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Socio-Economic Context and Stakeholder Dynamics in Reducing Inappropriate Use of Antibiotics in Punjab, Pakistan

MASTER THESIS

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List of Abbreviations

Abbreviation	Full Form
ABRS	Acute Bacterial Rhinosinusitis
AOM	Acute Otitis Media
AMR	Antimicrobial Resistance
ASP	Antimicrobial Stewardship Program
ATLAS	Antimicrobial Testing Leadership and Surveillance
CAP	Community-Acquired Pneumonia
CI	Confidence Interval
CME	Continuing Medical Education
CPD	Continuing Professional Development
DNA	Deoxyribonucleic Acid
FAO	Food and Agriculture Organization
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GER	Gross Enrolment Rate
GLASS	Global Antimicrobial Resistance and Use Surveillance System
HAW	Hamburg University of Applied Sciences
HD	Human Doctor (Interview Code)
ICU	Intensive Care Unit
KAP	Knowledge, Attitudes, and Practices
LIMS	Laboratory Information Management System
LMIC	Low- and Middle-Income Country
MDR	Multidrug Resistant
MSF	Médecins Sans Frontières
NAP	National Action Plan

OR	Odds Ratio
OTC	Over the Counter
RQ	Research Question
SDH	Social Determinants of Health
SOAR	Survey of Antibiotic Resistance
VD	Veterinary Doctor (Interview Code)
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

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Abstract

Background: Antimicrobial resistance (AMR) poses a critical global health challenge, particularly in low- and middle-income countries. In Pakistan despite the presence of National Action Plan, the extent to which policies are implemented in practice remains uncertain. This study investigates socio-economic, institutional and stakeholder factors shaping antibiotic use and AMR policies implementation in Punjab, Pakistan.

Method: A mixed-method design was employed. A cross-sectional survey of 273 healthcare professionals (47.6% human doctors and 52.4% veterinary doctors) from rural (35.2%) and urban (64.8%) areas assessed sociodemographic factors, AMR training and perception of misuse. Descriptive, bivariate and logistic regression analysis were performed. In parallel, 16 semi structured interviews with medical and veterinary professionals were analyzed thematically to explore policy awareness, challenges and stakeholder dynamics.

Results: Overall, 87.6% of respondents agreed that socio-economic status influences inappropriate antibiotic use. Rural respondents (97.9%) were significantly more likely to agree with this statement than urban respondents (81.9%). Younger professionals and those with AMR training also showed higher agreement (<0.05). Qualitative findings revealed recurring themes, including weak enforcement and policies existing only "on paper", limited access to diagnostics, persistent over the counter sales, patient and farmer pressure to prescribe, and the strong influence of pharmaceutical companies.

Conclusion: AMR policies in Punjab remain poorly enforced. Socio economic constraints, weak institutional capacity, and stakeholder interests continue to drive irrational antibiotic use in both human and veterinary sectors. Strengthening stewardship requires inclusive policy making, expanded diagnostic infrastructure and sustained awareness programs. This study provides evidence-based recommendations for policymakers to strengthen AMR governance in LMIC settings

Keywords: Antimicrobial resistance (AMR); policy implementation; socio-economic factors; Pakistan; mixed methods

1. Introduction

Antimicrobial resistance (AMR) has become a significant global public health issue because of its ability to undermine the effectiveness of antimicrobial agents and especially antibiotics. This causes treatment of infectious diseases more complicated which in return causes healthcare expenses to rise rapidly which is a major concern for especially LMICs. In addition to expenses it raises morbidity and mortality to a new high. (Bertagnolio et al., 2024; Matthiessen et al., 2022).. As per reports of World Health Organization(WHO), if this major public health issue is not addressed it may become a cause for loss of ten million lives per year by 2050, that can cause serious consequences not only for low-income nations but also for high -income nation (Bertagnolio et al., 2024).

Pakistan has a shockingly high burden of AMR like many LMICs, major causes include socio-economic disparities, lack of healthcare infrastructure and widespread abuse of antibiotics in veterinary and human medicine (Abdullah et al., 2014; S. Ahmed et al., 2023). According to recent survey, Pakistan is positioned at third place among countries with high antibiotic use (Mustafa et al., 2023). The crisis of AMR has been made worse by frequent use of broad-spectrum antibiotics and overprescription by healthcare workers even though prevalence of bacterial co-infection is low. This trend is more common among children hospitalized with viral diseases like Covid-19 (Mustafa et al., 2023).

Antimicrobial resistance in Pakistan is associated with systemic issues including unregulated health governance, corruption, and weak political will, with the irrational utilization of antibiotics(U. Ahmed & Abbas, 2022). The problems are exacerbated by insufficient funding for public health facilities, lack of economic accountability in the healthcare sector, and delicate regulatory frameworks. (Ghafoor et al., 2022; Idrees & Bakar, 2018).

Moreover, AMR is a complex, interconnected challenge that impacts human, animal, and environmental health; it surpasses hospitals and individual antibiotic prescriptions, rendering it a typical 'One Health' concern. (Founou et al., 2021; Mariappan et al., 2021). It is widespread practice to provide antimicrobials to cattle for the goals of prevention measure and growth promotion. This practice contributes to the spread of infections that are resistant to antibiotics further up the food chain (Founou et al., 2021). In order to combat antimicrobial resistance (AMR), it is necessary to

implement a comprehensive plan that integrates healthcare, agricultural, and environmental policy into a rational approach.(Khurana et al., 2023; Matthiessen et al., 2022).

Antimicrobial stewardship programs (ASPs) have been created as a result of attempts to manage AMR in hospital settings. These programs aims to maximize the responsible use of antimicrobials and the results for patients in hospitals (Mendelson et al., 2020). Nevertheless, Pakistan has a tough time initiating and maintaining such programs due to a shortage of healthcare professionals, lack of laboratory space, and inadequate policy execution and implementation.(Abdullah et al., 2014; Ali et al., 2021).

Recognizing the need for innovative antibiotics, behavioral and systemic therapy, and integrated surveillance systems, the World Health Organization (WHO) has made AMR a main focus over the course of its research and public health agenda on a global scale (Bertagnolio et al., 2024). On the other hand, the majority of the measures that are now in place are top-down, meaning that they focus on supply-side adjustments and clinical standards while paying little attention to the behavioral, social, and economic factors that contribute to antibiotic overuse in local areas (Borghi & Brown, 2022; Inoue, 2019).

Given the conditions surrounding Pakistan, it is critical to have a better understanding of the socio-economic factors that drive antibiotic use in both the human and animal health sectors. There are numerous factors that lead to the overuse of antibiotics as the standard of treatment. These variables include poverty, low health literacy, informal healthcare providers, and limited access to diagnostics(U. Ahmed & Abbas, 2022; Alam et al., 2023). Because pilgrims are more likely to abuse drugs and spread infectious diseases during large gatherings such as the Hajj, these risks become much more serious(Haseeb et al., 2023).

Taking this into consideration, the current thesis explores the institutional and socio-economic factors that have an impact on the implementation of antimicrobial resistance policy in Punjab, Pakistan. By leveraging both quantitative and qualitative data collected from medical practitioners working in the human and animal sectors, this study contributes to a better understanding of antimicrobial resistance governance in a health system that is fragmented. The study is based on the Social Determinants of Health (SDH) theoretical framework and the 'One Health' paradigm, which places an emphasis on the ways in which inter-sectoral cooperation and structural inequalities influence health outcomes. Through the process of bridging the gap between policy and practice, as

well as across sectors that usually operate in silos, the purpose of this research is to develop more equitable and successful approaches to the control of antimicrobial resistance in low- and middle-income countries.

The following is an outline of the structure of the thesis. A literature review on antimicrobial resistance (AMR) is presented in the second chapter. This review covers the epidemiological, sociological, and policy aspects of AMR. The third chapter is where the research questions and objectives that will serve as the basis for the study are provided. Chapter four provides a description of the methodology, which includes the study design, the methods of data collection, and the procedures of analysis. In Chapter five, the outcomes of the empirical research are presented. In Chapter six, an analysis and discussion of the findings are presented, with particular attention paid to how they relate to the study questions and the existing frameworks. In the seventh chapter, both the study's weaknesses and its strengths are taken into consideration. The thesis eventually ended in chapter eight, which also provides recommendations for the direction of future research and policy issues.

2.Theoretical Background

2.1. Understanding Antimicrobial Resistance (AMR)

Antimicrobial Resistance (AMR) occurs when microorganisms such as bacteria, fungi, parasites, and viruses evolve to resist antimicrobial treatments, leading to significant public health challenges globally. (Tang et al., 2023). Antimicrobial resistance (AMR) is a critical global health threat with profound economic and social consequences (Jamrozik & Selgelid, 2020; Tang et al., 2023). AMR exemplifies the One Health approach, recognizing the interconnectedness of human, animal, and environmental health (Velazquez-Meza et al., 2022) . Factors contributing to AMR spread include improper antimicrobial management, inadequate infection control, and migration of infected individuals and animals (Velazquez-Meza et al., 2022). The complexity of AMR is further compounded by genetic elements and transmission pathways between microbes (Aljeldah, 2022). Addressing AMR requires multidisciplinary efforts, including international strategies like the UN's Sustainable Development Goals and the One Health approach (Tang et al., 2023). Advancements in DNA sequencing and bioinformatics offer promising tools for real-time detection and prevention of AMR (Aljeldah, 2022).

2.1.1. Global Relevance of AMR

The paper addresses the critical issue of antimicrobial resistance (AMR) in low-and middle-income countries (LMICs), highlighting the challenges in data collection and the role of non-governmental organizations (NGOs) in combating AMR. The authors emphasize that obtaining reliable AMR data in LMICs is extremely difficult due to inconsistent data collection practices. They note that existing data often lack standardization and are not representative, leading to systematic inaccuracies and underreporting. This inconsistency is compounded by a lack of infrastructure, skilled personnel, and adequate laboratory facilities, which are essential for quality assurance in AMR surveillance. The paper discusses the significant role that NGOs, such as Médecins Sans Frontières (MSF), can play in addressing these challenges. NGOs often operate in parallel to public medical systems and can contribute to AMR data collection in areas where reporting is scarce. The authors argue that NGOs are responsible for a substantial amount of healthcare provision in low-resource contexts, thus positioning them as key players in AMR control efforts. The central focus of the paper is the Mini-Lab project developed by MSF, which aims to provide simplified bacteriological diagnosis and AMR surveillance in challenging settings. The Mini-Lab is designed to be

a turnkey solution that allows end-users to operate autonomously, supported by detailed guidance documents and a future Laboratory Information Management System (Mini-LIMS) that will enhance data management and result validation.

The implementation of the Mini-Lab in Haiti is highlighted as a case study, showcasing its potential to improve AMR data collection and surveillance. The authors conclude that effective surveillance systems are crucial for understanding the global AMR problem and for adapting therapeutic guidelines. They stress the need for comprehensive AMR surveillance networks that extend to primary care and utilize all existing data sources, which is currently lacking in most LMICs. (Tang et al., 2023)

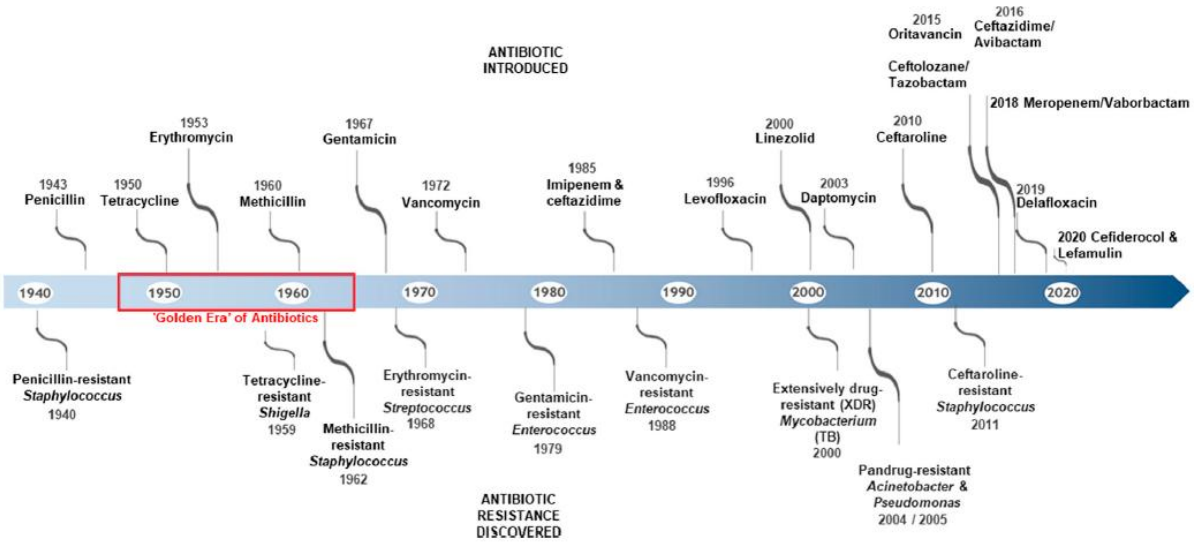

Figure 1: Timeline showing some of the key antibiotic discoveries and reports of the emergence of antibiotic resistance strains (Tang et al., 2023)

It discusses how antimicrobial resistance occurs naturally but is worsened by the overuse of antibiotics in humans, animals, and even plants. The paper emphasizes the importance of antimicrobial stewardship—that is, carefully managing and using antibiotics to preserve their effectiveness for future generations. It highlights that antibiotics are a shared resource, and everyone—from policymakers to farmers to patients—plays a role in protecting them. The Food and Agriculture Organization (FAO) is spotlighted for its global leadership in promoting responsible antimicrobial use in food systems, especially through education, policy, and collaboration. The authors synthesize existing initiatives, projects, and global efforts—particularly those led by the Food and

Agriculture Organization (FAO)—rather than collecting new data. Multiple experts across disciplines contributed to writing, validating, and editing the manuscript. This suggests a collaborative, multidisciplinary perspective rather than a single methodologically defined study. The paper emphasizes implementation strategies, challenges, and conceptual frameworks tied to antimicrobial stewardship on a global level. The document includes no references to experiments, participant samples, data analysis techniques, or specific statistical methods. In essence, this study likely uses a qualitative, policy-oriented methodology, drawing on global literature, institutional knowledge, and cross-sector insights to make its case for antimicrobial stewardship as a shared global responsibility.

