPs have demonstrated immense contribution in reducing AMR (Gitaka et al, 2020).

According to the national AMS guidelines (2020), timely and accurate identification of causative microorganisms and susceptibility tests to AM is a major component in improving AMS in a health care facility. Correct testing, diagnosis and treatment are all pegged on a well-equipped laboratory which gives diagnostic support to prescribers. Additionally, it is crucial for health

facilities to integrate adequate training and supervision of prescribing physicians. Hospitals must endeavor to establish prescribing recommendations for the management and prophylaxis of frequently encountered infections, taking into account the patient population, local AMR patterns, and the types of surgical procedures conducted within the facility (GOK, 2020).

2.3 The level of awareness of AMS by health care workers

The WHO Global Strategy describes the rational usage of AMs as the modest usage that aims at maximizing the clinical therapeutic ability while minimizing drug-induced adverse effects and AMR development. Irrational or injudicious prescription often describes a treatment sheet that does not align with the set guideline. This often alludes to the assumption that clinicians do not possess adequate knowledge on antibiotics (Pearson et al, 2018). The emergence of AMR is largely driven by irrational usage of AM drugs. This creates a burden to HCWs, in their capacity as prescribers and health educators, as they have been tasked with the mandate of ensuring that AMs are utilized appropriately (Rogers et al, 2018). As such, AMS advocates for treatment appropriateness which describes any treatment sheet adhering to treatment protocols; unanimity of resident professional views or microbiological tests (Maina et al. 2020).

The manner with which a HCW prescribes medicine is influenced by the individual practitioner's understanding and opinion regarding antibiotic utilization and resistance (Gonzalez-Gonzalez et al, 2015). However, Pearson et al. (2018) argues that being knowledgeable and aware does not necessarily determine behavior. In a qualitative study carried out in Sweden, it was established that some general practitioners (GPs) did not regard AMR as a problem encountered in normal practice. It further indicated that while some GPs considered it a

health issue, the awareness made minimal changes in individualized clinical undertakings as they deemed it a non-issue domiciled in distant health facilities, different locations within the country, or other health care institutions (Machowska & Lundborg, 2018). In Kenya, the situation is relatively the same with prescribers demonstrating an overall awareness of AMR but the application of this knowledge in clinical practice to prevent and contain AMR is gray (GOK, 2017). In a study on antibiotic use in Kenyan public health establishments, Maina et al. (2020) established that 26% of patients in the adult medical department diagnosed with pneumonia and 68% of patients in the surgical department with skin and soft tissue infections had inappropriate medical regimen.

Although there is limited data on AM consumption orchestrated by the lack of a surveillance system in the human health sector nationally, substantial evidence suggests high levels of AM use (WHO, 2022). Like in many developing countries, the rational use of AMs in Kenya is hampered by inaccessibility of microbiology laboratories, resources shortages and the absence of quality assurance for AM susceptibility data (GOK, 2017). This limits the effectiveness of AMS as it is closely associated with the ability to make accurate diagnosis through identification of AM and antimicrobial susceptibility testing. Subsequently, clinicians are left with complex deliberations of providing patient care based on their expertise on AM usage (GOK, 2020).

According to Rogers et al. (2018) HCWs have minimal teachings on AMR and judicious usage of antibiotics. In a survey conducted in Saudi Arabia, physicians expressed concerns about deficiencies in their knowledge of prescribing antibiotics. Meanwhile, in United States, the Infectious Disease Society of America pointed out that medical education regarding antimicrobial usage exhibits significant variability and lacks standardization. Similar account was held by students pursuing medical courses in Europe and the USA who expressed the need

for better training on selection of antibiotic treatment regimens (Rogers et al, 2018). The WHO (2017) notes the lack of harmonization in the AMR training approaches of HCWs posing hurdles in optimization of AM use. Basing on the study outcomes of Ogero et al. (2020) the extent of education level and years of medical practice is critical in guideline adherence and decision making. In their study on examination of hospital admission care by clinicians, they noted that majority of prescriptions are made by inexperienced clinicians attached to health facilities for internship programs. Thus fostering need for supervision and mentorship. This is because HCWs have the capability of reducing the burden of genetic varieties that fuel the advancement of resistance through the judicious prescription of AMs (Rogers et al, 2018).

Even though prompt initiation of antibiotics can reduce morbidity and mortality rates in cases of sepsis (CDC, 2019), Wangai et al. (2019) suggest that this war against antimicrobial resistance can be achieved by sticking to the first line of treatment. This increases the proper use of scarce AM, protecting current and future patients (Shrestha et al, 2022). Furthermore, the use of guidelines enhances treatment appropriateness positively (Maina et al. 2020). Ultimately, for AMS to be fulfilled, all clinicians must embrace their role as frontline AM stewards (Shrestha et al, 2022) since irrational usage of antibiotics has been cited as the main contributor of AMR globally (Ndaki et al, 2025). Further, Engler et al (2021) notes that the situation is worsened by deficient continuous medical education for HCWs at the primary health care level, with AMR campaigns are nearly non-existent.

2.4 Drivers of an effective AMS program

AMS program is pegged on nine core elements that form the pillars for well-functioning AMS. These are: committed leadership and structure of governance; accountability; expertise in antimicrobial drugs; AMS reduction actions and interventions; reporting; tracking and measurement; continuous medical education; proper communication and instituting quality management systems (GOK, 2020).

Health facility leadership commitment and governance structure

Supportive leadership is an essential component in implementing antimicrobial stewardship programs (Shrestha et al, 2022). ASP success is pegged on the presence and access of the requisite resources like human capital, financial resources, and information technology resources. These resources can be acquired through the good will of the hospital leadership (CDC, 2019). According to GOK (2020), leadership commitment may be evidenced by a formal statement supporting efforts to improve and monitor AM use; allocated time and resources in support of education and training; designated multidisciplinary stewardship team and clear communication strategies on AMS. GOK (2020) further states that successful ASPs in hospitals have deliberately integrated AMS governance into the hospital's structure to improve quality and secure patient safety.

Accountability and Drug Expertise

Accountability and drug expertise have been shown to be crucial elements in the successful implementation of ASPs (G0K, 2020). ASP should be spearheaded by one person who is accountable for the program results (CDC, 2019). Literature suggests that clinicians trained in

infectious diseases and AMS are better placed as leaders as they increase the probability of increasing success to the program (Shrestha et al, 2022).

Action/ interventions

These include policies and guidelines promoting the rational use of AMs. These interventions are selected on the basis of identified needs by a health care facility (GOK, 2020). Shrestha et al. (2022) notes that actions include: enforcement of guidelines that endorse responsible and judicious utilization of antibiotics; utilization of targeted approaches to improve usage of these drugs; and giving priority to interventions on the basis of the healthcare facility's requirements. According to CDC (2019) the two most effective foundational interventions in AMS are preauthorization and prospective review with concomitant advice. Preauthorization is a tactical approach that mandates clinicians to obtain approval for certain antibiotics prior to their prescription. Contrary, Prospective audit with feedback (PAF) involves giving feedback on the AM use to the clinician after the prescribed antibiotic has been issued (Yoon et al, 2021). These two fundamental interventions can be enhanced by the use of facility-specific treatment guidelines which establishes clear references for the optimal use of antibiotics at the hospital (CDC, 2019).

Yoon et al. (2021) suggests other supplementary strategies to include: stewardship through handshakes; educational recommendations and clinical trailing; optimizing treatment period for infectious diseases; focused evaluation of individuals with particular high risk infections; transitioning from injectable to oral drugs; optimizing dosages and utilizing treatment sheets with feedback; employing combination regimens; simplifying treatment; using e-based support systems; tracking AMR and drug use; prompt reporting of antibiotic susceptibility; microbiology laboratory alerts and rapid disease evaluation kits, and duration of administration post-

antimicrobial treatment. GOK (2020) cautions project leaders not to implement multiple AMS interventions instantaneously. Instead, strategic measures should be selected based on the uniqueness of the hospital culture, medical staff attitudes, availability of resources, and the benefits and limitations of the fundamental strategies (Yoon et al, 2021).

Monitoring, Evaluation and Reporting

The management of any strategic intervention is based on measurement. As such, the success of ASPs lies on the measurement of prescription methods and tactics and their subsequent bearing on the trends of resistance (GOK, 2020). This is crucial in the identification of opportunities for improvement and assessment of intervention impact (CDC, 2019). As such, reporting information on AM use and AMR patterns to medical staff regularly acts as a reminder on the significance of AMS activities within the health care facility (GOK, 2020) while simultaneously improving prescribing practices (CDC, 2019)

Education and training

According to the CDC (2019), education plays a significant role in ASP as it directly influences antibiotic utilization within healthcare facilities. However, education single-handedly does not qualify as an effective stewardship strategy. Its effectiveness is only realized when it is conjoined with corresponding interventions and measurement of outcomes. GOK (2020) suggests continuous provision of AMS education to medical workers focusing on AMR and enhancement of AM prescribing and dispensing practices. This ultimately provides a foundation of knowledge that not only enhances, but also increases acceptance of stewardship strategies.

2.5 Barriers for effective implementation of AMS activities

According to Fuller et al. (2022), substantial disparities are still apparent in the enhancement of AM utilization in WHO member states in Africa. Insufficient allocation of resources towards the implementation of ASP has always been cited as one of the top most barriers (CDC, 2019). According to Kamere et al. (2022) the execution of AMR activities is usually hampered by resource limitation, even with the availability of blue print policies. In their study on challenges of implementing the national core elements in the WHO African region for sustainability in antimicrobial usage, Fuller et al. (2022) noted that the AMS core elements implementation is challenged by sub-optimal funding, undeveloped plans and policies, inept government structures, and low uptake of the WHO AWaRe classification as an enabling tool to facilitate stewardship activities. They further noted the non-existence AMR incorporated curriculum in medical workers training and the lack of surveillance of AM consumption that would ordinarily inform improvement in AM use.

Leadership and communication skill barriers

Heath care facility leadership commitment is paramount for the success of any ASP (WHO, 2019). Implementation hiccups often lays bare the need for a more supportive leadership (Patrice et al, 2022). This was established in their study on implementation and functional hurdles of ASPs, where poor leadership was linked to resistance of AMS by medical workers. Further, poor leadership and communication hampered the ability to build in trust with medical personnel thereby limiting compliance to the proposed best practice.

Behavioral Barriers to AMS

Health care workers behavior affects the implementation of AMS activities (Kamere, 2022). According to Gebretekle et al (2018), the preferential usage of syndromic approach in the treatment of suspected infections rather than diagnostic tests greatly hinders the implementation of AMS in LMICs. In a study by Maina et al. (2020) they found out that only <0.1% of sampled patients on antibiotic therapy had supportive laboratory tests. Gebretekle et al (2018) also noted that junior clinicians' prescription behaviors tend to be driven by their perception of the possibility of failed therapy and the dread of retribution or admonishment by senior physicians rather than infection evidence. Further, pharmacists who possess greater probability of recognizing wrong drug regimens, dosages and therapeutic considerations than clinicians tend not to communicate these important findings to the prescribing clinician.

Availability and adherence to clinical guidelines

According to Maina et al. (2020), a positive robust association exists between the presence of physical guidelines and the institution of correct treatment regimen. Omulo et al. (2022) notes that the absence of facility produced antibiograms together with clinical guidelines may contribute to sub-standard medical care and rising AMR rates. Fuller et al. (2022) notes that even with the guidelines in place, there is laxity by prescribing clinicians to comply to the guidelines

AMS education and training

At the center of most approaches aiming to diminish the improper utilization of AM is education and information activities (OECD, 2016). Fuller et al. (2022) notes that medical personnel tend to possess rudimentary knowledge on AMS despite of it being a core element in the success of ASP. According to Rogers et al. (2018), there seems to be a considerable knowledge discrepancy

in the proper use of AMs, with clinicians who have received formal training possessing enhanced preparation for future clinical practice

Diagnostic stewardship

The success of AMS is intricately connected to the capacity to accurately diagnose medical conditions (GOK, 2020). Diagnostic stewardship has been cited as a core component of ASP in health-care facilities (GOK, 2021). Poor diagnostic stewardship is a major obstacle for implementation of AMS. (Gebretekle et al, 2018). It hinders physicians from getting the correct microbiological tests results in good time, hence causing delays in the selection of the most appropriate AM (GOK, 2021). This discourages physicians from sending specimens to the lab or following up microbiology results (Gebretekle et al, 2018). Worsening the scenario is the expensive cost of tests which makes clinicians opts for empirical therapy to alleviate the burden of high treatment cost (Omulo et al, 2022). For patients to receive optimum care, it is imperative that effective communication exist between laboratory personnel and HCWs so as to strengthen the lab- clinical interface (GOK, 2021).

2.6 Theoretical Framework

The study utilised the theoretical domains framework (TDF) and the Diffusion of Innovation (DOI) theory as its foundational theoretical approach to assess antimicrobial stewardship in a public health facility in Kenya. TDF will serve as the foundation for analyzing healthcare workers' knowledge, practices, and professional training to determine their readiness to adopt AMS principles. Further, it will aid in evaluating the impact of leadership, accountability, and institutional policies in driving AMS implementation. This theory will be complemented by the

DOI which explains how AMS programs spread and are adopted across healthcare settings. By integrating TDF and DOI, this study bridges the gap between individual behavior change and system-wide AMS adoption. TDF helps in identifying what needs to change at the HCW level, while DOI explains how AMS innovations spread and are sustained within healthcare institutions.

2.6.1 The Theoretical Domains Framework (TDF)

The TDF offers a cohesive approach which synthesizes multiple psychological and behavioral theories to comprehend and stimulate behavior change, particularly in health related settings. It was developed to identify key determinants of behavior, helping researchers and policymakers design and implement effective interventions. The TDF was initially formulated by Michie et al. (2005) and later reviewed by Cane et al. (2012) to provide a more structured and comprehensive approach to behavior change. TDF consolidates 128 theoretical ideas from 33 behavior change concepts into 14 key areas that influence decision-making and behavior adoption. These areas include knowledge, skills, social/professional role, beliefs about consequences, reinforcement, motivation, environmental context, and behavioral regulation, among others. The model is particularly useful in healthcare as it helps explain why healthcare workers (HCWs) adopt or resist certain practices, such as antimicrobial stewardship.

TDF provides a structured lens through which HCW behavior can be examined across different domains, offering insights into the factors influencing AMS implementation at the healthcare facility level. According to McGowan & French (2020), TDF is a valuable tool for recognizing behavioral influences and understanding the motivations behind HCWs' actions in AMS programs. It helps predict the relationships between various theoretical domains and the adoption of AMS practices while also evaluating transformative processes (Atkins et al., 2017). This is

crucial for designing targeted interventions that encourage appropriate antimicrobial use and enhance compliance with AMS strategies. Further, TDF facilitates a holistic and theory-based approach to identifying potential factors that can hinder changes in clinical undertakings (Phillips et al., 2015). In this study, TDF will help uncover key obstacles such as knowledge gaps, leadership challenges, and behavioral resistance among HCWs. By systematically identifying these barriers, TDF serves as a guide for designing behavior change strategies and informing AMS intervention approaches.

As a methodological tool, TDF enhances data collection by pinpointing drivers and challenges to AMS adoption (Atkins et al., 2017). It aids in structuring interventions to optimize AMS effectiveness by addressing identified challenges. Additionally, TDF provides a planning framework to design measures that positively influence intervention outcomes (Birken et al., 2017). This ensures that AMS programs are not only well-structured but also adaptable to the unique challenges faced in Kenya's healthcare settings.

By employing TDF, this research will provide a systematic approach to evaluating AMS initiatives, guiding the development of guidelines aimed at improving antimicrobial use, and ultimately strengthening Kenya's response to antimicrobial resistance.

2.6.2 The Diffusion of Innovations (DOI) Theory

Coined by Everett Rogers (2003), the diffusion of innovation theory postulates the sequence of spread of novel innovation within a societal setting over a given time period. Rogers describes diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system," whiles an innovation as "any idea, practice, or object perceived as new by individuals or organizations." The theory identifies key stages and

factors affecting the uptake of any invention (García-Avilés, 2020). In this study, DOI is used as a complementary theory to TDF to help explain how AMS programs can be introduced, adopted, and sustained across health care facilities.

The adoption of AMS programs in healthcare facilities follows five stages as outlined in Rogers' DOI theory. The process begins with the knowledge stage, where HCWs become aware of AMS programs, their principles, and the benefits of rational antimicrobial use. This is followed by the persuasion stage**,** in which HCWs evaluate the effectiveness of AMS based on perceived benefits, peer influence, and the level of institutional support available. The decision stage marks the point at which healthcare facilities choose whether to implement AMS programs based on leadership commitment, availability of resources, and perceived feasibility. Once the decision is made, AMS enters the implementation stage**,** where programs are integrated into daily clinical workflows through structured training, guideline dissemination, and the establishment of AMS committees. Finally, in the confirmation stage, healthcare facilities assess the impact of AMS programs, leading either to sustained adoption, modification of the programs, or abandonment due to challenges in implementation (Dearing & Cox, 2018).

Several factors drive the diffusion of AMS programs in healthcare facilities. Leadership commitment plays a crucial role, as strong administrative support and policy enforcement are necessary for effective AMS implementation. Accountability and drug expertise are equally important, requiring clearly defined roles, dedicated AMS teams, and active involvement of pharmacists to ensure responsible antimicrobial prescribing. Regular reporting, monitoring, and evaluation strengthen AMS adoption by enabling data-driven decision-making, ensuring that interventions remain effective. Furthermore, education and training provide HCWs with the

knowledge and skills needed to incorporate AMS practices into routine clinical care, fostering long-term behavioral change.

Despite the increasing recognition of AMS, various barriers hinder its full implementation in healthcare facilities. Limited diagnostic stewardship remains a significant challenge, as inadequate access to diagnostic tools prevents HCWs from making evidence-based prescribing decisions. Clinical guidelines and protocols, while essential for AMS success, often lack standardization, making it difficult for institutions to enforce consistent AMS practices. Additionally, leadership and communication gaps present obstacles, as poor coordination, resistance from decision-makers, and lack of clear directives delay AMS adoption. Behavioral barriers further complicate implementation, as HCWs' habits, beliefs regarding AMS effectiveness, and resistance to change can significantly impact the uptake of AMS initiatives.

The DOI theory lays a foundation on the understanding of how AMS programs spread and is adopted in the hospital facilities. By identifying the key stages of adoption, the driving factors that facilitate implementation and the barriers that hinder progress, this theory offer valuable insights for strengthening AMS initiatives. Addressing knowledge gaps, fostering leadership support, enhancing system-wide coordination, and overcoming behavioral resistance will be crucial for accelerating AMS implementation and effectively combating antimicrobial resistance in healthcare settings.

CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction

This section outlines the methodological strategies that were employed to collect pertinent data for this study. This chapter entails the study design, site, target population, sampling technique, sample size, data collection instrument, testing for validity and reliability, data analysis technique and ethical consideration.

3.1 Study Designs

A research study design is the general style taken up by an investigator to assimilate the several study components in a rational and structured approach to ensure that the problem under investigation is effectively tackled. It establishes the basis for gathering, measuring, and analyzing data (Creswell & Creswell, 2018). Further, it serves as a structure that guides the study's methodological choices. This study adopted a cross-sectional descriptive study design, which is particularly useful for capturing a snapshot of a phenomenon at a one given moment. According to Setia (2016), a descriptive cross-sectional study is a categorized as an observational study approach used in analyzing data from a population or a sample at one specific moment. It is primarily employed to assess the prevalence, distribution, and characteristics of a phenomenon without manipulating variables. This design is useful for understanding patterns, relationships, and associations but does not establish causality. This approach was chosen to examine the status of AMS at Kapsabet County Referral Hospital, providing insights into the "who, what, when, where, and how" of AMS implementation within the facility.

By using this design, the study sought to identify patterns related to AMS practices, HCWs' knowledge, and health facility challenges, without manipulating any variables. The cross-

sectional part of the study allowed for the collection of comprehensive data from different carders of HCWs tasked with the responsibility of driving stewardship, ensuring a broad and well-rounded understanding of AMS dynamics within the hospital. Additionally, this methodology enabled the researcher to assess AMS implementation levels, identify factors driving AMS, and highlighting barriers hindering effective antimicrobial stewardship efforts. The study's findings therefore, provide a baseline assessment that can inform future AMS interventions, policy adjustments, and capacity-building efforts within Kapsabet County Referral Hospital and similar healthcare facilities.

3.2 Study Site

The research study was undertaken in Kapsabet County Referral Hospital (KCRH), Nandi County. KCRH is a government health facility, ranked as level 5, located in Kapsabet Township. The 200 bed capacity hospital serves approximately one million persons from Nandi County and its environs. Although there is no statistics on the burden of AMR specific to the County, current research has shown first line drug resistance to causative organisms of common ailments (Zachariah et al, 2021).