The study doesn't present experimental or statistical results, since it's more of a narrative review. Instead, it highlights the following:

- Current levels of antimicrobial resistance (AMR) are critically high worldwide.
- Overuse of antimicrobials in human medicine, animal farming, and plant health is a major driver of AMR.
- The Food and Agriculture Organization (FAO) has launched multiple global initiatives, projects, and campaigns focused on stewardship and education. There is widespread variation among countries in terms of readiness, regulation, and resources to address AMR effectively.

AMR is a natural phenomenon and cannot be entirely eliminated, but its growth can be controlled. Stewardship is a challenging but essential concept; it requires all sectors to treat antimicrobials as a shared, limited resource. A global shift in mindset is needed—one that recognizes antimicrobials as common goods that must be preserved. The FAO's leadership and programs are central to promoting sustainable antimicrobial use, especially in the context of food security. (GBD 2021 Antimicrobial Resistance Collaborators, 2024).

2.1.2. Drivers of AMR

In addition to biological mechanisms, a variety of socio-economic and environmental factors also have a role in the emergence and dissemination of antimicrobial resistance (AMR). In an umbrella review that synthesized quantitative research, Ljungqvist et al., (2025) mapped 27 thematic

determinants of AMR into three interrelated levels: Institutions & Policies, Systems & Environment, and People & Public. This paradigm offers a thorough analysis of the ways in which governance arrangements, community structures, and individual behaviors combine to speed up resistance. Patterns of antibiotic exposure are shaped at the People and Public level by demographic and social factors such age, sex, ethnicity, migratory status, and socio-economic status. While older individuals are sometimes classified as both at risk and protected, there is evidence that childhood is substantially associated with greater risks of resistant diseases and inappropriate antibiotic usage. Since they are linked to antibiotic storage, self-medication, and the spread of resistant organisms, migration and forced relocation are frequently identified as risk factors. Similarly, a higher prevalence of resistant diseases has been associated with socio-economic marginalization, which includes homelessness, intravenous drug use, and incarceration. Nonetheless, correlations between income and education are frequently incongruous; some research indicates that greater educational attainment puts more pressure on prescribers, while other studies find protective effects due to increased awareness (Ljungqvist et al., 2025). Global investigations have also highlighted broader socio-economic variables as important contributors, such as living conditions, gender, and health disparities(Bertagnolio et al., 2024).

Aspects that go beyond humans to include ecological and community contexts are captured at the System and Environment level. Urbanization, healthcare occupational exposure, and home transmission are important factors that influence the spread of resistance. Risks are further increased by environmental cleanliness, local poverty, tourism, and climate-related variables. Crucially, food supply chains and animal husbandry are known to be sites of antibiotic abuse and spread. It has been frequently noted that a key route for the spread of resistance among populations is the contamination of water systems by pharmaceutical waste and agricultural runoff (Ye et al., 2025) Systemic flaws in finance and governance show up as significant AMR drivers at the institutional and policy level. Inappropriate antibiotic use and resistance have been linked to national poverty levels, poor governance systems, low health financing, and faulty and phony antibiotics. Numerous of these variables exhibit reciprocal relationships, indicating a complicated and non-linear link between socio-economic determinants and AMR. Higher AMR rates in Europe and abroad have been directly linked to poor governance and corruption(Collignon et al., 2018). More recent research demonstrates that in low- and middle-income nations, socio-economic deprivation—which includes low educational attainment and economic stagnation—significantly raises the risk of

AMR (Ho et al., 2025). Policy briefs also stress how crucial it is to incorporate socio-economic factors into AMR policy, contending that multisectoral approaches are necessary for efficient management (WHO, 2024).

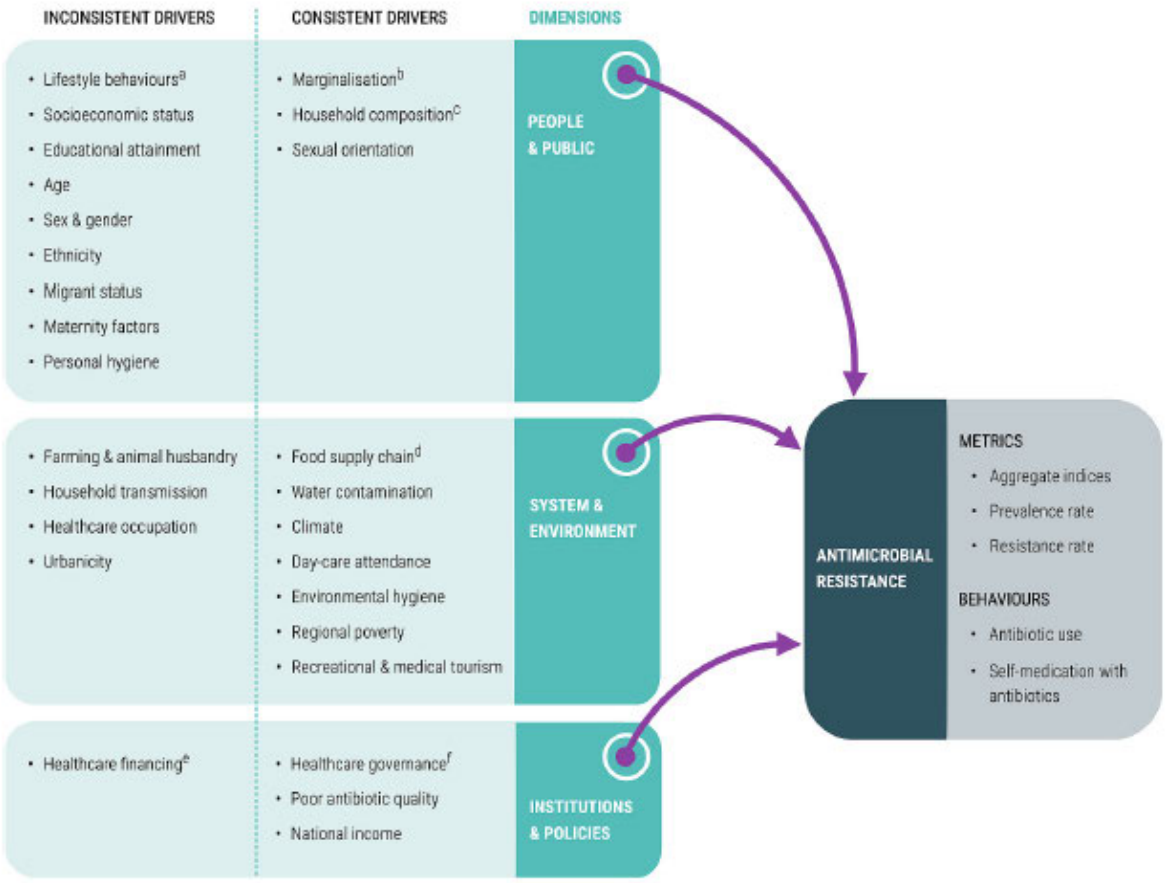

Figure 2*:* Drivers of AMR (Ljungqvist et al., 2025)

Another study explores the growing threat of antimicrobial resistance AMR and how it affects human, animals, and environment. It applies a system thinking approach to visualize the complex interconnections between different factors contributing to AMR. The study creates a system map to illustrate how AMR spreads and interacts with socio-economic s and environmental factors. First conducted a comprehensive review of existing studies on AMR focusing on its socio-economic factors, system dynamics and policy intervention. The study uses feedback loops to highlight how AMR is reinforced and suggests leverage points for effective interventions. The study

incorporated water, sanitation, and hygiene (WASH) as critical factors affecting AMR. Poor sanitation and hygiene practices facilitate the spread of resistant bacteria, making infection prevention more challenging. Disparities in healthcare access, showing how limited availability of medical services leads to self-medication and misuse of antibiotics, further driving AMR. The study mapped environmental contributors such as wastewater contamination, agricultural antibiotic runoff, and improper disposal of medical waste, which introduce resistant bacteria into ecosystems. The study emphasizes the need for improved surveillance systems to monitor antimicrobial use and resistance patterns. It also calls for stronger antimicrobial stewardship programs to ensure responsible prescribing and dispensing (Matthiessen et al., 2022).

2.1.3. AMR Situation in Pakistan

This study is retrospective observational analysis conducted to monitor antimicrobial resistance (AMR) in Punjab, Pakistan. Looking at the frequency of antimicrobial resistance among typical bacterial pathogens, the study emphasizes the increasing difficulty of multidrug resistant bacteria and widely drug-resistant bacteria in the area. Researchers analyzed clinical samples obtained from seven labs from 2018 to 2019 to identify bacterial strains and evaluate their resistance profile. Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and Klebsiella pneumoniae emerged among most often isolated pathogens, many showing resistance to several classes of antibiotics. Samples included pus, urine, blood sputum, tissue, and body fluids. Pathogens were identified using colonial morphology, Gram staining, and biochemical tests. Kirby-Bauer disc diffusion assay and Micro broth dilution methods were used for antibiotic susceptibility testing. Antibiotics that were tested include penicillin, cephalosporins, carbapenems, macrolides, fluoroquinolones, aminoglycosides, glycopeptides, polymyxins, and more.

The study found high resistance rates among pathogens, emphasizing the urgent need for antimicrobial stewardship programs and better prescribing practices in Pakistan. The results highlight restricted treatment options due to the emergence of MDR bacteria, calling for stronger surveillance, improved diagnostic testing, and WHO-complaint prescribing guidelines. AMR surveillance in Pakistan is inconsistent, leading to inadequate data on resistance trends. There is a need for structured programs to guide appropriate antibiotic use, reducing resistance. Many hospitals don’t routinely perform tests leading to widespread empirical antibiotic use. Limited financial and

personal resources impede the implementation of national AMR action curb rising resistance. (Saleem et al., 2023).

A study provides a narrative review of the country's National narrative review of the country's National Action plan NAP for AMR which was launched in 2017 by Minister of National Health Services. It analyzes Pakistan official NAP for AMR released by Ministry of National health Services in 2017. The study reviews antimicrobial resistance trends in Pakistan using data from healthcare institution and laboratories to track resistance patterns. Interviews and surveys with healthcare professionals, policymakers, and researchers provide qualitative insights into the challenges of implementing the NAP. It also examines official reports and government documents to assess the effectiveness of AMR-related policies and interventions. The study found major obstacles in executing Pakistan's National Action Plan NAP for AMR including inadequate diagnostic facilities, financial constraints and the widespread misuse of antibiotics in human and animal health. Healthcare professionals' policy makers and research express concerns about the slow progress in AMR containment. The lack of coordination between sectors insufficient public awareness are significant barriers. The findings suggest that Pakistan's healthcare system requires cohesive strengthen to effectively implement the NAP this includes better enforcement of policies, investment in research and enhanced infection prevention and control measures (Saleem et al., 2022).

A narrative review and the implication, explores Pakistan's efforts to tackle the growing threat of antimicrobial resistance. This study provides a narrative review of Pakistan's National Action Plan (NAP on antimicrobial resistance (AMR), analyzing its implementation and effectiveness. The study examines the five core components of NAP which are awareness surveillance, infection prevention and control, rational amicrobial use and investment research. The implementation NAP on Antimicrobial Resistance faces serval significant challenges. Many healthcare professionals lack sufficient knowledge about AMR and resistance patterns, leading to inappropriate antibiotic use. Pakistan's AMR surveillance efforts remain weak, with inconsistent data collection and limited laboratory capacity to track resistance trends. Over the counter antibiotic sales without prescriptions excessive use of antimicrobials in agriculture and veterinary sector exacerbate resistance. Limited funding and weak healthcare infrastructure hinder the effective implementation of AMR policies and stewardship programs. The disconnect between policy makers, healthcare providers, and the pharmaceutical industry slows down progress in AMR containment. The study emphasizes

the need for stronger antimicrobial stewardship programs, improved surveillance systems, and better policy enforcement to effective combat AMR in Pakistan. Effective coordination among healthcare professionals, policymakers and researchers is crucial for successful execution of the NAP. (Saleem et al., 2023).

Another study explores the links between antibiotic susceptibility, prescribing guidelines, access to medicine, and clinical outcomes. The study reviews resistance patterns in Streptococcus pneumoniae and Hemophilus influenzae, two major pathogens responsible for CA-RTIs. It compares local and international antibiotic prescribing guidelines used by healthcare professionals in Pakistan. The study highlights issues with antibiotic availability and over-the-counter sales, despite existing regulations. It identifies a lack of standardized AMR surveillance in Pakistan, which affects clinical decision-making. The researchers reviewed national and international antibiotic prescribing guidelines for community-acquired respiratory tract infections (CA-RTIs), including community-acquired pneumonia (CAP), acute otitis media (AOM), and acute bacterial rhinosinusitis (ABRS). To contextualize the findings, the study incorporated expert opinions from a local clinician and a clinical microbiologist, providing firsthand perspectives on AMR trends and challenges in Pakistan. The study examined local and global AMR surveillance reports, including data from SOAR (Survey of Antibiotic Resistance), ATLAS (Antimicrobial Testing Leadership and Surveillance), and GLASS (Global Antimicrobial Resistance and Use Surveillance System). the study found that Pakistan ranks among the top five countries with the highest neonatal deaths caused by resistant bacteria. The country is the third-highest antibiotic consumer among low- and middle-income countries, with a 65% increase in antibiotic use between 2000 and 2015. Despite legislation prohibiting the sale of antibiotics without a prescription, self-medication and unregulated antibiotic use remain widespread, contributing to resistance. While Pakistan has developed a National Action Plan (NAP) for AMR, surveillance of locally prevalent microorganisms is lacking, making it difficult to track resistance trends effectively. The study highlights decreasing susceptibility of Streptococcus pneumoniae and Hemophilus influenzae to commonly used antibiotics, raising concerns about treatment effectiveness. Healthcare professionals rely on both local and international prescribing guidelines, but the study suggests that standardized local guidelines based on up-to-date surveillance data would improve antibiotic prescribing practices. The study urges better enforcement of antibiotic regulations, improved surveillance, and enhanced infection prevention measures to curb AMR in Pakistan. (Torumkuney et al., 2022).

A study examines the excessive use of antibiotics in paediatric COVID-19 cases in Pakistan, highlighting concerns about antimicrobial resistance. Key aspects of the study include data collection from four referral/tertiary care hospitals in Pakistan, focusing on the clinical manifestations, laboratory findings, bacterial co-infections, and antibiotic prescribing patterns among neonates and children. The study aims to guide future strategies for reducing unnecessary antibiotic use. The findings indicate that 85.9 percent of admitted children tested positive for COVID-19. Only 3.7 percent confirmed bacterial co-infections, yet 85.5 percent were prescribed antibiotics. Among these, 54.3 percent received two antibiotics, and 20.8 percent received three or more. Most of the prescribed antibiotics, about 80.4 percent, belonged to the WHO "Watch" category, which has a higher resistance potential. Increased antibiotic prescribing was linked to ICU admissions, mechanical ventilation, and elevated inflammatory markers. The study concludes that excessive antibiotic use, despite the low bacterial infection rates, raises concerns about antimicrobial resistance and the need for antimicrobial stewardship programs to reduce unnecessary antibiotic prescriptions in paediatric COVID-19 cases. The study provides critical evidence on antibiotic overprescribing in paediatric COVID-19 cases, reinforcing the urgent need for antimicrobial stewardship in Pakistan. While it has some limitations, its findings are highly relevant for public health policy and clinical practice. Future studies should explore long-term AMR consequences and assess the effectiveness of intervention strategies. (Mustafa et al., 2023).

A study conducted on covid-19 patients examines the prevalence of bacterial co-infections and antibiotic resistance. Conducted at a tertiary care hospital in Lahore, Pakistan, it specifically focuses on patients requiring oxygen support or ventilation. The study collected 1251 clinical samples from COVID-19 patients, of which 234 tested positives for bacterial infections. The most isolated bacteria were Escherichia coli and Acinetobacter baumannii. E. coli showed the highest resistance to amoxicillin and ampicillin, while A. baumannii was highly resistant to tetracycline. Other resistant pathogens included methicillin-resistant Staphylococcus aureus, carbapenem-resistant Enterobacteriaceae, and vancomycin-resistant Enterococcus. The findings suggest that empiric antimicrobial treatment may be necessary for critically ill COVID-19 patients, but only if it is properly managed within institutional or national antibiotic stewardship programs. This approach is important to mitigate antimicrobial resistance, particularly in hospitalized patients with prior admissions. Findings from the study indicate that 1251 clinical samples were collected from

COVID-19 patients, with 234 samples testing positive for bacterial infections. The most commonly isolated bacteria were Escherichia coli and Acinetobacter baumannii. Escherichia coli exhibited high resistance to amoxicillin and ampicillin, while Acinetobacter baumannii was highly resistant to tetracycline. The prevalence of methicillin-resistant Staphylococcus aureus was recorded at 14.9 percent, carbapenem-resistant Enterobacteriaceae at 4.5 percent, and vancomycin-resistant Enterococcus at 3.96 percent. The study suggests that empirical antimicrobial treatment may be necessary for critically ill COVID-19 patients but should be managed within institutional or national antibiotic stewardship programs to mitigate antibiotic resistance risks. It emphasizes the importance of improved infection control measures in healthcare settings to reduce the spread of resistant bacterial strains. The study focuses on a single tertiary care hospital in Lahore, which may not fully represent bacterial co-infection trends across Pakistan. Including hospitals from different regions could enhance the generalizability of findings. No assessment of long-term antimicrobial resistance impact While the study discusses antibiotic resistance patterns, it does not track resistance trends over time. A follow-up study examining antimicrobial resistance in recovered COVID-19 patients would strengthen its conclusions (Rizvi et al., 2022).

2.2. Socio-Economic Determents of Antibiotic Use

Idrees, S., & Bakar, N. A. (2018) in their study argue that robust education and health systems are crucial for economic growth, poverty reduction, and enhanced quality of life. Despite some economic growth, Pakistan continues to face Low literacy rates, especially among women. Poor quality of education due to undertrained teachers and insufficient infrastructure. Inadequate healthcare access, especially in rural areas. High infant and maternal mortality rates. Public investment in these sectors is among the lowest in the region, at only around 2.5% of GDP, while other developing countries invest much more. The private sector is filling some gaps, but not everyone can afford to do so. The study uses a descriptive and analytical methodology to explore challenges in the education and health sectors. It doesn't conduct primary surveys or statistical modelling—instead, it relies heavily on secondary data from trusted national sources. The study doesn't use regression models or econometrics. Instead, it's structured around critical evaluation of government reports and statistics**,** interpreting how low investment translates into underperformance. National literacy rate stands around 60%, with a significant 21% gap between male (70%) and female (49%) literacy. Gross Enrolment Rates (GER) drop sharply after the primary level—many children don’t

continue to middle or high school. A major hurdle is poorly trained and underqualified teachers**,** especially in rural areas. Refresher training is inconsistent, and many teachers never receive it. Education costs are rising 10% annually**,** while family incomes aren't keeping pace, leading to dropouts from private schools. Private schools are largely urban-centric, limiting rural access to quality education.

The country has one doctor for every 1,038 people, one hospital bed per 1,613 individuals, and one dentist per 11,513—figures that reflect severe shortages across healthcare resources. Infant mortality is alarmingly high at about 88.1 deaths per 1,000 live births, and under-five mortality rates have only shown marginal improvement since 2000. Despite population growth, public healthcare infrastructure has not expanded at a comparable rate. Roughly 70% of the population depends on private healthcare due to poor public service quality, yet many cannot afford this option. Rural communities are particularly disadvantaged, with basic health units often more than 15 kilometres away, some even beyond 26 km. Sanitation and clean water are also major concerns: only 20% of urban residents and 1.5% of rural dwellers treat their drinking water, and 21% of the population lacks toilet access altogether. In maternal care, fewer than half of deliveries are attended by skilled personnel, and rural areas suffer from a severe shortage of female doctors, especially gynaecologists. Altogether, these indicators reveal a troubling reality: Pakistan's healthcare system is strained, unevenly accessible, and in urgent need of better funding and targeted reforms to meet even basic public health needs (Idrees & Bakar, 2018).

Another study explores the factors influencing healthcare-seeking behavior among rural women in the region. The study highlights that rural women in Khyber Pakhtunkhwa face significant barriers to accessing healthcare due to social, cultural, and economic factors. Addressing these challenges requires long-term planning and policy interventions to improve healthcare accessibility and awareness. Many rural women depend on their spouses for financial support, affecting their ability to seek healthcare. High healthcare costs and transportation challenges further limit access to medical services. Low literacy rates among rural women contribute to poor healthcare-seeking behavior. Educated women are more likely to seek timely and quality healthcare services. Unequal gender relations within societal institutions (family, education, politics, and economics) affect healthcare access. Social norms often prioritize men's healthcare needs over women's, leading to disparities in health outcomes. Gender plays a crucial role in healthcare-seeking behavior,

particularly in traditional societies. Women in developing countries, including Pakistan, face sociocultural and socio-economic barriers that limit their access to healthcare. A significant portion of rural women did not seek immediate healthcare despite encountering illnesses. **73**% sought healthcare**,** while 27% did not**.** Among those who sought healthcare, 65% sought immediate care**,** while 35% delayed treatment**.** 52% received formal healthcare**,** while 48% relied on informal healthcare sources**.** (Naz et al., 2023).

2.2.1. Healthcare Access and Service Utilization

Healthcare infrastructure plays a crucial role in shaping healthcare behavior among rural women. Limited access to healthcare resources, geographic isolation, and cultural barriers significantly impact healthcare utilization (Etobe et al., 2024). In Bangladesh, intersecting factors like gender, ethnicity, and socio-economic status influence health-seeking behavior among rural ethnic women(Nawaz & Bushra, 2023). A study in North India found that 79% of rural residents used formal healthcare, with a preference for private facilities due to perceived higher quality and proximity (Yadav et al., 2022). However, in rural Telangana, only 34.5% of women sought medical care promptly when symptoms appeared, highlighting the need for increased awareness about healthcare importance and available facilities (Reddy et al., 2020). Factors such as education level, socio-economic status, and gender roles significantly affect healthcare utilization among rural women (Etobe et al., 2024; Yadav et al., 2022).

2.3. Stakeholder Dynamics in AMR Control

Antimicrobial resistance (AMR) necessitates coordinated multi-stakeholder strategies owing to its intricate, interrelated characteristics spanning healthcare, veterinary, and regulatory sectors. Systems thinking uncovers many feedback loops across AMR factors that transcend clinical environments (Pham et al., 2024). Efficient antimicrobial resistance (AMR) management necessitates the formation of interdisciplinary coalitions that include government entities, academic institutions, and faith-based organizations, as evidenced by successful five-step coalition-building methodologies implemented in Zambia, Ethiopia, and Namibia (Joshi et al., 2018). Stakeholder mapping tools such as Net-Map facilitate the identification and prioritization of principal actors according to their power, interest, and influence, exemplified in the regulation of over-the-counter antibiotic sales in India, where 25 stakeholders from government, private, and academic sectors were

identified (Kotwani & Joshi, 2021). In veterinary contexts, supply chain analysis uncovers intricate formal and informal interactions across 23 stakeholders, underscoring the necessity for dialogue between the public and commercial sectors and a joint comprehension of AMR challenges to effectively enforce new legislation (Poupaud et al., 2021)

2.3.1. Role of Human and Veterinary Doctors

This study examines healthcare access and utilization among rural populations in North India, particularly in Gorakhpur. The study highlights disparities in healthcare access between urban and rural areas in India. Rural populations often face challenges such as limited healthcare facilities, financial constraints, and lack of awareness. Objective of this study is to analyse the health-seeking behavior of individuals in rural North India. To identify factors influencing the use of formal healthcare services. Data collected through structured questionnaires covering demographics, health-seeking behavior, and healthcare utilization. Statistical analysis used to determine factors affecting healthcare access. Study found that 16% of surveyed individuals reported health issues in the last 15 days. 90% sought healthcare, with 79% opting for formal healthcare services**.** 63% preferred private healthcare, while 37% used public health facilities**.** Women, educated individuals, and those from wealthier backgrounds were more likely to seek formal healthcare. Respiratory, gastrointestinal, and musculoskeletal issues were associated with lower formal healthcare utilization. The study underscores the importance of improving healthcare accessibility in rural areas**.** Private healthcare is preferred due to perceived better quality and availability. Targeted interventions are needed to enhance public healthcare infrastructure and awareness. (Yadav et al., 2022).

2.3.2. Government And Policy Implementation Gaps

Pakistan encounters considerable implementation deficiencies in combating antimicrobial resistance (AMR) despite possessing a National Action Plan. Five years post-implementation, significant actions are still inadequate due to limited awareness among healthcare personnel, inadequate surveillance, and ineffective infection prevention methods. The pharmaceutical sector prioritizes branded generics above the development of novel antibiotics (Saleem, 2025). Policy implementation encounters significant obstacles, as there is considerable support just for regulating less powerful entities, such as unqualified healthcare providers, but imposing little limitations on more prominent groups, such physicians and pharmaceutical firms. A disparity arises between global

AMR strategies and local political-economic situations. Discrepancies between Pakistani and external agency documentation may hinder cohesive policy formulation. Hospital-level antimicrobial stewardship programs encounter obstacles such as inadequate administrative backing, restricted health insurance reimbursement for bacterial cultures, and a deficiency of qualified personnel(khan et al., 2019).

2.4. Policy Framework and Global Best Practices

Antimicrobial resistance (AMR) surveillance in low-resource settings faces significant challenges, including inconsistent data collection and limited access to quality bacteriology (Ronat et al., 2021)To address these gaps, Médecins Sans Frontières developed the Mini-Lab, a portable, self-contained clinical bacteriology laboratory that can be operated by inexperienced technicians in remote areas (Natale et al., 2020). This initiative demonstrates the potential for non-governmental organizations to contribute to AMR control and data collection in underserved regions. Emerging technologies, such as point-of-care testing and next-generation sequencing, offer promising solutions for improving AMR surveillance in low-income settings (Okeke et al., 2020). To support global efforts, the World Health Organization developed the Global AMR Surveillance System (GLASS), and guidelines have been created to help low-income countries implement core protocols that ensure valid and comparable data collection(Seale et al., 2017). These efforts aim to provide crucial health intelligence for evidence-based interventions at local, national, and international levels.

The paper addresses the critical issue of antimicrobial resistance (AMR) in low-and middle-income countries (LMICs), highlighting the challenges in data collection and the role of non-governmental organizations (NGOs) in combating AMR. The authors emphasize that obtaining reliable AMR data in LMICs is extremely difficult due to inconsistent data collection practices. They note that existing data often lack standardization and are not representative, leading to systematic inaccuracies and underreporting. This inconsistency is compounded by a lack of infrastructure, skilled personnel, and adequate laboratory facilities, which are essential for quality assurance in AMR surveillance. The paper discusses the significant role that NGOs, such as Médecins Sans Frontières (MSF), can play in addressing these challenges. NGOs often operate in parallel to public medical systems and can contribute to AMR data collection in areas where reporting is scarce. The authors argue that NGOs are responsible for a substantial amount of healthcare provision in low-

resource contexts, thus positioning them as key players in AMR control efforts. The central focus of the paper is the Mini-Lab project developed by MSF, which aims to provide simplified bacteriological diagnosis and AMR surveillance in challenging settings. The Mini-Lab is designed to be a turnkey solution that allows end-users to operate autonomously, supported by detailed guidance documents and a future Laboratory Information Management System (Mini-LIMS) that will enhance data management and result validation. The implementation of the Mini-Lab in Haiti is highlighted as a case study, showcasing its potential to improve AMR data collection and surveillance. The authors conclude that effective surveillance systems are crucial for understanding the global AMR problem and for adapting therapeutic guidelines. They stress the need for comprehensive AMR surveillance networks that extend to primary care and utilize all existing data sources, which is currently lacking in most LMICs. (Ronat et al., 2021).