3.3 Study Variables

3.3.1. Independent variables

The predicting study variables were; healthcare workers' awareness of AMR, health facility drivers of AMS program, and the barriers to AMS implementation.

3.3.2 Dependent variables

The measured variable was the status of AMS program at Kapsabet County Referral Hospital.

3.4 Target Population

A target population denotes the whole cluster of persons or elements whence the investigator intends to investigate and make conclusions. It consists of all individuals sharing similar characteristics with reference to the research objectives, thus serving as a basis out of which a segment is drawn for analysis (Banerjee & Chaudhury, 2010). The population targeted in this study consisted of medical doctors, clinical officers, and pharmacists working at Kapsabet County Referral Hospital. These healthcare professionals were specifically selected due to their direct involvement in AMS through the prescription, administration, and regulation of antimicrobial use. Their roles are crucial in ensuring rational antibiotic use, minimizing AMR, and implementing AMS policies and guidelines within the hospital facility setting. By scaling down to this group, the study aimed to generate valuable comprehensions into their knowledge, practices, and challenges related to AMS, ultimately contributing to more effective AMS interventions. According to the staff returns report 2023, the hospital has 36 medical doctors; 70 clinical officers and 6 pharmacists. This is inclusive of medical and clinical officers interns. This makes a total population of 112 individuals. This population was deemed best placed to give feedback pertaining to the research problem.

Table 3. 1 Target Population

Target population category	**Target population**
Medical doctors	36
Clinical officers	70
Pharmacists	6
	Total population:112

Source: KCRH (2023)

3.5 Inclusion and Exclusion Criteria

3.5.1 Inclusion Criteria

All consented medical doctors, clinical officers, and pharmacists working at Kapsabet County Referral Hospital. These groups of healthcare workers were specifically identified due to their direct involvement in AMS through the prescription, administration, and regulation of antimicrobial use at health care facilities.

3.5.2 Exclusion Criteria

Other carders of healthcare workers, such as; nurses, radiographers, laboratory technicians were not included in the study. While these categories of HCWs play varied roles that contribute to the containment of AMR, they are not directly involved in AMS activities which majorly rely on prescribing and regulation of antimicrobials. However, their involvement may require instructions and guidance of medical doctors, clinical officers, and pharmacists.

HCWs that fit into the inclusion criteria but were not at work during the period of study did not participate in the study.

3.6 Sampling Technique

Sampling techniques are approaches employed by investigators to choose a selection of respondents from the wider populace for the purpose of conducting a study. This research employed a stratified random sampling method which ensures adequate representation of key healthcare worker (HCW) groups involved in antimicrobial stewardship (AMS). Stratified sampling is a technique that splits up the populace into smaller sets, or stratums, based on shared characteristics, then randomly picking participants from each set (Scribbr, 2024). This approach ensured that sub-sets were adequately represented within the overall sample, enhancing the

precision and representativeness of the research results. The study population was first categorized into three strata; medical doctors, clinical officers, and pharmacists based on their distinct roles in AMS. Stratification was essential in minimizing variability and ensuring that each professional carder was proportionally included in the study.

After stratification, probability sampling was applied in all stratums, allowing everyone within the respective groups an unbiased probability of selection. This approach reduced sampling error and improved the accuracy of the study outcomes. The number of participants picked from every section was determined proportionally to its population weight, ensuring a fair and balanced distribution of participants. This method was chosen because these three cadres play a critical role in AMS, including prescribing, dispensing, and monitoring antimicrobial use, making them best suited to provide valuable insights for the study. Probability sampling was then employed to select individuals that would participate in the study.

3.7 Sample Size

Majid (2018) defines a sample size as the number of elements or respondents included in a study, which directly impacts the accuracy, reliability, and applicability of the study outcomes to the general population. Using the Yamane (1973) sample size formula, 88 participants were at derived from the initial target population of 112, as shown;

$$n = \frac{N}{1 + Ne^2}$$

$$n = \frac{112}{1 + 112(0.05)^2}$$

Where:

n = Sample size

N = Population size

e = the error of Sampling (0.05)

As a result, 88 respondents were obtained as sample size. The study further employed stratified sampling technique in the selection of respondents. The number of respondents for each stratum was calculated using Neyman's (1934) allocation formula as follows;

$$n_h = \left(\frac{N_h}{N}\right) n$$

$$n_h = \left(\frac{36}{112}\right) 88$$

$$n_h = \left(\frac{70}{112}\right) 88$$

$$n_h = \left(\frac{6}{112}\right) 88$$

Where:

n_h - The sample size for stratum h,

n - Total sample size,

N_h -The population size for stratum h,

N- The total population.

Consequently, respondents were distributed as follows;

Table 3. 2 Sample allocation

Target category	Target population	Sample %	Sample size
Medical officers	36	31.8%	28
Clinical officers	70	62.5%	55
Pharmacists	6	5.7%	5
Total	**112**	**100%**	**88**

Source: Researcher (2023)

3.8 Data Collection Instruments

The research study utilized questionnaires as well as checklists for collecting primary data.

A questionnaire is a data collecting instrument that comprises of a series of open and closed-ended questions crafted to collect qualitative as well as quantitative data from participants. Roopa and Rani (2012) emphasize that a properly designed questionnaire is not only a fundamental tool for collecting primary data in research but it also serves to guarantee that the data collected is consistent and coherent, which is essential for accurate analysis. The questionnaire utilized in the study was crafted by use of a three-point summated/Likert scale, spanning from "agrees" to "disagree." Each response was assigned a scoring figure, and the cumulative score indicated the position of the respondent along the continuum of favorability in line with the research problem. It comprised of open-ended as well as closed-ended questions, meticulously designed and subjected to a pre-test to ascertain consistency and precision of the data collected.

The questionnaires were circulated to the sampled population, which included medical doctors, clinical officers, and pharmacists practicing at Kapsabet County Referral Hospital. To ensure convenience and encourage a high response rate, the researcher employed a drop-and-collect approach. This method involved personally delivering the questionnaires to the health facility, where the targeted healthcare workers were given ample time to carefully go through and respond to the questions. The extended response period allowed participants to provide thoughtful and well-considered answers, minimizing the likelihood of rushed or incomplete responses. Additionally, an agreed-upon collection date was set in advance to facilitate the retrieval of completed questionnaires while maintaining efficiency in data collection. This approach helped in reducing non-response bias and increasing the reliability and validity of the collected data.

A checklist entails the variables that give structure and framework for observation. It provides a transparent, organized, and a set out criteria for data collection besides reducing the probable risk of encountered human errors (Makram et al, 2022). The researcher prepared a checklist which was employed to gather data that would answer the first study objective. The checklist was adopted and modified from the checklist provided by the AMS national guidelines 2020 for AMS programs in hospitals.

3.9 Data collection Procedures

Data collection procedures are a set of specific, methodological process of collecting data that is appropriate in addressing the study questions or hypothesis (Gray et al, 2013). Primary data was gathered after the acquisition of data collection permits, pre-testing the study tool, and processing sufficient copies of the study questionnaires and checklist for distribution to the study

participants. Study permits were obtained from Mount Kenya University Ethics Review Board (license No.:2364); the National Commission for Science, Technology and Innovation (NACOSTI) (license No.:NACOSTI/P/23/31439) and Kapsabet County Referral Hospital (R.1/VOL.1/18/275).

Data was gathered by use of self-administered questionnaires as well as checklists. The self-administration approach was chosen as it is a more convenient method for study participants, as it allows them to fill the questionnaires at an ideal time within the given timeframe. A drop-and-pick strategy was employed, where the study tools were delivered to study participants, who were given a time frame of two weeks before retrieval with the support from a research assistant. This method was considered most suitable given the demanding nature of clinical work and therefore effective in the study context.

3.9 Pretesting

Pre-testing of a data collecting tool involves the replication of the data gathering method on a reduced scale to detect potential issues concerning the data collecting tool and research method employed (Hurst et al, 2015). Mugenda and Mugenda (2012) notes that, for a pilot study, ten percent of the target population is considered an acceptable sample. The questionnaires used in the study underwent testing with HCWs from the Iten County Referral Hospital in Elgeyo-Marakwet County. 9 questionnaires were pretested primarily to confirm the reliability of carrying out the study. Ambiguous questions were refined to reduce potential issues and errors in the study. After ascertaining the validity and reliability of the research tool, they were administered to the population of interest.

3.9 Validity

According to Taherdoost (2016), validity denotes the accuracy and precision with which the data collected aligns with the study scope. To uphold accuracy, the researcher made sure that the measurement instruments are aligned with the study parameters and their respective indicators of measurement.

3.10 Reliability

Reliability in research assesses the stability and consistency of a measured phenomenon (Taherdoost, 2016). To guarantee consistency, each item on the questionnaire underwent item analysis to assess its internal reliability. Additionally, the Cronbach's Alpha reliability coefficient α was employed for internal reliability testing which ranged from 0.718 to 0.741. According to Creswell (2014), an alpha value of greater than 0.6 denotes reliability. Therefore, the adopted scales to measure the level of awareness and understanding by HCWs, the factors that drive AMS and the barriers for effective implementation of AMS in a health facility level constituted a reliable tool for conducting the research.

Table 3. 3 Reliability Statistics

Variable	Cronbach's Alpha	No. of Items
Level of Awareness of AMS	0.741	5
Drivers of AMS in health facility	0.724	5
Barriers for effective AMS implementation	0.718	5

3.11 Data Analysis Techniques

Developed structured questionnaires and checklists were adopted as data collecting tools to gather information from the selected respondents. Qualitative and quantitative data was gathered, which was analyzed by use of descriptive statistical approaches. Data sorting, categorization, coding, and tabulation were done to facilitate ease in analyzing data. The conversion and modeling of the data collected into pertinent information was accomplished through quantitative analysis of data.

Descriptive statistics was employed to organize and condense the responses from the structured questionnaires and checklists. Numerical figures and categories were assigned to the responses of the questionnaire and checklist. The data was fed into frequency distribution tables to tabulate the frequency, average, standard deviations and percentages for better comprehension. Organization of data was accomplished by the use of the Statistical Package for Social Sciences (SPSS) version 23. Frequency tables and bar graph is used to present data findings.

Qualitative data was generated from open-ended questions in the questionnaire. The data collected was grouped based on recurrent themes using thematic analysis.

3.12 Ethical Consideration

For ethical approvals; the researcher sought for the necessary clearance after the authorization of the research study by the School of Public Health. Clearances were secured from Mount Kenya University Ethics Review Board (license No.:2364) and the National Commission for Science, Technology and Innovation (NACOSTI) (license No.:NACOSTI/P/23/31439) prior to the data

gathering process. Approval was also sought from the health care department of Nandi County through the administration of Kapsabet County Referral Hospital (R.1/VOL.1/18/275).