Antimicrobial stewardship programs (ASPs) in hospitals aim to optimize antimicrobial use, improve patient outcomes, reduce costs, and combat antimicrobial resistance (Drew, 2009; Mendelson et al., 2020). Implementing an ASP requires a multidisciplinary approach, typically led by an infectious diseases physician and a clinical pharmacist (Drew, 2009). Key strategies include formulary restriction, prospective audit with feedback, education, and guidelines (Drew, 2009; MacDougall & Polk, 2005). Starting small, such as focusing on surgical prophylaxis, can pave the way for more complex interventions (Varma et al., 2023). Regular monitoring through point prevalence surveys and well-defined metrics is crucial for assessing program success (Varma et al., 2023). Hospitals should tailor their ASP strategies to their specific needs and available resources (MacDougall & Polk, 2005). Despite challenges like obtaining administrative support and physician acceptance, ASPs have been shown to significantly reduce antimicrobial resistance, particularly when coupled with infection prevention and control measures (Drew, 2009; Mendelson et al., 2020).

This study is centered on addressing the global threat of antimicrobial resistance (AMR) and the importance of coordinated cross-sector efforts to manage it. Rather than presenting new experimental data, the authors provide a comprehensive overview of policies, strategies, and global initiatives focused on improving how antimicrobials are used, particularly in food systems. It explains how AMR is a natural phenomenon but is being dangerously accelerated by excessive and inappropriate use of antibiotics in humans, animals, and agriculture. Antimicrobial test the idea of

"antimicrobial stewardship," which means using antibiotics responsibly to ensure their effectiveness for future generations. It emphasizes that antibiotics are a shared global resource, requiring collective action to preserve them, treating them as "common goods." The study highlights the efforts of the Food and Agriculture Organization (FAO), particularly its initiatives and policies aimed at reducing AMR risk in global food production systems. It calls for international collaboration, improved awareness, and practical implementation of standards to contain AMR. So, in a nutshell, it's a global call-to-action for smarter antimicrobial use—not just in healthcare, but in farming, food safety, and environmental policy too. Study uses a qualitative, narrative review approach. Rather than conducting new experiments or collecting fresh data, the authors examine and synthesize information from existing policies, programs, and global initiatives related to antimicrobial resistance (AMR) and stewardship. The paper summarizes global trends in AMR and antimicrobial use across human, animal, and plant health. It draws on existing international frameworks, including those developed by the Food and Agriculture Organization (FAO), to highlight best practices and areas for improvement. Multiple authors from different fields contribute to the discussion, bringing in cross-sectoral expertise rather than structured data analysis. There's no experimental design, sampling, or statistical analysis, which confirms it's a policy-oriented, descriptive study. This type of narrative or opinion-driven methodology is common in global health policy papers where the aim is to guide implementation, build awareness, and encourage collaboration rather than test a specific hypothesis. The authors synthesize key observations from global efforts to combat antimicrobial resistance (AMR), particularly in the food and agriculture sectors. Key points include AMR levels are alarmingly high and rising, largely due to overuse and misuse of antimicrobials across human, animal, and plant health. The study describes international efforts, especially those led by the Food and Agriculture Organization (FAO)—to promote responsible antimicrobial use. It highlights gaps in national policies, uneven regulatory frameworks, and the challenge of implementing stewardship in low- and middle-income countries. Emphasis is placed on multisectoral cooperation, awareness campaigns, and capacity building as essential components of sustainable stewardship. AMR cannot be eliminated because it is a natural biological process—but its acceleration due to human activity is preventable and manageable. Stewardship is framed as a shared responsibility: antimicrobials are common goods that require collective protection. The role of global actors like the FAO is crucial, especially in driving food-system-level changes and

leading international campaigns. The authors advocate for a shift in global mindset and behavior toward long-term preservation of antimicrobial effectiveness. (Inoue, 2019)

2.4.1. WHO Global Action Plan on AMR

The WHO Global Action Plan on Antimicrobial Resistance (AMR), ratified in 2015, mandates member states to prepare National Action Plans (NAPs) within a two-year timeframe (Ohmagari, 2019). An examination of 78 National Action Plans (NAPs) indicates considerable discrepancies in substance and alignment with the five objectives of the Global Action Plan, with high-income nations demonstrating more advancement, whilst low- and middle-income countries have resource limitations (Willemsen et al., 2022).There is robust vertical alignment between National Action Plans and the Global Action Plan, especially in lower-income nations; but, horizontal alignment within regions is deficient (Munkholm & Rubin, 2020). Although vaccination is emphasized as a crucial intervention for antimicrobial resistance (AMR), merely 87% of the analyzed National Action Plans (NAPs) incorporated vaccination methods, revealing deficiencies in implementation planning and monitoring elements (Van Heuvel et al., 2022). The analysis indicates fragmented procedures and restricted global information acquisition, demonstrating "isomorphic mimicry," wherein policy alignment occurs without adequate implementation (Munkholm & Rubin, 2020; Willemsen et al., 2022)

2.4.2. One Health Approach to AMR

Antimicrobial resistance (AMR) is a growing global health concern, affecting human, animal and environmental health. The OneHealth approach recognizes the interconnected nature of these sectors and aims to develop integrated strategies to combat AMR. In Malaysia, AMR has been exacerbated by widespread antibiotic use in healthcare, agriculture, and animal husbandry, leading to emergence of resistant bacterial strains. (Mariappan et al., 2021).

This study examines how One Health strategies contribute to AMR mitigation in Malysia, emphasizing the need for cross-sector collaboration to address surveillance gaps and improve antimicrobial. The study gathers and analyses published research on antimicrobial resistance within the OneHealth framework focusing on Malaysia. It examines AMR across human, animal, and environmental health, highlighting how antibiotic use in different sectors contributes to resistance. The study evaluates existing AMR policies, antibiotic stewardship programs, and surveillance system

in Malaysia. The study found that AMR spread across human, animal, and environmental sector, making it a complex issue requiring integrated solutions. Excessive antibiotics use in healthcare, animal husbandry, and agriculture contributes to resistance development. There is limited research assessing AMR coexistence across different sectors, particularly in lower- and middle-income countries like Malaysia. Human activities, social norms, economic, conditions, and peer pressure influence antibiotic use and resistance patterns. The study calls for cross-sector collaboration between healthcare, veterinary, and environmental sectors to curb AMR. While stewardship policies exist in high income countries, they remain underexplored in Malaysia. AMR spreads through wastewater irrigation and improper disposal of human and agricultural waste, further complicating containment efforts. The study urges stronger surveillance system, better antimicrobial guideline, and improved public awareness to mitigate AMR risks in Malaysia. (Mariappan et al., 2021)

This study explores how antimicrobial resistance (AMR) in agriculture isn't just a localized food safety problem, it's **a** global One Health crisis with wide-ranging consequences for public health, food security, animal welfare, environmental sustainability, and socio-economic development. It examines how the overuse of antibiotics in food production—such as in livestock, aquaculture, and crop farming—has led to the rise of drug-resistant bacteria. These resistant bacteria and genes can spread along the farm-to-plate continuum: from animals and soil to food products, and eventually to humans through direct contact or consumption. This poses health risks to farmers, food handlers, consumers, and even healthcare systems worldwide. The study argues that AMR in the food chain is a multisectoral and cross-border challenge, fueled by gaps in hygiene, poor waste management, lack of regulation, and excessive antibiotic use. It also warns that foodborne illnesses caused by resistant pathogens threaten to derail progress toward multiple Sustainable Development Goals (SDGs) not just those related to health and hunger, but also poverty reduction, climate action, and economic growth.(Founou et al., 2021)

Study adopts a perspective-based, narrative review methodology. Rather than presenting new experimental data, it synthesizes existing research and global evidence to argue that antimicrobial resistance (AMR) across the food production chain—spanning agriculture, animal husbandry, aquaculture, and food handling, is more than a localized food safety issue; it's a multidimensional global threat. The authors draw on studies from the World Health Organization (WHO), Food and Agriculture Organization (FAO), World Organization for Animal Health (OIE), and various

international public health and development agencies. They weave together findings related to foodborne illness, resistant pathogens in livestock, antibiotic use in farming, and environmental contamination. The approach is multidisciplinary and rooted in the One Health framework, which emphasizes the interconnectedness of human, animal, and environmental health. Instead of empirical field data, the study relies on published literature, systematic reviews, global surveillance reports, and case examples to explore how AMR in the farm-to-plate continuum affects sustainable development goals, food security, climate change, and economic resilience (Founou et al., 2021).

The narrative structure allows the authors to advocate for integrated, multisectoral interventions while urging global action to safeguard both public and planetary health. AMR is spreading across the farm-to-plate continuum**,** from animal farming and aquaculture to food processing and human consumption. This transmission occurs through direct contact (farmers, abattoir workers, food handlers) and indirect contact (consumption of contaminated food or exposure to polluted environments). Foodborne illnesses caused by antimicrobial-resistant pathogens, such as *Salmonella*, *E. coli*, and *Campylobacter*, are increasing. These diseases disproportionately affect vulnerable populations—infants, the elderly, and immunocompromised individuals—and contribute to significant global morbidity and mortality. Developing countries face the greatest burden, due to inadequate infrastructure, poor sanitation, lack of food safety regulations, and widespread use of antimicrobials in livestock without veterinary oversight. For example, in Southeast Asia and sub-Saharan Africa, hundreds of thousands of children under five died annually due to foodborne diarrheal diseases. AMR undermines food security and animal health, as outbreaks of resistant infections in livestock reduce productivity, increase food costs, and require the culling of herds or flocks. This is especially concerning in low- and middle-income countries already grappling with hunger and malnutrition.

In summary, the study stresses that AMR in the food system is not just about what's on our plate—it's a global One Health issue that requires coordinated international action, sustainable agricultural practices, stronger regulation of antimicrobial use, improved hygiene and food safety standards, and comprehensive public health policy reform. (Founou et al., 2021).

2.4.3. International Examples of Successful AMR Policy Implementation

The study argues that although many countries have developed national action plans (NAPs) to combat AMR, the real challenge lies in implementing these plans effectively and sustainably. Resource limitations, weak coordination, and interventions that aren't tailored to local contexts are major obstacles, particularly in LMICs. To bridge this gap, the researchers propose using implementation research as a practical strategy to adapt and scale AMR solutions according to regional needs. The study outlines a three-phase continuum for this approach: first, proving the concept of an intervention in a controlled setting; second, testing its effectiveness in real-world context**s**; and finally, informing sustainable scale-up. The study includes real-world examples across human, animal, and environmental health, such as improving antibiotic prescribing in Kyrgyzstan, reducing post-weaning diarrhea in pigs in Colombia, and managing poultry manure in Tanzania to prevent environmental AMR spread. This work blends public health science with hands-on strategy, emphasizing that successful AMR mitigation requires not only evidence-based interventions but also deep engagement with local systems, cultures, and stakeholders.

Study uses implementation research (IR) methodology tailored to address the challenges of applying AMR mitigation strategies in real-world settings, especially in low- and middle-income countries. Rather than focusing on controlled laboratory experiments or clinical trials alone, the study emphasizes a three-phase continuum: proving the concept of an intervention, testing its effectiveness in everyday practice, and informing scale-up for long-term sustainability. It integrates both qualitative and quantitative approaches, including observational studies, randomized controlled trials, pragmatic or hybrid trials, participatory action research, and mixed-methods analysis. These methods help examine how AMR interventions work in diverse settings, taking into account real-world complexities like political context, resource availability, infrastructure, and stakeholder engagement.

Importantly, the study doesn't evaluate a single intervention—it showcases a variety of case studies across human, animal, and environmental health sectors. For example, it includes projects focused on appropriate antibiotic use in children in Kyrgyzstan, vaccination strategies in Colombian pig farming, and manure treatment in Tanzanian poultry systems. By embedding this research into actual policy and implementation environments, the study aims to bridge the gap between knowing

what works and actually making it work sustainably on the ground. Findings of this study are more strategic and illustrative rather than numerical or clinical. Instead of reporting one set of results from a single trial, it draws lessons from multiple implementation projects tackling AMR across human, animal, and environmental health sectors. Inappropriate antibiotic use in children with respiratory infections was significantly reduced by using C-reactive protein (CRP) point-of-care tests. Implementation outcomes showed the intervention was acceptable, cost-effective, and feasible for scale-up in primary health care. Improved prescriber knowledge and diagnostic confidence were key positive effects. Projects in pig farming demonstrated that vaccination and improved colostrum feeding effectively reduced post-weaning diarrhea, minimizing the need for routine antibiotic use. The approach was economically viable and led to behavior changes among farmers and veterinarians. By introducing composting techniques for poultry manure, the project reduced environmental contamination with antibiotic residues and resistant pathogens. Farmers and regulators found the composting solution acceptable and were willing to adopt it, especially after capacity-building and cost-benefit modeling. Demand for processed manure increased, pointing to potential for entrepreneurship and sustainable environmental practice. In essence, the study shows that context-driven, participatory implementation of AMR solutions across different sectors can not only improve outcomes but also enhance sustainability, policy adoption, and health system resilience. (Khurana et al., 2023)

This study examines how the world can enhance the responsible use of antimicrobials—particularly in agrifood systems—to combat the growing threat of antimicrobial resistance (AMR). It is authored by experts from the Food and Agriculture Organization (FAO) of the United Nations. It highlights both the barriers and solutions to implementing antimicrobial stewardship (AMS) across human, animal, and plant health sectors.

The study emphasizes that AMR is not confined to hospitals or people—it also arises in animals, crops, and the environment due to the widespread use of antimicrobials. Resistance genes can pass between bacteria in humans, animals, and the environment, which means misuse anywhere can become a problem everywhere. Despite global agreements and action plans, actual on-the-ground implementation of AMR stewardship is inconsistent, especially in low- and middle-income countries.