The study purpose and scope was clearly communicated to the study participants as we sought their permission to participate. For research respondents' right to privacy; the participants' privacy was protected by excluding the specification of names in the biographical data section. In lieu of participants' names, numerical codes were utilized for identification purposes in the study. This approach enhanced anonymity and upheld data confidentiality. Consent forms were provided to the respondents, with the assurance that their participation was self-determined and that they bear the freedom to drop out of the research at any given time. When distributing the consent agreement forms to the sample population, the investigator underscored that the provided information will be handled with strict discretion, concealing their identity during the entire period of the research study. A part from prioritizing participant privacy, the researcher was devoted to upholding utmost ethical standards in carrying out and reporting the study. This includes a firm commitment to reporting the research findings fully and honestly, with strict adherence to ethical guidelines to prevent any form of scientific misconduct or fraud.

CHAPTER FOUR
FINDINGS AND DISCUSSIONS

4.0 Introduction

The study aim was to assess the antimicrobial stewardship status of Kapsabet County Referral Hospital. It objectively focused on assessing the level of awareness of antimicrobial stewardship by health care workers; determine factors that drive antimicrobial stewardship program; and assess barriers for effective implementation of antimicrobial stewardship activities in Kapsabet County Referral Hospital. The study findings with subsequent interpretations are presented in this section.

4.1 Response Rate

The SAGE encyclopedia (2018), describes a response rate as the proportion of the selected study respondents to the individuals who actively took part in the study. From the 88 questionnaires distributed, 63 were returned, translating to a return rate of 72%. This rate of participation was satisfactory to draw study conclusions according to Mugenda and Mugenda (2012) and Kothari (2014) whom recommends a 50% participation rate as sufficient for data analysis and reporting. Kumar (2019) further notes that a participatory rate of 60% is acceptable, while a rate greater than 70% is considered good.

4.2 Demographic Characteristics of Respondents

The respondents of the study were requested to choose a category that best matches their age set, gender, education level and designation as tabulated in table 4.1.

Table 4. 1 Socio-demographic factors of the Respondents

	Frequency	Percentage
Age of respondents		
20-30 years	35	55.6
31-40 years	23	36.5
41-50 years	5	7.9
Above 51 years	0	0.0
Total	63	100.0
Gender of respondents		
Male	27	42.9
Female	36	57.1
Total	63	100.0
Level of Education		
Diploma Level	26	41.3
Higher Diploma Level	9	14.3
Undergraduate Level	27	42.8
Post-graduate Level	1	1.60
Total	63	100
Designation		
Medical officers	15	23.8
Clinical officers	45	71.4
Pharmacists	3	4.8
Total	63	100

From the research findings presented in table 4.1, it was evidenced that the HCWs actively involved in prescribing antimicrobials are youthful persons. Persons between 20-30 years were 35 (55.6%), 31-40 years were 23(36.5%), and 5 (7.9%) were between 41-50 years. There was fair distribution of both genders with 27(42.9%) of respondents being male and 36(57.1%) female. Regarding the education level, the study determined that most of the study participants had reached undergraduate level by 27(42.8%), diploma level by 26(41.3%), higher diploma level by 9(14.3%) and postgraduate level by 1(1.60%). This implies that the education level of HCWs contributes towards the understanding and comprehension of AMR and subsequent translation of knowledge acquired into actionable stewardship. These findings are in congruent with Muloi et al, (2019) who noted that clinical education considerably influences AMU and AMR knowledge. The designation of respondents revealed that the HCWs who are involved in

prescribing AMs at a health facility level are clinical officers 45 (71.4%), medical officers 15 (23.8%) and pharmacists 3(4.8%).

4.3 The status of antimicrobial stewardship in Kapsabet County Referral Hospital

The first study objective sought to assess the status of antimicrobial stewardship in Kapsabet County Referral Hospital. Using a checklist adopted from the AMS guidelines, the study sought to establish how many interventions have been implemented and are operational during the study period. The antimicrobial stewardship status at Kapsabet County Referral Hospital was therefore assessed in line with the main elements that provides a baseline for AMS as outlined in the national Antimicrobial Stewardship guidelines for health care settings (March, 2020). Each item on the checklist was assigned a binary score, 1 (Yes) and 0 (No). The AMS score was calculated by summing the total number of items marked "Yes", divided by the total number of checklist items and the results were expressed as a percentage score. AMS Score (%) = (Number of items met/Total checklist items) * 100. The scores were then categorized into two levels for interpretation purposes. The scores between (0-49) percent were classified as ‘below average’, indicating an AMS program that is not well developed or implemented, while scores between (50-100) percent were classified as ‘above average’, indicating well developed or implemented AMS program.

Table 4. 2 Status of Antimicrobial Stewardship in Kapsabet County Referral Hospital

Score	Frequency	Percentage
0.-49	34	54
50-100	29	46
Total	63	100

As depicted in table 4.2, 54% of the participants rated AMS status of Kapsabet County Referral hospital as below average while 46% of the respondents noted that the AMS status was above average. This shows that there is relatively low uptake of AMS activities, and therefore a re-evaluation of the areas lagging behind may be paramount to ensure full execution of the key components that constitutes the AMS framework at the health facility level. The study additionally sought the respondents' views on the status of AMS in the health facility. Respondents reported that AMS was not well undertaken, "*the stewardship is poor and not well undertaken in the facility"* with inadequate follow-ups on antimicrobial use, *"there is poor follow-up of antimicrobial use at our facility,"* and therefore ineffective in curbing AMR. Similar findings were reported at Mbagathi County Referral Hospital by Sikuku (2018). His study revealed that the stewardship programs were informal with unavailability of local policy document to monitor the use of antimicrobial at the facility. Sefah et al (2024) also noted similar findings in public hospitals in Ghana where the performance of most of the core elements were noted to be operating sub-optimally.

4.4 Level of Awareness of AMS by HCWs

This objective focused on assessing the level of awareness of antimicrobial stewardship by HCWs in Kapsabet County Referral Hospital. By use of a 3-pointer likert scale, the degree of consensus on the level of awareness of AMS by HCWs was assessed. To determine the mean response for each variable, the responses were averaged individually. Subsequently, the level of all items was calculated using the formula: (highest value on the Likert scale – lowest value on the Likert scale) divided by the number of levels present.

Table 4. 3 Extent of Agreement to Level of Awareness of AMS by HCWs

Statement	Mean	Std. Deviation
Antimicrobial Resistance (AMR) occurs when the microorganism responsible for an infection survives exposure to a medication that would typically eradicate it or inhibit its growth.	2.94	0.23
AMR is increasingly becoming a problem due to overuse of antimicrobials	2.90	0.40
Kenya is already experiencing increasing levels of antimicrobial resistance	2.78	0.55
Kenya has a national policy document on prevention and containment of AMR and a national antimicrobial stewardship guideline for health care facilities	2.06	0.80
Do you find the policy and guideline beneficial to HCWs?	2.05	0.70
Have you ever been trained on AMR/AMS?	1.41	0.78
AMS Programs reduces antimicrobial use overall and can result in cost savings	2.89	0.31
AMS Programs reduces duration of hospital stay	2.96	0.19
HCWs bear the responsibility of safeguarding and prolonging the effectiveness of antimicrobial agents through stewardship.	2.73	0.44
Antimicrobial stewardship makes a difference in patient outcomes	2.69	0.66
Effects of AMR decreases patients confidence in healthcare	2.42	0.60
Lack of adequate diagnostic tests leads to overuse of antibiotics	2.80	0.40
AMR knowledge influences AMS	2.85	0.36
AMR knowledge is important in clinical practice	2.77	0.42
Weighted Mean Score	2.59	0.49

Basing on the study results on table 4.3, participants were in agreement that AMR occurs when the microorganism responsible for an infection survives exposure to a medication that would typically eradicate it or inhibit its growth (mean, 2.94). They further agreed that AMR is becoming a problem due to overuse of antimicrobials (mean, 2.90), and that Kenya is witnessing increasing levels of antimicrobial resistance (mean, 2.78). This implies that the respondents have the basic understanding of AMR and are capable of depicting a picture of the weight of AMR Kenya shoulders. These findings are similar with the National Policy for the Prevention and Containment of AMR (2017), which notes that there is general knowledge of AMR and its ramifications on the society by the different carders of HCWs. It was however not clear whether Kenya has a national policy document on prevention and containment of AMR and a national antimicrobial stewardship guideline for health care facilities (mean, 2.06), with most HCWs reporting that they are not trained on AMR/AMS (mean, 1.41). This shows that there is need for the hospital leadership to provide opportunities for HCWs to address information gaps through clinical education and continuing professional development. Despite the lack of training, they demonstrated knowledge on the perceived benefit of AMS. This is evidenced by the agreement that AMS programs reduces antimicrobial use and can result in cost savings (mean, 2.89) in addition to a reduction of the overall hospital stay duration (mean, 2.96).

HCWs reported that they do bear the responsibility of safeguarding and prolonging the effectiveness of antimicrobial agents through stewardship, which makes a difference in patient outcomes (mean, 2.73 and 2.69 respectively). This implies that HCWs are aware of their role in AMR prevention and its subsequent effects in the confidence of patients seeking healthcare services (mean 2.42). The lack of adequate diagnostic tests was noted as a reason for overuse of antibiotics (mean, 2.80), with HCWs reporting that AMR knowledge not only influences AMS

but is important in clinical practice (mean, 2.85 and 2.77 respectively). This was also evidenced by HCWs selecting the correct reserve group of antibiotics used in the treatment of multidrug resistant organisms. In general, the level of awareness of antimicrobial stewardship by HCWs summed up a mean of 2.59 and standard deviation of 0.49.

Additionally, the participants' general opinion on the level of awareness of AMS was sought out. There was varied response with some respondents recording that HCWs were well-versed with AMS. Others noted that there were knowledge gaps, *"there is general knowledge gaps on AMS in the facility. All patients in the wards come with already prescribed and initiated antibiotics,"* comprehension challenges, "*AMS is not comprehensively understood thus contributing to poor implementation by healthcare providers*," rating the level of awareness as average*, " the level of awareness is boderline.* Similar findings was reported in Uganda by Kimbowa et al (2022) whom made a conclusion that most HCWs had encouraging understanding and attitude towards AMS but fair AMS practice. These findings are also reflected by Mangesho et al. (2021), whom concluded that knowledge and attitudes does not necessarily correlate with AMS practices.

4.5 Drivers of AMS Program in a Health Care Facility

The third study objective sought to determine factors that drive antimicrobial stewardship program in Kapsabet County Referral Hospital. By use of a three response option likert scale, the extent of agreement on drivers of AMS program was assessed. To calculate the average response of variables, the items for every variable were separately averaged. To determine the mean response for each variable, the responses were averaged individually. Subsequently, the level of each item was calculated using the formula: (highest point on the Likert scale – lowest point on the Likert scale) divided by the number of levels used.

Table 4. 4 Extent of Agreement to Drivers of AMS in a Health Care Facility

Statement	Mean	Std. Deviation
The facility is provided with support from leadership to enhance antimicrobial use, including having a dedicated budget for these efforts	1.27	0.65
There is a clinical point person responsible for AMS program at the facility	1.85	0.49
There is an AMS team that monitors the outcomes of AMS activities	1.24	0.64
It is a requirement for the facility that prescribers document the full name, dose, route, frequency, duration, and indication for all antimicrobial prescriptions in the medical record or during order entry	2.70	0.49
The facility conducts audits on clinicians' antimicrobial use, and clinicians receive direct interaction and feedback from either an infectious diseases physician or a clinical pharmacist	1.35	0.59
Pre-authorization is required before prescribing restricted antimicrobials	1.74	0.86
The facility provides workshops aimed at educating healthcare workers on guidelines to ensure the optimal utilization of antimicrobials for treating common infections.	1.60	0.69
Antimicrobial choices are reviewed and discussed during ward rounds to ensure they are in line with the best practice guidelines	2.56	0.55
Clinicians are alerted when antimicrobial treatment sheets overlap or are duplicative	2.67	0.70
Antibiotics are automatically discontinued after a predetermined time period based on the indication (e.g., 24 hours for surgical prophylaxis), irrespective of physician orders.	2.15	0.59
The AMS team monitors adherence to AMR documented policy	1.86	0.69
The leadership of the facility share facility-specific reports on antimicrobial use with prescribers	1.32	0.58
Weighted Mean Score	1.86	0.63

Basing on the findings of table 4.5, HCWs reported that the facility is neither provided with support from leadership to enhance antimicrobial use (mean, 1.27) nor has an AMS team that monitors the outcomes of AMS activities (mean, 1.24). This implies that there is need for the hospital administration to focus on AMS activities by dedicating resources as a measure to preserve the longevity of antimicrobials. Kamere et al. (2022) in congruent noted the

implementation of AMR activities is usually hampered by resource limitation The respondents were uncertain as to whether there is a clinical point person responsible for AMS program giving an average of 1.85. This alludes that there might be loopholes in accountability of the AMS program. Further, the facility does not conduct audits on clinicians' antimicrobial use; neither do clinicians receive direct interaction and feedback on use (mean, 1.35). Pre-authorization is uncertain before prescribing restricted antimicrobials (mean, 1.74), however, respondents noted that full documentation is required for all antimicrobial prescriptions (mean, 2.70).

The facility does not provide workshops that aim at educating healthcare workers on policy and guidelines on optimization of antimicrobials usage when managing common infections (mean 1.60). This is contrary to Tadesse et al, (2017) who recommended the use of treatment guidelines to optimize AM. Nevertheless, antimicrobial choices are reviewed and discussed during ward rounds to ensure that they align with the best practice guidelines (mean, 2.56), with clinicians notified when antimicrobial treatment sheets overlap or are duplicative (mean, 2.67). This implies that there are actions instituted to optimize the usage of antimicrobial drugs in the facility. It was unclear whether antibiotics are discontinued automatically after a predetermined period of time based on the indication, irrespective of physician orders resulting in a mean of 2.15. This suggests that there are cases when antimicrobials are issued for a longer duration than necessary. It was not certain whether the AMS team monitors adherence to AMR documented policy (mean, 1.86), with respondents reporting that the leadership of the facility does not desseminate facility-specific reports on the use of antimicrobial with prescribers (mean, 1.32). In general, the factors that drive antimicrobial stewardship program in Kapsabet County Referral Hospital yielded an average of 1.86 and a standard deviation of 0.63. The study findings suggests that the drivers of AMS in the health facility are partially implemented and AMS is not therefore,

fully owned to ensure its sustainability. This findings mirror the AMR diagnostic capacity and antibiotic use report published in 2024, where Nandi County was among the sampled sites, noting poor development of ASPs at the sub-national levels (Karanja et al, 2024).

4.6 Barriers for Effective Implementation of AMS Activities

This objective focused on identifying barriers for effective implementation of antimicrobial stewardship activities in Kapsabet County Referral Hospital. The study participants were presented with a list of potential barriers to AMS implementation and asked to identify the challenges applicable to Kapsabet County Referral Hospital.

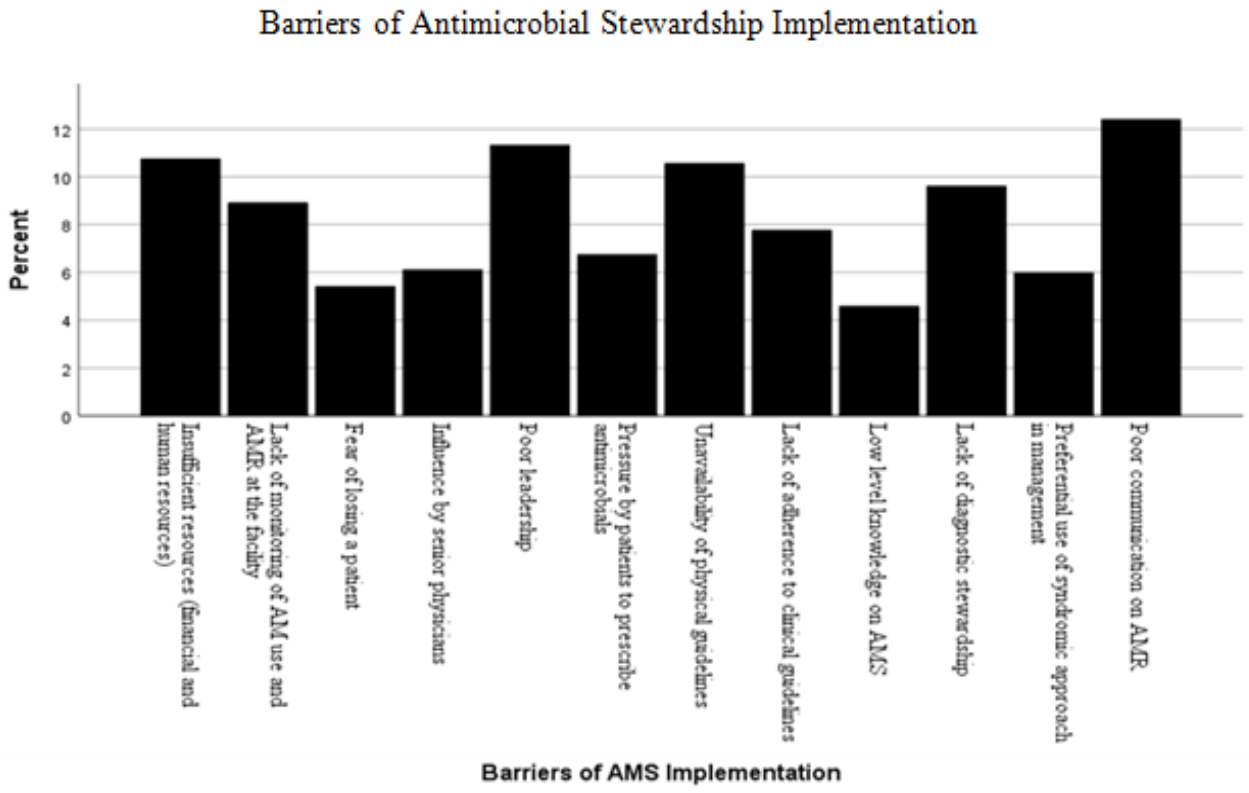

Figure 4. 1 Barriers of AMS Implementation

Basing on the presented results on figure 4.1, poor communication on AMR, poor leadership, insufficient resources (financial and human resources), unavailability of physical guidelines and lack of diagnostic stewardship were cited as the most common barriers of AMS implementation in a health facility setting with 12.4%, 11.3%, 10.7%, 10.5% and 9.6% respectively. Similar findings have been cited by Iskandar et al (2021); Lazure et al (2022); Gebretekle et al (2018); and Omulo et al. (2022) who have linked poor leadership and communication, poor diagnostic stewardship and the absence of clinical guidelines as obstacles for implementation of AMS. Other barriers included: lack of monitoring of AM use and AMR at the facility (8.9%); lack of adherence to clinical guidelines (7.8%); pressure by patients to prescribe antimicrobials (6.7%); preferential use of syndromic approach in management (6.0%); influence by senior physicians (6.1%); and fear of losing a patient (5.4%). Respondents identified low level knowledge on AMS as the least important barrier for effective AMS implementation with 4.6%.

Respondents were additionally asked to cite the top most hindrance in the implementation of AMS in the facility. Common cited barriers included: the lack of diagnostic stewardship, "*lack of culture and sensitivity studies to determine which antibiotic is sensitive*," policy implementation, "*poor implementation of policies*," and unavailability of physical guidelines. Participants noted that these barriers can be mitigated through: diagnostic stewardship, "*equipping of laboratory to do culture and sensitivity , provide enough resources to clinicians to harvest samples in sterile way for culture,"* policy implementation, *"Good and efficient policy implementation,"* leadership support, *"good leadership and clinical awareness"* and availability of guidelines, *"provision of physical guidelines."*

4.10 Discussions of Key Findings

The study results are discussed in this section, presented in relation to the study objectives. This study was focused on to: assess the level of awareness of AMS by HCWs; determine factors that drive AMS program; and assess the barriers for effective implementation of AMS activities in Kapsabet County Referral Hospital.

4.10.1 The status of antimicrobial stewardship in Kapsabet County Referral Hospital

The first objective focused on assessing the status of AMS in Kapsabet County Referral Hospital. Based on the study outcomes, 54% of the respondents rated AMS status of Kapsabet County Referral hospital as below average while 46% of the respondents noted that the AMS status was above average. This shows that AMS activities are partially carried out, giving AMS status a lower rating. This study results are in alignment with Mbugua et al. (2020), who explored perceptions of health administrations on AMS in Kenya and noted that the practice of AMS in health facilities are neither implemented nor well established as shown by the inadequate of critical AMS complementary elements. Mcknight et al. (2019) also concluded from their study on antibiotic stewardship in hospitals that antibiotic stewardship programs were inexistence with no official recognition. Further, its elements are not implemented in regional hospitals, depicting a fragmented status (Sohaili et al, 2024) despite the dire need of AMS programs (Khadse et al 2023), illuminating how low stewardship status may contribute towards steady rise of AMR in Kenya (Sohaili et al, 2024).