To address this, the FAO proposes a structured global framework based on four pillars: awareness, governance, best practices, and surveillance. The study outlines real-world FAO initiatives like the InFARM data platform, the Farmer Field School programs, and Codex AMR standards—all aimed at helping countries develop locally adapted stewardship strategies. It stresses the importance of cross-sector cooperation, context-specific solutions, and behavior change to move from talk to action.

Study follows narrative and descriptive methodology, grounded in real-world policy analysis and global case examples. Rather than conducting experimental research or collecting primary data, the authors—working under the FAO of the United Nations—review global initiatives, institutional strategies, and implementation efforts related to antimicrobial stewardship (AMS), especially in agrifood systems. The paper draws heavily on qualitative analysis of FAO-led programs, global policy frameworks, country-level action plans, and governance mechanisms. It is structured around four pillars that form the foundation of the FAO's approach to AMS: awareness, governance, good practices, and surveillance. Through these, the study offers a broad synthesis of successes, barriers, and opportunities in applying AMS worldwide. This includes descriptions of efforts like the In-FARM surveillance platform, Codex Alimentarius AMR standards, Farmer Field Schools, and legislative reforms guided by the FAO's AMRLEX and One Health frameworks.

This approach is best suited for highlighting policy lessons, identifying global gaps, and proposing adaptable stewardship strategies across human, animal, and environmental sectors. It does not involve statistical modelling or quantitative trials but relies on thematic integration of existing initiatives and lessons learned from FAO field experience. The conclusion strikes a thoughtful balance between realism and urgency. It acknowledges that antimicrobial resistance (AMR) is a natural, ongoing phenomenon, something we can't eliminate—but underscores that its dangerous acceleration is driven by human behavior. Food and Agriculture Organization (FAO) as a global leader on this front makes a lot of sense. It expands the conversation beyond healthcare to include agriculture, trade, and food security—which is exactly the kind of big-picture thinking a global issue like AMR needs. (Pinto Ferreira et al., 2022).

2.6. Research Gaps and Future Directions

Even though the literature on antimicrobial resistance (AMR) is expanding, there are still a number of unanswered questions, especially when considering low- and middle-income nations like Pakistan. These deficiencies are noted in this section along with possible future study directions. Although the cross-sectoral aspect of AMR is acknowledged in many studies, little is known about integrated surveillance systems that link Pakistan's environmental, animal, and human health sectors (Bengtsson-Palme et al., 2023; Founou et al., 2021; Mariappan et al., 2021) Future research should create scalable models for integrated AMR surveillance in the fields of environmental, animal, and human health (Mariappan et al., 2021; Matthiessen et al., 2022).

Few studies look at the socio-economic factors that contribute to irrational antibiotic use, such as poverty, informal care practices, and cultural norms, despite the fact that the biological elements of AMR are well-established (U. Ahmed & Abbas, 2022; Alam et al., 2023; Borghi & Brown, 2022). Understanding the behavioral dynamics of antibiotic usage should be the main goal of research, taking into account local government structures, provider incentives, and community knowledge (Borghi & Brown, 2022; Inoue, 2019). In Pakistan, the majority of AMR research is still concentrated on human health, with little consideration given to veterinary care or environmental factors such pharmaceutical waste (Alam et al., 2023; Bengtsson-Palme et al., 2023; Ghafoor et al., 2022). Focused studies on the use of antibiotics in cattle, waste management procedures, and environmental transmission channels are required (Bengtsson-Palme et al., 2023; Founou et al., 2021)

Even though ASPs have been tested in a number of nations, there are still few assessments of these initiatives in Pakistan, particularly in basic care and public hospitals (Abdullah et al., 2014; Mendelson et al., 2020). The viability and effects of ASPs in Pakistani urban and rural healthcare settings require further research (Mendelson et al., 2020). There aren't many empirical studies that look at the difficulties of putting AMR-related policies into practice in environments with limited resources or that analyze decentralization, poor governance, and corruption as obstacles to enforcement (U. Ahmed & Abbas, 2022; Khurana et al., 2023). The political economics of AMR governance should be studied in implementation research, with an emphasis on resource allocation, accountability, and coordination systems (U. Ahmed & Abbas, 2022; Khurana et al., 2023).

3. Research Question and Objectives

3.1. Primary Research Question

How do socio-economic factors and stakeholder dynamics influence the implementation of policies aimed at reducing inappropriate antibiotic use in Punjab, Pakistan?

3.2. Study Aim

The aim of this study is to investigate the socio-economic determinants and stakeholder perspectives that shape antibiotic use and the implementation of antimicrobial resistance (AMR) policies in Punjab, with a view to identifying barriers and opportunities for more effective stewardship.

3.2. Specific Objectives

Socio-Economic Context: Investigate how socio-economic factors, including healthcare access, economic pressures, and rural-urban disparities, affect the use of antibiotics and acceptance of interventions to reduce misuse, from perspectives of healthcare professionals (human and veterinary doctors)

- To investigate the effects of rural-urban disparities, diagnostic affordability, and healthcare access on the prescription and use of antibiotics.
- To evaluate how much a patient's or client's financial situation influences the antibiotics that prescribers choose and leads to improper use.
- To evaluate the knowledge, attitudes, and training of medical personnel regarding antibiotic stewardship in light of socio-economic difficulties.

Stakeholder Dynamics: Explore the roles, influences, and perspectives of human and veterinary doctors in shaping and implementing AMR-related policies.

- To investigate how human and veterinary physicians shape and carry out AMR-related policies, as well as their roles, viewpoints, and influence.
- To investigate how interactions between stakeholders—pharmaceutical companies, legislators, chemists, and unlicensed practitioners—affect the use of antibiotics and the enforcement of policies.
- To determine the tactics and suggestions put forth by frontline experts to improve Punjab's implementation of the AMR policy.

4. Methods

In chapter 4 a detailed description of material and method is provided. Firstly, it focuses on study design and data collection procedures which also provide inclusion and exclusion criteria for participants, regarding the study followed by description of all variables included in analysis specifically how they were operationalized and assessed later. Finally, a detailed planned statistical analysis is explained to answer the thesis research questions.

4.1. Project Design

Mixed method approach was used to better understand the research question of this study. Quantitative method was used to access the first part of the study which tends to analysis the role of socio-economics on misuse of antibiotics. To understand stakeholder dynamics for the implementation of policies for the control of misuse of antibiotics qualitative method was used.

4.2. Study Area and Population

"This study was conducted in Punjab, the most populous province of Pakistan, chosen for its diverse health systems and significant socio-economic disparities." Furthermore, Punjab significantly contributes to the national AMR burden, representing nearly 88% of invasive pathogen isolations from 2011 to 2015, highlighting its critical role in comprehending the rising trends of antimicrobial resistance in both human and animal health sectors (Javaid et al., 2021)

Target population for this study were healthcare professionals (human and veterinary doctor) working in both private and public sector. This study included professionals from private and public hospitals, clinics, and veterinary hospital from both urban and rural areas of Pakistan.

Those doctors currently participating in Punjab were included in the study. Furthermore, those involved in prescribing antibiotics and having minimum experience of one year in practice were included in this study.

4.3. Sampling Strategy

A multistage sampling method was used in this study. First selection of districts was conducted based on appropriate urban and rural representation, then random sampling was conducted in health facilities within each district. Only those professionals were added to the study which were

available and willing to participate at the time of visit. Sample size of 273 questionnaires was used for quantitative analysis and 16 in depth interviews were conducted for qualitative analysis (stratified by profession, urban/ rural and public private). The sample size is considered sufficient to statistical validity for quantitative findings and thematic saturation for qualitative analysis.

4.4. Data Collection

4.4.1. Quantitative Data Collection

A structure questionnaire was developed to collect data on socio-economic and professional factors affecting antibiotic prescribing behavior. The questionnaire that was used included both Likert-scale questions as well as closed questions.

The structured questionnaire used in collection of data covered a series of areas, starting from information on demographics and professional background with focus on rural – urban disparities. The questions related to type and frequency of antibiotic prescribed. It also focuses on economic pressure in terms of antibiotic use and in that not ignoring patient expectation and communication. Access to diagnostics and continuing education was also considered. Last but not the least the questionnaire focused on knowledge and awareness about AMR policies and perceived barrier to policy implementation.

Questionnaire Development: Tool development is a foundational step in ensuring the research instrument is both valid and contextually appropriate. The validated AMR-related KAP (Knowledge, Attitude, Practices) questionnaires that have been used in similar research around the world was modified for this study. The process of adaptation was guaranteed that socio-economic factors unique to the healthcare context in Pakistan were included, especially in Punjab's rural and urban areas (Oppenheim, 2000).

To guarantee clarity, cultural relevance, and internal consistency, the instrument was pilot tested with a limited sample of veterinary and human physicians after adaption. The tool was improved based on pilot feedback prior to extensive data collecting. Improving the overall quality, accuracy, and reliability of the results depends on this stage.

4.4.2. Qualitative Data Collection

To gain a deeper understanding of stakeholder experiences, power dynamics, and institutional barriers in policy implementation, semi-structured interviews were conducted.

A purposively chosen sample of human and veterinary physicians employed in a range of healthcare settings in Punjab's rural and urban areas participated in semi-structured interviews as part of the study's qualitative component. The purpose of these interviews was to thoroughly examine the attitudes, experiences, and difficulties that medical professionals had when putting antimicrobial resistance (AMR) policies into practice. Their opinions on the efficacy of the regulations in place, the difficulties they face in following AMR guidelines, and their relationships with other stakeholders—such as legislators, pharmacists, and pharmaceutical representatives—were all covered. The interviews also explored the power and influence dynamics in the healthcare system, with a special emphasis on how pharmaceutical business and patient expectations affect the way antibiotics are prescribed.

Participants were invited to offer ideas for enhancing policy enforcement and antibiotic stewardship. Depending on participant option, each interview was done in either Urdu or English and was anticipated to last between twenty to thirty minutes. To guarantee reliable analysis, interviews were audio recorded, transcribed, and translated (if necessary) with the participants' permission. In addition to complementing the quantitative data, this qualitative method offered deep, contextual insights that revealed the complex, practical difficulties in preventing the region's inappropriate use of antibiotics.

4.4.3. Data Access

Primary data for the study came from veterinary and human doctors working in Punjab’s rural and urban districts. On-site visits to clinics and hospitals both public and private facilitated data collection. Where required verbal consent was obtained from management of hospitals and clinics. Prior to taking part in the questionnaire or interviews each participant gave their informed consent after being made aware of the study goals.

Reputable sources, including the world health organization (WHO), government of Pakistan’s National Action Plan and peer review journal articles accessible through scholarly databases like PubMed and google scholar, provided secondary data on AMR trends, national policy and international action plans.

Every piece of information gathered was safely kept in password protected digital folders. R-studio was used to enter and anonymize quantitative data for analysis. QCAmap software was used to

transcribe and analyze qualitative interview recordings. Only researchers had access to the raw data. To maintain confidentiality, no personal identifiers were incorporated into the final analysis.

4.5. Variables and Instruments.

In alignment with the study's objectives, the analysis was conducted using dependent and independent variables drawn from the questionnaire dataset. Summary of all variables used in the analysis is presented in table 1.

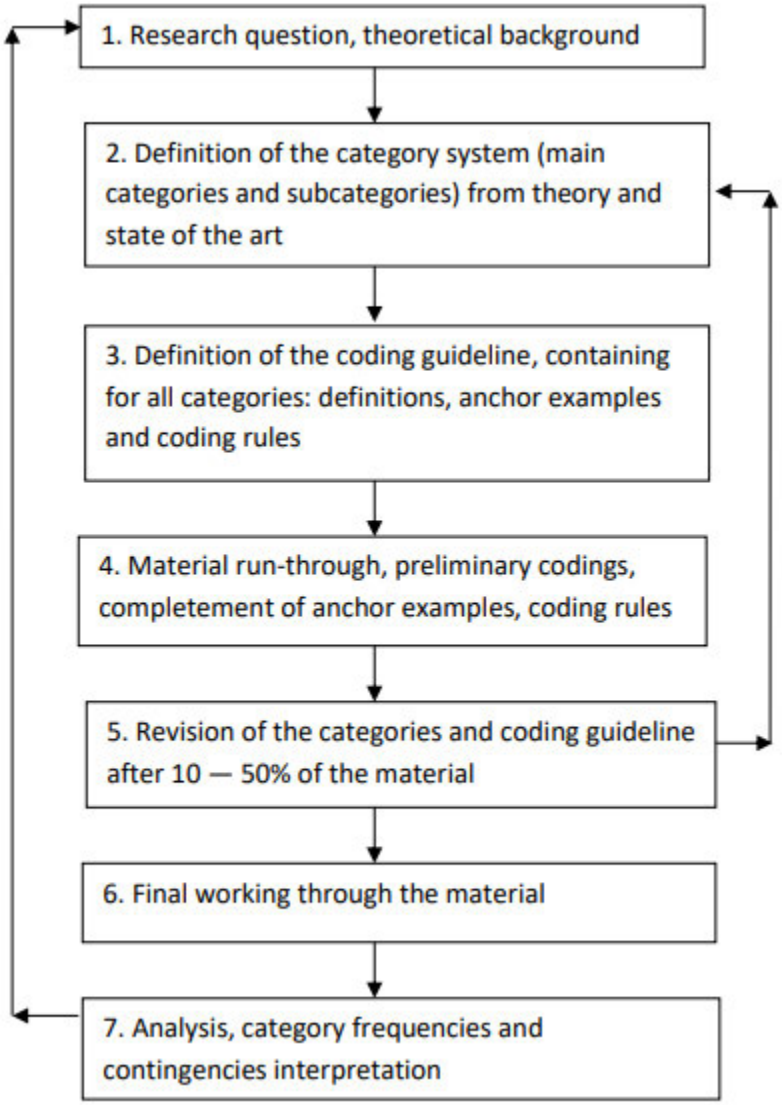

Figure 3. Process model for deductive category analysis QCAmap. *Source: (Mayring, 2014)*

4.5.1. Key Variables

Independent Variables were sociodemographic, professional and training related characteristics of both animal and human doctors, as well as selected contextual indicators. The variables that were included in the study were age recorded in categories as reported later re-coded into three groups. This reclassification was undertaken to ensure adequate group size for statistical analysis. Gender as male or female as binary. Profession was documented as human doctor or veterinary doctor. Years of experience recorded in ordinal categories and later merged into three groups for analysis. Work setting was categorized as clinic or hospital; location type was classified as urban or rural. AMR training was coded as yes or no. These independent variables were selected based on theoretical relevance and prior evidence linking socio-economic and professional characteristics with antimicrobial stewardship practices.