4.10.2 Level of Awareness of AMS by HCWs

Secondly, the study objectively sought out to assess the level of awareness of AMS by HCWs at Kapsabet County Referral Hospital. Basing on the research findings, it was noted that the HCWs were knowledgeable, demonstrating general awareness and an understanding of AMS (mean, 2.59; standard deviation, 0.49). The study findings resonates with the National Policy for the Prevention and Containment of AMR (2017), which connotes that there is general knowledge of AMR and its ramifications on the society by the different carders of HCWs. Respondents noted that AMR is present in Kenya showing an upward trend, with antimicrobial overuse being a contributory factor. This corresponds with the conclusion drawn by Sohaili et al. (2024) who noted that the scenario of AMR status in Kenya shows an increase in resistance to commonly used first-line regimens with a corresponding increase in deadly infections resulting from drug-resistant microbes.

According to Khadse et al. (2023), educating HCWs and continually disposing information about AMR helps in restricting the emergence of microbes resistant to multiple drugs. This is consistent with the study findings as HCWs reported that AMR knowledge not only influences AMS but is also important in clinical practice as they bear the responsibility of safeguarding and prolonging the effectiveness of antimicrobial agents through stewardship, which makes a difference in patient outcomes. Despite the importance, most HCWs reported that they are not trained on AMR/AMS (mean, 1.41) implying that there is need for training. The WHO (2021) endorses continuous clinical education as an essential component in the provision of optimal care to patient. However, Mangesho et al. (2021), argues that knowledge and attitudes does not necessarily correlate with AMS practices. Similar sentiments were also echoed in a South African KAP study where pharmacists in public hospitals demonstrated good knowledge and

attitude towards the implementation of ASP but poor ASP practices (Mthombeni et al, 2024). Thus a combination of education with other AMS interventions may result in better stewardship outcomes (Otieno et al, 2022).

AMS programs can reduce antimicrobial use resulting in cost savings through the reduction of the hospital stay duration, hence contributing to increased confidence in health care services. Khadse et al. (2023), equally in their study on the impact of AMS on AMR reduction, concluded that AMS programs markedly reduce the duration of higher broad-spectrum antimicrobials, yielding cost saving benefits to the patient. These glaring benefits of AMS program are however overshadowed by the lack of adequate diagnostic tests (mean, 2.80), as described by (Gitaka et al, 2020) who noted that a majority of Kenyan hospitals do not have the capability of conducting sensitivity tests for antimicrobials. This may limit the translation of knowledge into actual practice.

4.10.3 Drivers of AMS Program in a Health Care Facility

The third study objective sought to determine factors that drive AMS program at Kapsabet County Referral Hospital. The research findings showed that most of the core interventions that are designed to drive AMS at the health care facility level, as outlined in the Kenyan AMS guidelines for health care settings (2020) have been carried out partially, yielding a mean of 1.86 and a standard deviation of 0.63. Similar results were reported by Mbugua et al. (2020) who pointed out that there are critical deficits of essential AMS elements in health facilities in Kenya. The WHO (2021), outlines a strong and committed leadership as a pre-requisite of implementing most of AMS core interventions. Similar sentiments were cited by Kumar et al (2021), noting the necessity of administration commitment in the successful execution of AMS programs.

However, the study findings revealed that the facility does not enjoys leadership support, implying that a critical building block for AMS program identified as a low-lying fruit by Mbugua et al (2020) is lacking, suggesting the need of creating leadership buy-in.

The facility does not conduct audits on clinicians' antimicrobial use; neither do clinicians receive direct interaction and feedback on use. Further, pre-authorization is not necessarily required before prescribing restricted antimicrobials. These findings are contrary to the WHO (2021) recommendations, which support the audits with subsequent feedbacks, in addition to preauthorization of restricted antimicrobials. These interventions not only provide direct control over targeted restricted drugs but also foster communication, presenting learning opportunities that reinforce principles of antimicrobial prescriptions. Otieno et al (2022), further suggests that prospective audits with feedbacks yields greater output as it aligns well with clinicians in comparison to preauthorization. Clinical review with prescriber feedback is an important core intervention that is conducted at the facility in line with the national AMS guidelines (2020). However, it was uncertain whether automatic stop orders (ASO) for antimicrobials were adhered to, with the aim of preventing the issuance of antimicrobials for a prolonged period of time than what is deemed as necessary. This may be a result of the lack of workshops to sensitize HCWs on guidelines designed to facilitate the prudent antimicrobial usage when treating common microbial illnesses. Ndakala et al (2023) carried out an assessment of AMS in Kenya and concluded that training opportunities should be availed to strengthen AMS program.

4.10.4 Barriers for Effective Implementation of AMS Activities

The final objective sought out to assess barriers for effective implementation of antimicrobial stewardship activities in Kapsabet County Referral Hospital. Basing on the study findings: poor

communication on AMR; poor leadership; insufficient resources (financial and human resources); unavailability of physical guidelines and lack of diagnostic stewardship were cited as the most common barriers of AMS implementation in a health facility setting. These findings are congruent with McKnight et al (2019) who noted that hospitals in lower and middle income countries rarely have an annual planned budget towards stewardship depicting lack of leadership commitment in supporting AMS activities (Otieno et al, 2021). Further, the slow adoption of AMS activities has been attributed to health leaders failing to give precedence to AMR and AMS over other public health issues. Rolfe Jr et al. (2021) also noted the lack of diagnostic capabilities and unavailability of hospital-level antimicrobial treatment guidelines as common barriers to AMS in Kenya. Kariuki et al. 2021 suggests that for AMS programs to yield meaningful results, leadership commitment is paramount at all healthcare levels. Mbugua et al (2020) further notes that capitalization of the low lying fruits such as financial support and health leadership; laboratory competencies; and HCWs training on AMR and AMS strategies is paramount. These interventions can run with low budgets and sustainable impacts given a change in attitude, commitment, and administrative support in public hospitals (Kumar et al, 2021). Engler et al (2021) notes that the AMS program in public health facilities can only succeed when the challenges that bombards it are adequately addressed.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter provides a summary of the study findings, conclusion and recommendations.

5.1 Summary of findings

5.1.1 The status of antimicrobial stewardship in Kapsabet County Referral Hospital

The first objective sought to assess the status of AMS in Kapsabet County Referral Hospital. From the study results, 54% of the participants rated AMS status of Kapsabet County Referral hospital as below average while 46% of the respondents noted that the AMS status was above average. Respondents reported that AMS was not well undertaken with inadequate follow-ups on antimicrobial use and therefore ineffective in curbing AMR. This shows that AMS activities are partially carried out, giving AMS status a lower rating.

5.1.2 Level of Awareness of AMS by HCWs

The second objective sought out to assess the level of awareness of AMS by HCWs at Kapsabet County Referral Hospital. Basing on the research findings, it was noted that the HCWs were knowledgeable, demonstrating general awareness and an understanding of AMS. However, there were dissenting opinions with some respondents recording that even though HCWs may demonstrate some knowledge on AMS; the concept is not comprehensively understood pointing to knowledge gaps. In general, the level of awareness of antimicrobial stewardship by HCWs summed up an average of 2.59 and standard deviation of 0.49.

5.1.3 Drivers of AMS Program in a Health Care Facility

The third study objective sought out to determine factors that drive AMS program at Kapsabet County Referral Hospital. The research findings showed that most of the core interventions that are designed to drive AMS at the health facility level, as outlined in the Kenyan AMS guidelines for health care settings (2020) have been carried out partially, yielding an average of 1.86 and a standard deviation of 0.63. This findings suggests that the drivers of AMS in the health facility are partially implemented and AMS is not therefore, fully owned to ensure its sustainability.

5.1.4 Barriers for Effective Implementation of AMS Activities

The final objective sought out to identify barriers for effective implementation of antimicrobial stewardship activities in Kapsabet County Referral Hospital. Basing on the study findings: poor communication on AMR; poor leadership; insufficient resources (financial and human resources); unavailability of physical guidelines and lack of diagnostic stewardship were cited as the most common barriers of AMS implementation in a health facility setting with 12.4%, 11.3%, 10.7%, 10.5% and 9.6% respectively.

5.2 Conclusions

The first objective sought to establish the status of AMS in Kapsabet County Referral Hospital. The study concluded that the AMS status was not well developed or implemented.

The second objective sought to assess the level of awareness of AMS by HCWs at Kapsabet County Referral Hospital. Basing on the study findings, it is reasonable to conclude that the

HCWs based at Kapsabet County Referral hospital were well aware and demonstrated an understanding of AMS.

The third objective sought to determine factors that drive AMS program at Kapsabet County Referral Hospital. It was concluded that optimal antimicrobial usage through documentation of drug dosage, duration and indication as the main driver of AMS program at the facility. However, other interventions as outlined in the AMS guidelines need to be implemented to ensure optimum usage of antimicrobials with the facility.

The fourth objective sought out to assess barriers for effective implementation of antimicrobial stewardship activities in Kapsabet County Referral Hospital. From the study findings, poor communication on AMR; poor leadership; and insufficient resources were considered the major hindrance of AMS program at the facility.

5.3 Recommendations

Listed below are proposed recommendations in line with the study objectives and subsequent study findings.

1. **Enhance AMS Awareness and Continuous Medical Education (CME)**

Given the evolving nature of medicine and AMR, continuous medical education should be conducted to reinforce best practices on emerging trends in antimicrobial resistance (AMR) and AMS strategies. Further, most HCWs reported not having undergone formal AMR/AMS training. To bridge this gap, the study recommends comprehensive sensitization and training programs on AMR and AMS guidelines. Such initiatives will not only foster HCW ownership of AMS programs, but also enhance knowledge application, and promote the sustainability of AMS

interventions. Incorporating AMS training into the hospital's orientation program for new staff and conducting regular refresher courses will be essential in standardizing best practices.

2. **Optimize Antimicrobial Usage**

Since documentation of drug dosage, duration, and indication was identified as a key driver of AMS at Kapsabet County Referral Hospital, strict adherence to antimicrobial prescribing guidelines should be enforced. The hospital should consider implementing an electronic prescribing and surveillance system which would help in real-time monitoring and feedback on antimicrobial use.

3. **Improve Communication and Leadership Commitment**

Poor communication and weak leadership were cited as significant barriers to AMS implementation. The hospital management should enhance communication channels between HCWs and hospital leadership. This can be achieved by scheduling regular AMS meetings, disseminating AMS updates, and fostering a culture of open dialogue on antimicrobial use and resistance. Leadership commitment should be strengthened by appointing AMS champions who can advocate for and oversee the implementation of AMS activities within departments.

5.4 Recommendations for Further Studies

The empirical analysis disclosed issues that were not addressed by this research project but are significant for future studies. Potential areas for further research include:

i. An evaluation of the effectiveness of AMS frameworks and models used in implementing AMS in healthcare facilities in Kenya.

ii. Strategies for improving AMS in public hospitals in Kenya.

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APPENDICES

Appendix A: Questionnaire

SECTION A: GENERAL INFORMATION OF THE RESPONDENTS

1. Respondent's Age

a) 20-30 years ( )

b) 31-40 years ( )

c) 41-50 years ( )

d) Above 51 years

2. Respondent's sex

a) Male ( )

b) Female ( )

3. Highest level of Education

a) Diploma L ( )

b) Higher Diploma ( )

c) Degree Level ( )

d) Post- graduate ( )

4. Designation of the respondent

a) Clinical officer ( )

b) Pharmacists ( )

c) Medical doctor ( )

SECTION B: LEVEL OF AWARENESS AND UNDERSTANDING OF AMS

The following are some statements on the level of awareness of AMS. Using the rank of Agree=3, Neutral=2, Disagree=1, please indicate the level of your agreement with each statement by ticking only one answer for each of the statements.

STATEMENT	1	2	3
Antimicrobial Resistance (AMR) occurs when the microorganism responsible for an infection survives exposure to a medication that would typically eradicate it or inhibit its growth.			
AMR is increasingly becoming a problem due to overuse of antimicrobials			
Kenya is already experiencing increasing levels of antimicrobial resistance			

Kenya has a national policy document on prevention and containment of AMR and a national antimicrobial stewardship guideline for health care facilities			
Do you find the policy and guideline beneficial to HCWs?			
Have you ever been trained on AMR/AMS?			
HCWs bear the responsibility of safeguarding and prolonging the effectiveness of antimicrobial agents through stewardship.			
AMR knowledge is important in clinical practice			
AMR knowledge influences AMS			
Lack of adequate diagnostic tests results in overuse of antibiotics			
Effects of AMR decreases patients confidence in healthcare			
Antimicrobial stewardship makes a difference in patient outcomes			
AMS Programs reduces antimicrobial use overall and can result in cost savings			
AMS Programs reduces duration of hospital stay			

5. The reserve group comprises antibiotics and antibiotic classes reserved for treating confirmed or suspected infections caused by multidrug-resistant organisms. They are considered as "last-resort" options for treatment. Kindly circle the antibiotics that belong in these group

a) Amikacin
b) Linezolid
c) Ceftriaxone
d) Meropenem
e) Clindamycin
f) Vancomycin
g) Cotrimoxazole

6. Comment on the level of awareness and understanding of antimicrobial stewardship (AMS) by clinicians in the health facility

……

……

……

SECTION C: DRIVERS OF AMS PROGRAM IN A HEALTH CARE FACILITY

The following are some statements on the Implementation of AMS activities in a health care facility. Using the rank of Agree=3, Neutral=2, Disagree=1, please indicate the level of your agreement with each statement by ticking only one answer for each of the statements.

STATEMENT	1	2	3
The facility is provided with support from leadership to enhance antimicrobial use, including having a dedicated budget for these efforts			
There is a clinical point person responsible for AMS program at the facility			
There is an AMS team that monitors the outcomes of AMS activities			
It is a requirement for the facility that prescribers document the full name, dose, route, frequency, duration, and indication for all antimicrobial prescriptions in the medical record or during order entry			
The facility conducts audits on clinicians' antimicrobial use, and clinicians receive direct interaction and feedback from either an infectious diseases physician or a clinical pharmacist			
Pre-authorization is required before prescribing restricted antimicrobials			
The facility provides workshops aimed at educating healthcare workers on guidelines to ensure the optimal utilization of antimicrobials for treating common infections.			
Antimicrobial choices are reviewed and discussed during ward rounds to ensure they are in line with the best practice guidelines			
Clinicians are alerted when antimicrobial treatment sheets overlap or are duplicative			
Antibiotics are automatically discontinued after a predetermined time period based on the indication irrespective of physician orders.			
The AMS team monitors adherence to AMR documented policy			
The leadership of the facility share facility-specific reports on antimicrobial use with prescribers			

7. Comment on the status of AMS in the health facility……
……

SECTION D: BARRIERS FOR EFFECTIVE IMPLEMENTATION OF AMS ACTIVITIES

In your opinion, what are the challenges that hamper the implementation of antimicrobial stewardship activities in your facility? Please tick your chosen challenge/s on the left column.

No.	Challenge	Tick
a.	Insufficient resources (financial and human resources)	
b.	Poor leadership	
c.	Pressure by patients to prescribe antimicrobials	
d.	Unavailability of physical guidelines	
e.	Lack of adherence to clinical guidelines	
f.	Low level knowledge on AMS	
g.	Lack of diagnostic stewardship	
h..	Preferential use of syndromic approach in management	
i.	Poor communication on AMR	
j.	Lack of monitoring of AM use and AMR at the facility	
k.	Fear of losing a patient	
l.	Influence by senior physicians	
m.	Add any other	

8. In your opinion, which is the top most hindrance in the implementation of AMS in the health facility and why?

……

……

……...

9. How can the barrier pointed out above (9) be mitigated?

……
……
……
……

Appendix B: Checklist for Antimicrobial Stewardship Program

AMS Component	Yes/No
Leadership Support	
KCRH has leadership support to boost antimicrobial use, e.g a dedicated budget.	
Is the support formal and in blue print?	
The facility receives budgeted financial assistance from the hospital administration/county for AMS activities.	
Accountability	
There is a clinician charged for AMS program outcomes	
Medicines Expertise	
There is a pharmacist/pharmaceutical technologist leader in charge for AMS program outcomes	
Key support for the ASP	
The following HCWs work with the stewardship leaders to improve AM use a) Clinicians b) Infection Prevention and Control c) Quality Improvement d) Microbiology (Laboratory) e) Information Technology f) Nursing g) Other (Specify)	
Actions to Improve Optimal Antimicrobial Use	
The hospital has a policy mandating prescribers to document the full name, dose, route, frequency, duration, and indication for all AM prescriptions	
The facility has implemented prospective audits of AM use	
The facility has implemented restriction of drugs and preauthorization measures for antimicrobials	
Training on guidelines	
Regular ward rounds are conducted to review and discuss antimicrobial choices to ensure compliance with evidence-based practice.	
Clinicians receive heads-up in cases where prescriptions might be overlap or are duplicated.	
There is a prerequisite for clinicians to obtain approval before dispensing select antibiotics for patient use.	
There is an overarching regulation that prohibits clinicians from prescribing certain antibiotics to specific classes of patients.	

Antibiotics are discontinued automatically after a predetermined time period, following the indication irrespective of physician orders.	
The facility has specific treatment guidelines readily available to aid in AM drug selection for the following common clinical conditions a) Urinary tract infections b) Community-acquired respiratory tract infections c) Skin and soft tissue infections d) Blood stream infections e) Surgical antimicrobial prophylaxis f) Acute pharyngitis g) Acute infectious diarrhea h) Ventilator-associated pneumonia i) Acute otitis media j) Other (Specify)	
Tracking: Monitoring Antimicrobial Prescribing, Use, and Resistance	
AMS program is responsible for tracking adherence to facility-specific treatment guidelines	
Monitoring of AM consumption id done using: a) Counts of antibiotic(s) administered to patients per day b) Number of grams of antibiotics used c) Direct expenditure for antibiotics	
Reporting Information to Staff on Improving Antibiotic Use and Resistance	
AMS program shares facility-specific reports on AM use with prescribers	
Prescribers are provided with direct, in- person communication regarding ways of enhancing AM prescribing practices	
Education	
AMS program offers trainings to clinicians and other relevant staff with the aim of enhancing AM prescribing practices	

Appendix C: Informed Consent Form

STUDY TITLE	**AN ASSESSMENT OF ANTIMICROBIAL STEWARDSHIP STATUS IN KAPSABET COUNTY REFERRAL HOSPITAL, NANDI COUNTY, KENYA**
RESEARCHER	KIPKEMOI MOREEN/ MPH- EPIDEMIOLOGY/MKU

IDENTIFICATION OF THE INVESTIGATOR

You are hereby requested to take part in a research study undertaken by Kipkemoi Moreen, a graduate student at Mount Kenya University, Department of Epidemiology and Biostatistics.

PURPOSE

The goal of this research is to assess the current status of Antimicrobial Stewardship (AMS) at Kapsabet County Referral Hospital. Your participation will help in assessing healthcare workers' awareness and understanding of AMS, identifying key factors that drive AMS implementation, and examining the barriers hindering its effectiveness within the facility.

RISKS, BENEFITS, AND CONFIDENTIALITY

No anticipated risks have been determined to be associated with participation in this study. Participation is entirely cost-free, and while there are no direct personal benefits, the findings may contribute to improved antimicrobial use and strengthen stewardship roles among healthcare workers. All responses will remain anonymous, and participants should avoid sharing any personal identifiers during data collection. The data collected in this study will be handled with strict discretion.

VOLUNTARY PARTICIPATION AND WITHDRAWAL

Taking part in this research undertaking is completely voluntary. You may opt not to answer any question or pull out from the study at any given time without any consequences.