Dependent Variable was primary outcome variable. Perception that socio-economic status influences inappropriate use of antibiotics. Responses were coded as agree and disagree. This binary outcome variable reflects the respondent's perception of socio-economic influence on antimicrobial misuse, serving as a proxy for attitudes towards equity in antibiotic stewardship.

Table 1: Summary of Study Variables and Data Levels

Prediction	Variable	Original data level	Final data level
Dependent Variable	Inappropriate Use of Antibiotics	Nominal	Binary: Yes (1), No (0)
Sociodemographic Factors	Age	Ordinal	Grouped: <30 (1), 30-49 (2), ≥50 (3)
	Gender	Nominal	Binary: Male (1), Female (2), Other (3)
	Professional role	Nominal	Binary: Human (1), Veterinary (2)

	Years of experience	Ordinal	0-5 (1), 6-10 (2), ≥11 (3)
	Workplace setting	Nominal	Binary: Hospital (1), Clinic (2)
	Location of practice	Nominal	Rural (1), Urban (2), Semi-urban (3)
Socio-economic Factors	Training on antibiotic stewardship	Nominal	Binary: Yes (1), No (0)
	Access to antibiotic	Ordinal	Very easy (1), Easy (2), Difficult (3), Very difficult (4)
	Economic influence on prescribing frequency	Ordinal	Sometimes (1), Rarely (2)
	Prescription adaptation due to economic status	Nominal	Smallest pack (1), Leftovers (2)
	Patient demand influence prescription	Ordinal	Sometimes (1), Rarely (2)
	Economic status affecting diagnostic test choice	Nominal	Yes (1), No (0)

	Prevalence of antibiotic misuse	Ordinal	Very prevalent (1), Somewhat (2), Rare (3)
	Perceived socio-economic impact on misuse	Nominal	Agree (1), Disagree (0)

4.5.2. Instruments

The quantitative tool employed in this study was a structured questionnaire including closed-ended and Likert-scale questions. It was built on existing material and validated by experts to fit the local environment. The questionnaire asked about demographics, antibiotic prescribing habits, policy awareness, and impediments to implementation. The qualitative data collection tool was a semi-structured interview guide designed to elicit in-depth stakeholder perspectives on AMR policy implementation, institutional obstacles, and cross-sectoral cooperation. Prior to beginning the primary study, both instruments were pre-tested for clarity and dependability.

4.7. Statistical Analysis

All statistical studies were conducted utilizing the most recent version of RStudio, namely RStudio Desktop Pro 2024.04.2+764. For all tests to find statistically significant findings, a significance level of ($p < 0.01$) was used. Some initial cleanup was done to the data to make sure it was good and correct. This also meant looking for values that were missing.

4.7.1. Descriptive Analysis.

Descriptive statistics were employed to describe demographic information, professional background, and significant survey responses. Means, frequencies, and percentages were calculated to offer a summary of the dataset. The variables included were Inappropriate Use of Antibiotics, Age, Gender, Professional Role, Years of Experience, Workplace Type, Location of Practice, Training on Antibiotic Stewardship. These variables were summarized using absolute frequencies and relative percentages. These summaries provided an initial overview of the composition of the sample and allowed for the identification of patterns or irregularities within the data. To ensure data

integrity missing values were examined. This stage served as a foundation for subsequent inferential analysis by clarifying the distributional properties of each variable.

4.7.2 Bivariate Analysis.

Following the descriptive phase, bivariate analysis was undertaken to investigate the crude associations between each independent variable and the dependent variable. Cross tabulations were generated to display the joint distribution of categories, and proportion was calculated to facilitate interpretation. Statistical significance was assessed using Pearson's chi-square test of independence, with a two tailed p-value <0.05 considered statistically significant. This method was selected due to its appropriateness for examining relationship between categorical variables. the bivariate analysis allowed for the identification potential predictors of outcome variable, which were subsequently considered for inclusion in the multivariable model.

4.7.3 Logistic Regression Model

To access the independent associations between predictor variables and the outcome, a multivariable logistic regression model was fitted in RStudio. The initial model incorporated all independent variables of interest: age, gender, professional role, years of experience, work setting location type and AMR training status**.** The results of the regression analysis were expressed as odds ratios (ORs) with corresponding 95% confidence interval (CI), obtained by exponentiating the estimated regression co-efficient.

To refine the model and improve parsimony, a backward stepwise selection procedure was applied, removing non-significant predictors sequentially based on the likelihood ratio test and the Akaike Information Criterion (AIC). This approach ensured the retention of variables that provided meaningful explanatory power while controlling for potential confounding effects. Statistical significance for all predictors was determined at $p <0.05$.

4.8. Ethical Consideration

This study followed the recognized ethical guidelines for public health research. Because the research did not include patients or at-risk groups and was based only on the professional observations of medical and veterinary specialists, official ethical approval was not required at HAW Hamburg. Following university guidelines, ethical approval was not required, as the study

depended exclusively on professional insights rather than patient-specific or sensitive personal information. People might choose whether to take part in the study. For the quantitative survey, filling out and returning the questionnaire was seen as giving permission. Before the qualitative interviews began, all participants gave their written agreement. Participants were made aware of the study's objectives, their entitlement to withdraw at any moment without justification, and the guarantee that their professional reputation would remain unaffected by their participation or lack thereof. It was important to keep everything private and anonymous. No personal information was collected, and answers were coded (for example, HD-1, VD-5) to keep the identities of the people who answered safe. The researcher was the only one who had access to all of the transcripts and survey data. After the interviews were transcribed, the audio recordings were erased. There were no therapies, clinical studies, or patient-level data in the study, thus it didn't put anyone at danger of bodily or mental harm. The study was carried out in compliance with the Declaration of Helsinki (2013), adhering to the ideals of respect, beneficence, and fairness.

5. Results

5.1. Result of Statistical Analysis

5.1.1. Sample Description

There were 273 people that took part in this study. Table 2 shows the participants' professional and social-demographic traits. The most people who answered (48.00%) were between the ages of 30 and 39. The second most people (37.36%) were under the age of 30. A smaller number were between the ages of 40 and 49 (7.33%), 59 and older (6.59%), and 50 and 59 (0.73%). The sample was mostly male (71.79%), and females made up 28.21% of the participants. Moreover, half of the respondents were veterinary professionals (52.38%), while the rest were human doctors (47.62%). The distribution of years of professional experience is explained in more depth in later analyses, however most respondents said they had several years of experience. Most of the people who took part worked in hospitals (61.54%), while the rest worked in clinics (38.46%). Of the people who answered, 64.84% lived in cities and 35.16% lived in rural areas. Almost three-quarters (72.53%) of the people who answered did not have formal AMR training, while 27.47% said they had. A huge majority (87.55%) agreed that the socio-economic situation of patients affects the wrong use of antibiotics, whereas just 12.45% disagreed.

Table 2: key variables of study with number of sample (n) and percentage (%)

Variable	Category	n	%
Age	<30 years	102	37.36
	30–39 years	131	48.00
	40–49 years	20	7.33
	50–59 years	2	0.73
	>59 years	18	6.59
Gender	Female	77	28.21
	Male	196	71.79

Profession	Human doctor	130	47.62
	Veterinary doctor	143	52.38
Work setting	Clinic	105	38.46
	Hospital	168	61.54
Location type	Rural	96	35.16
	Urban	177	64.84
AMR training	No	198	72.53
	Yes	75	27.47
Dependent variable	Agree	239	87.55
	Disagree	34	12.45

5.1.2. Bivariate Analysis

Table 3 illustrates the bivariate relationships between the independent variables and the dependent variable, confirming that socio-economic status affects improper antibiotic use. Notable correlations ($p < 0.05$) were identified for age, work environment, location category, and AMR training. Individuals under 30 years and those aged 30 to 39 were more like to concur with the dependent statement than their older counterparts. Individuals employed in clinics indicated diminished levels of consensus relative to their counterparts at hospitals. Urban respondents exhibited a markedly higher propensity to concur compared to their rural counterparts. Participants that underwent AMR training demonstrated a greater level of consensus compared to those lacking this training. Gender, occupation, and years of professional experience exhibited no statistically significant correlations with the dependent variable, despite typically elevated levels of agreement across all categories.

Table 3: Association between significant variable and socio-economic infulence on antibiotic use

Variable	Category	Agree (%)	Disagree (%)	χ^2	df	p-value
Age	<30 years	88.24	11.76	19.5	4	0.001
	30–39 years	90.08	9.92			
	40–49 years	75.00	25.00			
	50–59 years	50.00	50.00			
	>59 years	72.22	27.78			
Gender	Female	87.01	12.99	0.0	1	1.000
	Male	87.76	12.24			
Profession	Human doctor	89.23	10.77	0.38	1	0.535
	Veterinary doctor	86.01	13.99			
Experience (yrs)	Category 1			6.06	3	0.109
	Category 2					
	Category 3					
	Category 4					
Work setting	Clinic	80.00	20.00	7.82	1	0.005*
	Hospital	92.26	7.74			

Location type	Rural	97.92	2.08	13.18	1	0.000*
	Urban	81.92	18.08			
AMR training	No	83.84	6.16	4.84	1	0.028*
	Yes	97.33	2.67			

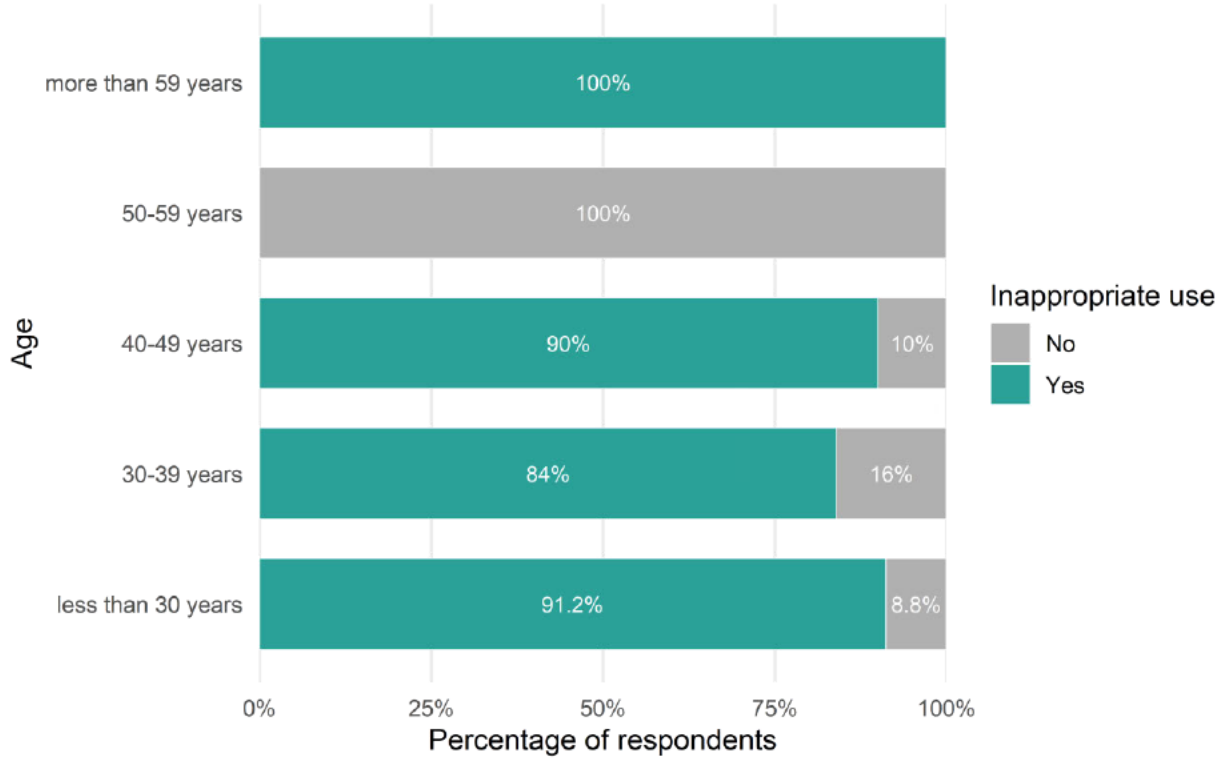

Figure 4. Distribution of agreement with the statement "Socio-economic status influences inappropriate use of antibiotics" by age group.

Figure 4 displays a bar chart depicting the percentage of respondents in each age group who concurred or disagreed with the assertion that socio-economic status affects improper antibiotic usage. The graphic pattern distinctly illustrates the findings in Table 2, indicating that consensus was greatest among those aged 30–39 years (90.08%) and those under 30 years (88.24%). The agreement rate begins to diminish in the 40–49 age range (75.00%), declines further in those over 59 years (72.22%), and is lowest among respondents aged 50–59 years (50.00%). This declining trend indicates that younger and early mid-career professionals may be more susceptible to the socio-

economic factors affecting prescribing behaviors, potentially because of their recent exposure to public health education or contemporary training. In contrast, seasoned doctors may depend more on conventional clinical practices, potentially resulting in diminished focus on socio-economic factors. The significant decline in the 50–59 age group is particularly noteworthy and may suggest a generational shift in viewpoints.