CONTACT INFORMATION

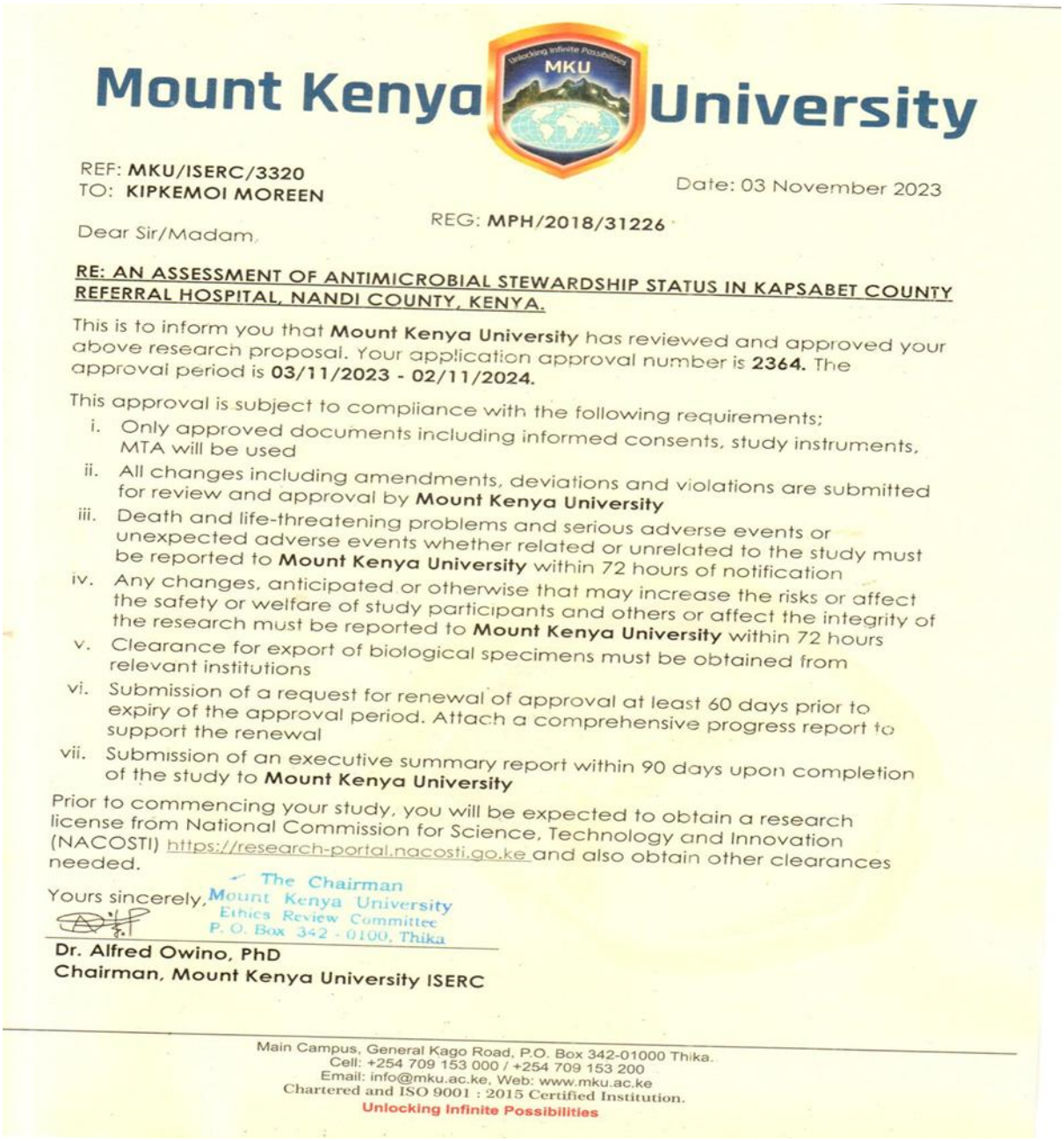
For any queries or concerns regarding this research, please contact the investigator, Kipkemoi Moreen, at +254731562177 or via email at kipkemoichebii@gmail.com. This study has been reviewed and approved by the Mount Kenya University Ethics Review Committee and the National Commission for Science, Technology & Innovation (NACOSTI).

CONSENT

I have read and understood the information provided about this study. I was given a chance to ask questions and obtain clarifications. I am aware that taking part in this study is optional, and I am free to pull out my contribution at any stage. I confirm that I will receive a copy of this consent form. By signing below, I freely agree to take part in this study.

Participant's signature _____ Date _____
Investigator's signature _____ Date _____

Appendix D: ERC Certificate



Mount Kenya University

REF: MKU/ISERC/3320
TO: KIPKEMOI MOREEN

Date: 03 November 2023

REG: MPH/2018/31226

Dear Sir/Madam,

RE: AN ASSESSMENT OF ANTIMICROBIAL STEWARDSHIP STATUS IN KAPSABET COUNTY REFERRAL HOSPITAL, NANDI COUNTY, KENYA.

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **2364.** The approval period is **03/11/2023 - 02/11/2024.**

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 **Mount Kenya University**
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 **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** 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 **Mount Kenya University**

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.

Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 0100, Thika

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Chairman, Mount Kenya University ISERC

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Appendix E: Introduction letter from MKU

Mount Kenya University

DIRECTORATE OF GRADUATE STUDIES

MPH/2018/31226

3rd November, 2023

National Commission for Science Technology & Innovation (NACOSTI)
Off Waiyaki, Upper Kabete
P.O Box 30623- 00100
NAIROBI, KENYA

Dear Sir/Madam,

RE: KIPKEMOI MOREEN – REGISTRATION NO. MPH/2018/31266

The purpose of this letter is to introduce the above named student who is pursuing **Master of Public Health** in the department of **Epidemiology and Biostatistics** in the school of **Public Health.**

The title of the research is **"An Assessment of Antimicrobial Stewardship Status in Kapsabet County Referral Hospital, Nandi County, Kenya."** It has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data between **November, 2023 and January, 2024.**

Any assistance accorded to the student will be highly appreciated.

Thank you.

Mount Kenya University
P. O. Box 342 - 01000, THIKA
Office of the Director,
Graduate Studies

Dr. Samuel M. Kareriga, Ph.D
Director, Graduate Studies
Enc.

Appendix F: NACOSTI Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **492673**

Date of Issue: **14/November/2023**

RESEARCH LICENSE

This is to Certify that Miss.. Moreen Jepkoech Kipkemoi of Mount Kenya University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nandi on the topic: AN ASSESSMENT OF ANTIMICROBIAL STEWARDSHIP STATUS IN KAPSABET COUNTY REFERRAL HOSPITAL, NANDI COUNTY, KENYA for the period ending : 14/November/2024.

License No: **NACOSTI/P/23/31439**

492673

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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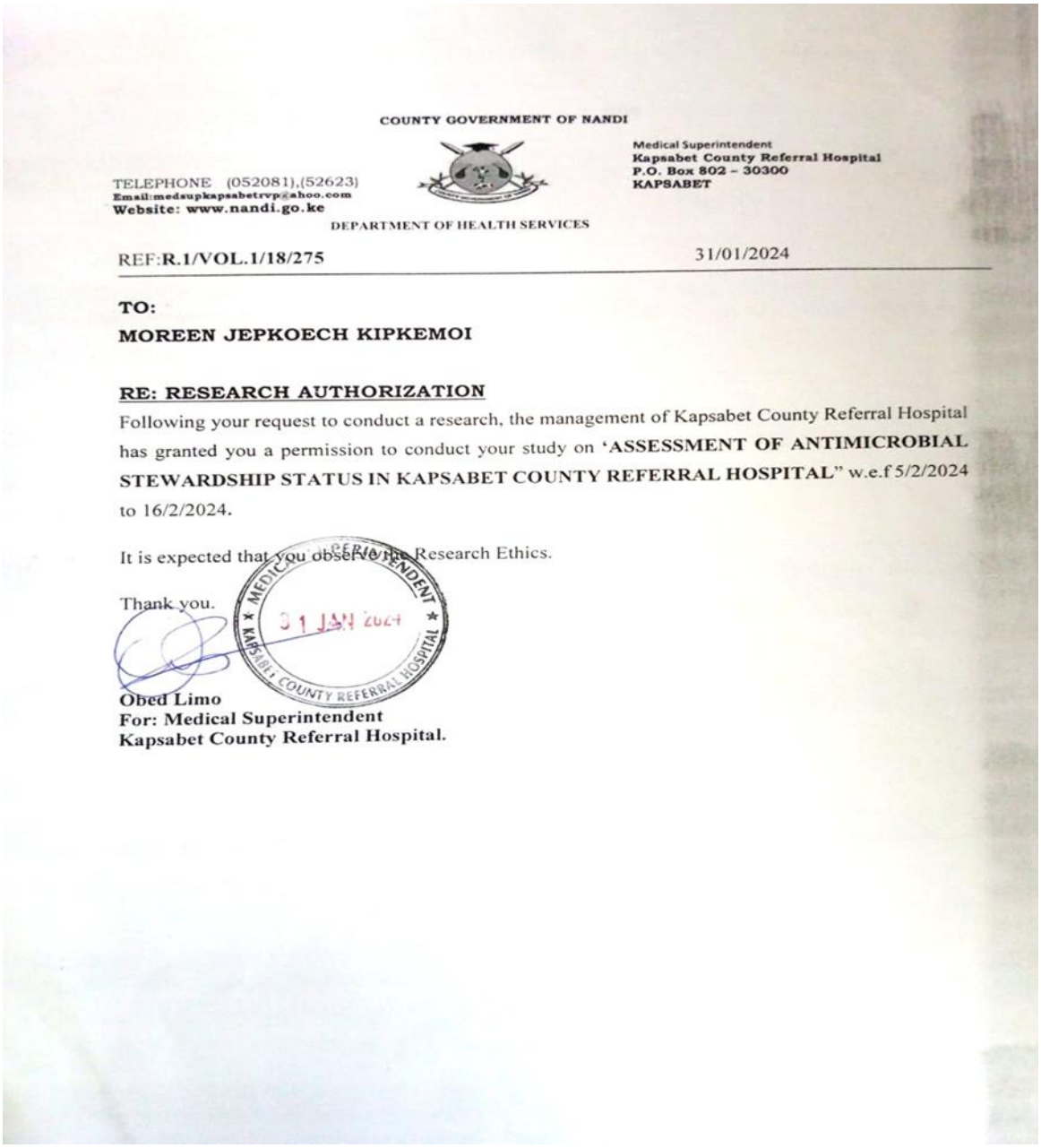
See overleaf for conditions

Appendix G: Research Authorization



COUNTY GOVERNMENT OF NANDI

TELEPHONE (052081),(52623)
Email:medsupkapsabetrvp@ahoo.com
Website: www.nandi.go.ke

Medical Superintendent
Kapsabet County Referral Hospital
P.O. Box 802 – 30300
KAPSABET

DEPARTMENT OF HEALTH SERVICES

REF:R.1/VOL.1/18/275 31/01/2024

TO:
MOREEN JEPKOECH KIPKEMOI

RE: RESEARCH AUTHORIZATION

Following your request to conduct a research, the management of Kapsabet County Referral Hospital has granted you a permission to conduct your study on '**ASSESSMENT OF ANTIMICROBIAL STEWARDSHIP STATUS IN KAPSABET COUNTY REFERRAL HOSPITAL**" w.e.f 5/2/2024 to 16/2/2024.

It is expected that you observe the Research Ethics.

Thank you.

MEDICAL SUPERINTENDENT * KAPSABET COUNTY REFERRAL HOSPITAL *
31 JAN 2024

Obed Limo
For: Medical Superintendent
Kapsabet County Referral Hospital.

Appendix H: Turnitin Report

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