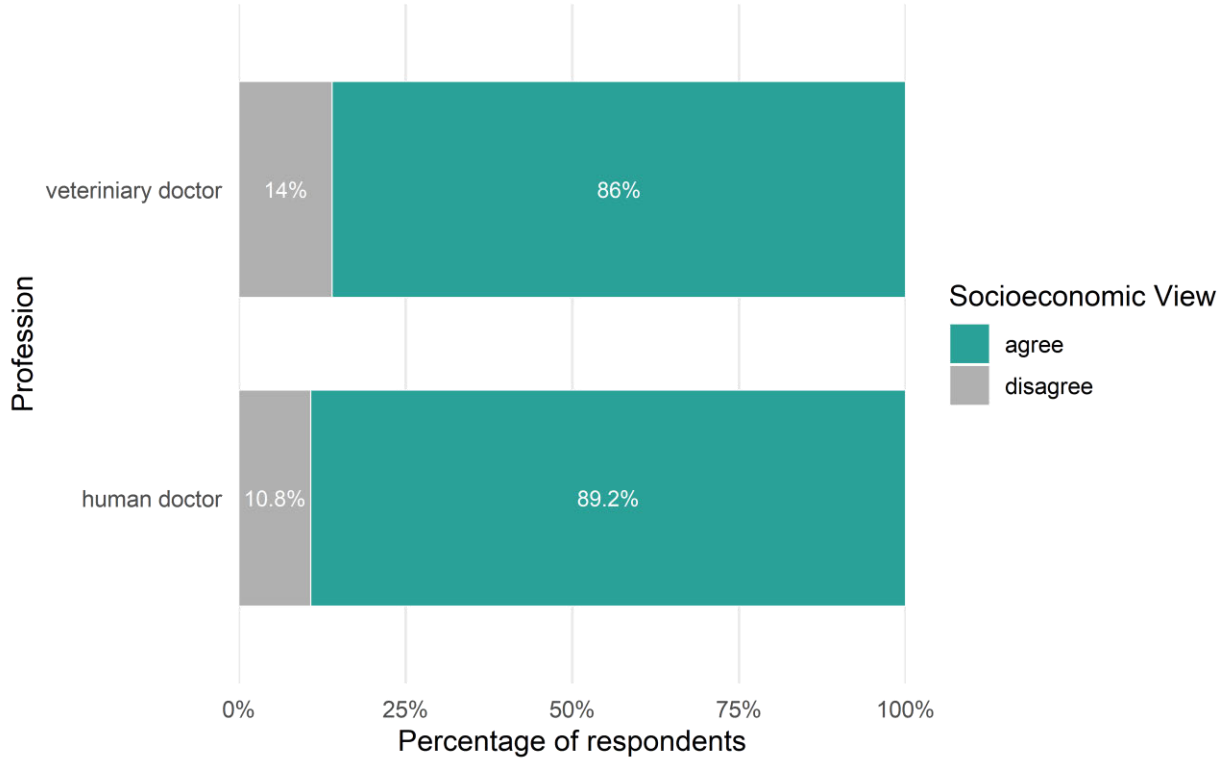

Figure 5. Distribution of agreement with the dependent variable by work setting.

Figure 5 contrasts the level of agreement between respondents employed in hospitals and those in clinics. The picture illustrates a distinct disparity: 92.26% of hospital-based participants concurred with the statement, whereas only 80.00% of clinic-based participants did. The statistically significant difference ($p = 0.005$) may be due to variations in patient exposure and case severity. Hospital practitioners are more likely to encounter patients from varied socio-economic backgrounds, including individuals from lower-income groups who may experience obstacles in acquiring medications or diagnostic services. Conversely, clinic patients may constitute a more homogeneous or

self-selecting cohort, thus affecting practitioners' impressions of socio-economic influence. The spacing between the bars in the chart visually corroborates this conclusion.

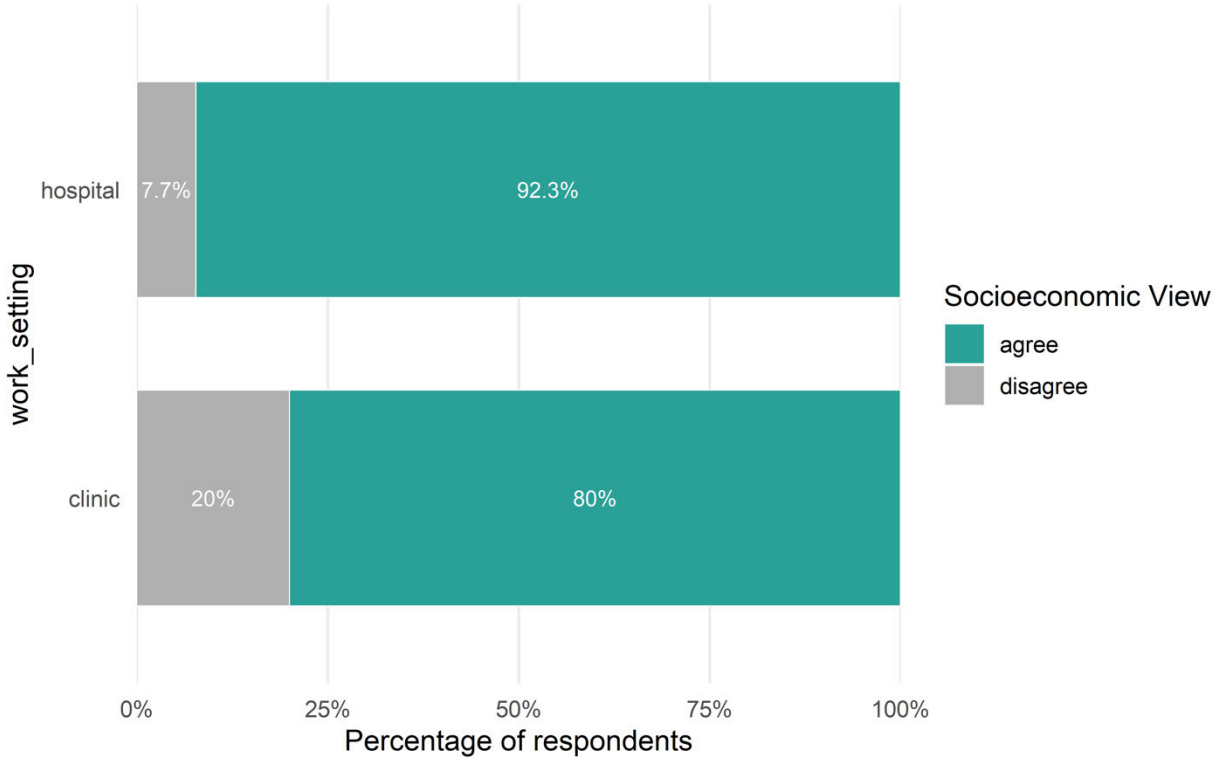

Figure 6. Distribution of agreement with the dependent variable by location type.

A notable distinction between responders from rural and urban areas is shown in Figure 6. In both the bivariate and logistic regression studies, site type was one of the best predictors of perception, with agreement in rural settings reaching 97.92% versus 81.92% in urban regions. This discrepancy can result from the greater exposure of socio-economic inequities in rural areas, where patients frequently face more financial hardships and have less access to healthcare facilities. As a result, rural practitioners can encounter circumstances more frequently when financial limitations influence treatment choices, like the antibiotic to use or the length of therapy. With the rural bar substantially higher than the urban bar, the chart effectively illustrates this contrast and provides visual support for the statistical significance ($p < 0.001$) mentioned in Table 3.

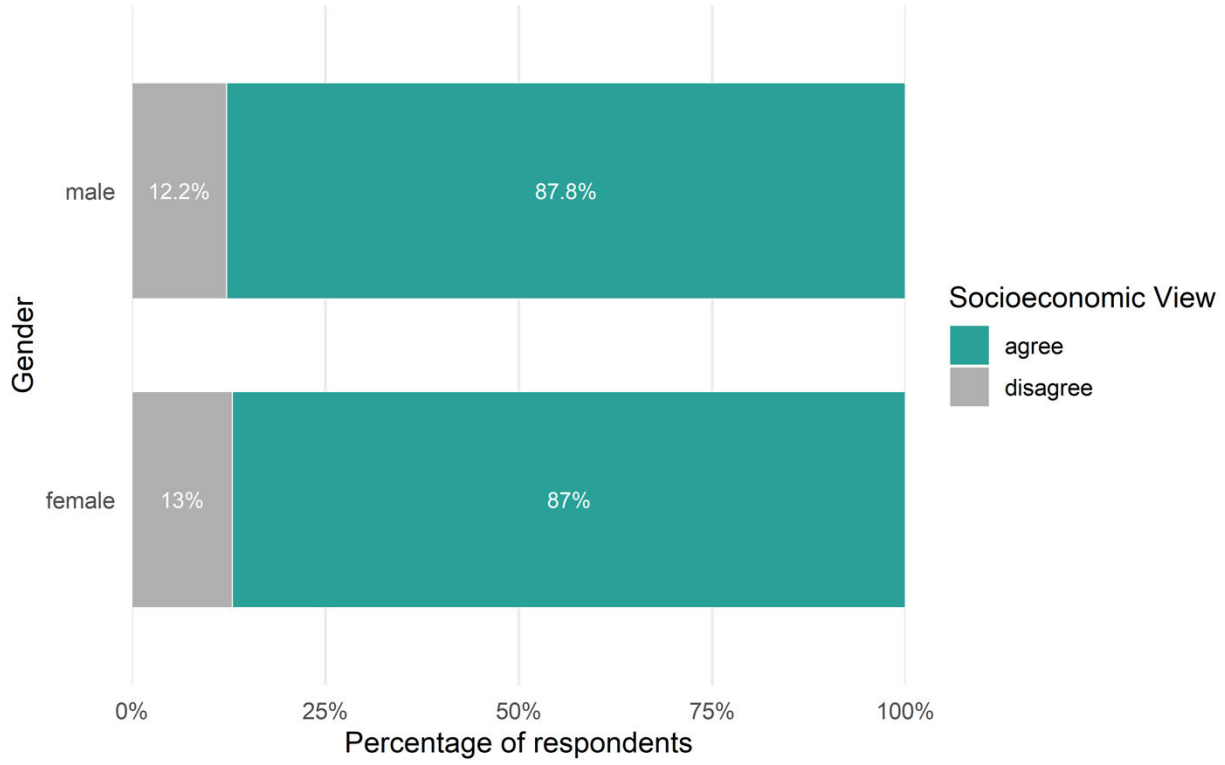

Figure 7. Distribution of agreement with the dependent variable by AMR training status.

Figure 7 illustrates how many people who had AMR training agreed with the statement compared to people who didn't have AMR training. There is a big difference: 97.33% of trained respondents agreed, but only 83.84% of unskilled respondents did. The picture shows how targeted instruction can change how professionals think about things. Training might help practitioners learn more about the bigger elements that affect antibiotic resistance, such as social and economic factors. People who have been trained in AMR may be better able to see how a patient's financial situation can lead to the wrong use of antibiotics, whether that means using them too often, not enough, or relying on treatment plans that aren't the best. The big difference between the two bars matches the statistically significant result ($p = 0.028$) in Table 3 and the large odds ratio (OR = 5.48) from the logistic regression model.

5.1.3. Logistic Regression Analysis.

A multivariate logistic regression model was used to see if the predictor variables were linked to the likelihood of agreeing that socio-economic status affects the usage of antibiotics

inappropriately. The first model had all the independent variables, but a backward stepwise selection method was used to keep just the variables that made the model fit better. Years of professional experience, work context, kind of location, and AMR training were all still important factors in the final model. Respondents with less professional experience (category 2 and 3) were far less likely to agree than those with the least experience. People who worked in a clinic were less likely to agree than people who worked in a hospital. Compared to rural areas, living in a city was strongly linked to reduced risks. On the other hand, people who had received AMR training were much more likely to agree. Age, gender, and job were not included in the final stepwise model because they did not have any statistical significance after adjustment.

Table 4: Stepwise backward selection model

Variable	Category	OR	95% CI	p-value
Experience	Category 2	0.21	0.08–0.53	0.004
(yrs)	Category 3	0.25	0.08–0.78	0.017
Work setting	Clinic	0.28	0.12–0.63	0.002
Location type	Urban	0.05	0.01–0.19	<0.001
AMR training	Yes	5.48	1.48–35.73	0.028

5.1.4. Key Findings

This study looked into how socio-demographic, professional, and contextual factors are linked to the belief that socio-economic position affects the wrong use of antibiotics. The key points of the final model are; years of professional experience, work context, type of location, and AMR training were all significant independent predictors of agreement with the dependent measure, according to multivariable logistic regression. People with the least professional experience were more likely to agree than those with the second and third most professional experience. People who worked in a clinic were less likely to agree than people who worked in a hospital. People who lived in cities were much less likely to agree than people who lived in rural areas. Having AMR training made it more than five times more likely that people would agree. For all tests to find statistically significant findings, a significance level of ($p < 0.01$) was used.

5.2. Result of Interviews

5.2.1. Awareness And Perceptions of AMR Policies (RQ1)

The sample had a lot of knowledge on antimicrobial resistance (AMR) policies, but the level of understanding, significance, and practical use of this knowledge varied. Nearly all participants were aware of Pakistan's National Action Plan (NAP) or mentioned institutional norms in some way. However, their narratives showed that there was a difference between knowing that policies exist and really following them in their daily lives. The analysis revealed four subthemes: (1) awareness of the NAP and institutional standards, (2) views of effectiveness, (3) the disparity between policies "on paper" and their implementation, and (4) sectoral distinctions between human and animal healthcare.

Awareness of the NAP and institutional guidelines (RQ1-1)

Respondents consistently recognized some familiarity with AMR rules; however, this understanding was influenced by organizational structures and professional contexts. Only one tertiary hospital (HD-3) showed an example of systematic oversight where rules were followed and enforced:

"In my workplace, antibiotic use is monitored very closely. We have to follow the institutional guidelines, and I'd say they are implemented effectively here." [HD-3]

This story shows how institutional processes like stewardship committees and medication monitoring may turn vague policies into everyday practices. But this experience was more of an exception than a rule. Doctors who worked in metropolitan hospitals or private practice more often said that their awareness was shallow or not connected to their actual clinical practices. A junior doctor said: *"In my own daily practice, they don't exist, at least not in a way that I can see or apply."* [HD-5] Others said the same thing, saying that even while they had "heard of the NAP" or "knew guidelines existed," they had never gotten direct training or documentation in their particular contexts. In this regard, awareness frequently functioned as a symbol rather than a practical tool. For veterinarians, awareness was even less a part of their regular work. People generally learned about policies through one-time workshops or CPD seminars instead of through organized guidelines. For instance.

"Yes, I learned about the National Action Plan during a CPD seminar at UVAS in 2021. It explained the dangers of overprescribing and why proper antibiotic stewardship is important. But

honestly, it doesn't directly affect what I do day to day because there's no enforcement in the pet clinic sector." [VD-5]

This story shows that awareness in veterinary medicine was only ephemeral and based on events, without the institutional support that would have made it useful. A rural veterinarian put it more plainly: *"Policies for vets are mostly symbolic; they don't translate into real practice."* [VD-1] So, even if people and animals were aware of the issue, the level of that awareness varied greatly depending on the institution.

Perception of Effectiveness (RQ1-2)

In all settings, people thought that policies were not working very well. People who answered the survey kept saying that policies didn't work to change how doctors prescribed drugs. As one city expert said:

"Any policy related to AMR is completely ineffective. They're not achieving any reduction in in-appropriate antibiotic use." [HD-2]

This opinion was not unique. Other doctors acknowledged that there were policies in place but they didn't have any real effect: *"Honestly, I think NAP is not effective at all."* [HD-4]

"In my experience, there's a big gap between policy and practice. In most settings they're limited to paper." [HD-8]

Veterinarians shared these frustrations, pointing out that there was no real enforcement or public compliance:

"Effectiveness is almost zero when you see what's happening in real life. People use antibiotics on their own without consulting a vet, and they don't follow prescriptions. This makes the whole effort ineffective." [VD-3]

When you look at all of these reports together, they show a clear pattern: the people who answered were not arguing that rules didn't exist, but that they didn't change people's behavior in the real world.

Paper Versus Practice (RQ1-3)

The most interesting thing that came up in both human and veterinary interviews was the perception that AMR policies were mostly just words on paper. Doctors kept talking about how policies that were written down but not followed were only symbolic:

"The policies exist, but they're not consistently followed. There's a large gap between what's on paper and what happens." [HD-7]

For some, this discrepancy was considerably bigger:

"Mostly, they're just on paper. Only in very few settings are they actually implemented." [HD-5]

"They may be documented somewhere, but in reality, there's no proper enforcement." [HD-2]

Veterinary professionals talked about an even bigger gap, where policy frameworks were almost never used in practice. One doctor said:

"In veterinary, especially for animals, there is almost no restriction — you can just buy and use antibiotics freely." [VD-3]

Another person said: *"In the human health sector, there's at least some level of regulation and enforcement. In veterinary practice, we're largely neglected in this regard."* [VD-2] So, the "paper versus practice" difference was not a small issue; it was a big problem in both sectors.

Human – Veterinary Differences (RQ1-4)

Lastly, the people who answered the survey pointed out big contrasts between the human and veterinary fields. Doctors, especially those who work in some city hospitals, talked about partial checks like having a pharmacist involved or using digital prescription systems. On the other hand, veterinarians always said there was a lack of oversight:

"In human hospitals, pharmacists review prescriptions and can intervene if guidelines aren't followed but that too very limited. In veterinary practice, especially rural areas, there's no such monitoring." [VD-7]

The veterinary field was seen as doubly disadvantaged: not only were rules not implemented well, but institutional neglect led to fewer resources, less training, and little integration of AMR into everyday work.

In general, people knew about AMR policies, although not very well or evenly. Only one institution gave a clear example of systematic enforcement. Most other respondents thought that policies were just symbols or pieces of paper. Doctors said they didn't work, and veterinarians said they were essentially useless in everyday practice. The separation between human and veterinary sectors further solidified the belief in unequal policy execution, with veterinary medicine regarded as an overlooked field. These data indicate that knowledge, devoid of institutional reinforcement and enforcement mechanisms, minimally influences behaviors, rendering AMR regulations predominantly aspirational rather than functional.

5.2.2 Policy Implementation Challenges (RQ2)

Even though people in both the human and veterinary fields knew that antimicrobial stewardship was necessary, they all said that putting policies into place was difficult because of several overlapping barriers. Six subthemes emerged: (1) over-the-counter (OTC) antibiotic availability, (2) quackery and unlicensed practice, (3) lack of diagnostic facilities, (4) poor pharmacist and laboratory collaboration, (5) patient and farmer non-compliance, and (6) economic barriers to adherence.

OTC Antibiotic Availability (RQ2-1)

Most people who answered said that the unrestricted selling of antibiotics without a prescription was the biggest problem for putting the policy into action. Doctors said that patients may easily avoid seeing a doctor by going straight to a pharmacy:

"Patients can walk into any pharmacies and get antibiotics without seeing a doctor. That makes it easy for people to bypass consultation altogether." [HD-2]

Veterinarians agreed with this worry and said that agro-vet stores in rural areas often sold antibiotics without any professional supervision:

"OTC sales are common at agro-vet outlets, undermining professional control and enabling misuse. It's just like getting a candy from shop" [VD-1]

"Farm suppliers sell antibiotics without prescriptions openly. Preventive use of antibiotic is still the norm. It's common for farm to keep 2–3-month supply of antibiotics" [VD-8]

Because people could still get antibiotics over the counter, even when doctors or vets didn't want to, patients and farmers could get them on their own. Respondents said that this dynamic made a parallel supply chain of misuse, which hurt stewardship at its core.

Quackery and Unlicensed Practice (RQ2-2)

A second problem was that many unlicensed practitioners gave out antibiotics without the right training or diagnosis. Human doctors pointed out the dangers of "quacks" in the community: *"Patients sometimes take unlabeled herbal powders or get antibiotics or steroids in the wrong doses from unqualified practitioners. This damages proper antibiotic use and can harm patient outcomes."* [HD-4]

Veterinarians recounted a comparable scenario in rural regions, where para-veterinarians or self-proclaimed "poultry advisors" often administered potent antibiotics as preventive measures:

"Para-vets and unlicensed sellers often dispense antibiotics without proper diagnosis, leading to irrational use. I have even seen a guy on a farm who doesn't know how to read or write providing treatment to animals" [VD-1]

"Many so-called 'village vets' give high doses of strong antibiotics like enrofloxacin for minor illnesses. They genuinely believe stronger means faster recovery." [VD-6]

Quackery was depicted not merely as a peripheral occurrence, but as a mainstream rival to licensed practitioners, undermining the efficacy of AMR programs in both human and animal health.

Lack of Diagnostic Facilities (RQ2-3)

Respondents also stressed that diagnostics don't play a big impact in how doctors prescribe drugs. In metropolitan hospitals, cultures and sensitivity tests could be done, but patients typically said no since they didn't have the money or time:

"In my hospital, these tests are available, but many patients skip them due to cost or time, which leads to empirical prescribing." [HD-8]

The situation was significantly worse in veterinary practice. Rural vets talked about how hard it was to go to diagnostic labs:

"Labs are not available locally. The nearest lab is in Multan, about 70 km away. For a small farmer, the travel and lab fees make it impractical, so they usually skip it." [VD-6]

When there wasn't reliable diagnostic input, empirical prescription became the way to go. Several respondents emphasized that this not only restricted rational use but also compromised AMR surveillance systems, resulting in policymakers lacking field-level data on resistance developments.

Poor Pharmacist and Laboratory Collaboration (RQ2-4)

Another common issue was the poor cooperation between doctors, pharmacists, and lab staff. Doctors commonly said that pharmacists were not there or were only somewhat involved in stewardship:

"Collaboration with pharmacists is very poor. There's hardly any teamwork between doctors and pharmacists when it comes to monitoring or controlling antibiotic use." [HD-2]

Some stressed that even when pharmacists were there, they mostly just gave out medications:

"There's one pharmacist in the pharmacy, but he's not always available and doesn't monitor prescriptions. Collaboration between doctors and pharmacist is a myth in my setting." [HD-1]

Veterinarians also said that lab staff were often technicians who had little to do with making decisions about AMR:

"We don't have direct contact with pharmacists, and lab staff. They are just there to follow our direction; they don't have the knowledge to contribute to AMR discussions." [HD-4]

Because there was little collaboration between disciplines, AMR policies were rarely put into action as team-based stewardship frameworks. Instead, they were left up to individual prescribers to follow.

Patient and Farmer Non-Compliance (RQ2-5)

Respondents also said that not following prescriptions was a big problem. Doctors said that patients often stopped treatment too soon:

"To make patient follow complete course of antibiotic is very difficult, especially among those who self-medicate. They'll stop once they feel better." [HD-2]

Veterinarians talked about how farmers did the same things:

"Rarely do they complete the course. Many stop as soon as the animal looks better, sometimes after just two doses and the result the animal becomes resistant to the antibiotic with passing time" [VD-6]

"Most of the time they will stop once animal is getting better and think there is no need to complete the course and then save whatever's left and use it next time when the condition comes back without consulting me." [VD-3]

This widespread non-adherence made the cycle of overuse worse because antibiotics were either stopped too soon or administered again without competent supervision. People who answered said that even when prescriptions were right, patients and farmers misused them, which hurt the goals of the policy.

Economic Barriers to Adherence (RQ2-6)

Lastly, the people who took part in the study talked about how economic pressures affect how antibiotics are used and how policies are put into place. People commonly thought that diagnostic tests and complete courses of antibiotics were too expensive for healthcare:

"A blood culture can be six to seven thousand rupees, and most patients have to pay out of pocket since they don't have insurance. Thats why they will try everything to skip it" [HD-1]

Veterinarians said that farmers felt the same kind of pressure and chose cheaper drugs even when they weren't the best choice:

"Poor farmers often ask for cheaper drugs, even if they're not the best choice medically and most of the farmers are poor in my area" [VD-3]

"Cost is often the main factor. They might choose a cheaper drug even if it's less effective." [VD-6]

Because of these economic constraints, both empirical prescribing and non-compliance became more common, as patients and farmers put short-term affordability ahead of long-term stewardship aims. Respondents in both human and veterinary medicine said that six related problems made it hard to put AMR policies into action: the availability of antibiotics over the counter, the

widespread use of unlicensed practitioners, the lack of accessible diagnostics, weak collaboration with pharmacists and lab staff, widespread non-compliance by patients and farmers, and economic barriers. These obstacles did not function alone; rather, they cooperated to cultivate an atmosphere in which AMR regulations remained merely aspirational. Even when prescribers knew about and wanted to obey the rules, it was very hard to do so because of problems with the system and the way things are in the world.

5.2.3. Stakeholder Power Dynamics (RQ3)

A common topic in the interviews was how influential stakeholders affect how antibiotics are used and how AMR policies are put into action. Respondents characterized a multifaceted environment wherein pharmaceutical companies, policymakers, and frontline professionals wielded intersecting yet disproportionate influences. Three subthemes emerged: (1 Pharmaceutical company influence, (2) Policymaker/regulatory role, and (3) Professional authority & autonomy.

Pharmaceutical Company Influence (RQ3-1)

Respondents from both the human and veterinary fields stressed how powerful and frequently bad pharmaceutical companies are. Human doctors said that firms changed how doctors wrote prescriptions by giving them incentives and marketing pharmaceutical brands:

"Pharma companies offer incentives to doctors to prescribe their brands, and they also influence policymakers to avoid strict regulations that would hurt antibiotic sales." [HD-1]

Some people said that pharmaceutical companies not only affected individual doctors but also had a structural grip in the health system:

"Many owners of pharmaceutical companies are also major stakeholders in the health system. Sometimes they're even policymakers themselves, which makes their influence very strong." [HD-2]

Veterinarians said they felt the same kind of stress. A veterinarian who works with tiny animals recounted how businesses encouraged clinics to stock up on antibiotics: *"They offer bulk discounts on antibiotics, and that can make it tempting for clinics to stock up and prescribe more."* [VD-5]

Another academic veterinarian pointed out how aggressive marketing is used in the chicken industry:

"They give bulk discounts to large farms, encouraging them to stockpile antibiotics and use them preventively. I've seen farms with shelves of different antibiotics bought in advance 'just in case'." [VD-7]

These accounts together show how marketing efforts focus on making money messed with rational prescription and made AMR stewardship weaker. Pharmaceutical firms were shown to have both direct (via incentives) and indirect (through structural entrenchment in the health system) effects.

Policy-Maker/Regulatory Role (RQ3-2)

Respondents also thought critically about the roles of policymakers and regulatory bodies, typically saying that they were either not there or had conflicts of interest that made them less effective. Doctors said that policymakers' ties to drug industries made it harder to implement the law:

"When policymakers have ties to pharmaceutical companies, it creates a conflict of interest. That's one reason why strict enforcement of AMR laws doesn't happen." [HD-2]

Some people were upset that policies were mostly declarative and not operational, which showed a lack of political will:

"Policy makers set the guidelines, but enforcement is weak. There's very little on-ground follow-up." [HD-7]

Veterinary professionals agreed with these worries, saying that there was still a gap between formulating central policies and what was happening in the field:

"Policymakers create policies, but there's often a gap between them and the people implementing them. They don't engage enough with vets or understand the field realities, so the policies don't work well on the ground." [VD-3]

Many respondents saw policymakers as distant actors who were more interested in writing documents than making sure they were put into action. Because they didn't regulate things very well, there was a gap where OTC sales, quackery, and misuse could all happen without any rules.

Professional Authority & Autonomy (RQ3-3)

Lastly, the participants thought about their own professional authority in respect to other people who were involved. Doctors usually thought they had control over their own prescribing choices, but not much else:

"In the hospital, I can control my own prescribing. But outside that, my influence is minimal, because patients can still get antibiotics from pharmacies without ever seeing a doctor." [HD-1]

Some people said that this authority was limited by nature:

"I can control what I prescribe in my own practice, but beyond that, my influence is limited. If a patient wants antibiotics, they can easily get them from a pharmacy without coming to me." [HD-2]

Veterinarians said they had even less power, especially in rural areas where farmers might completely ignore professional advice:

"Very little, because even if I refuse to prescribe unnecessarily, the farmer can just go and buy it elsewhere without any checks." [VD-3]

Some experts, on the other hand, stressed the need of teaching patients and clients to have an indirect effect. A surgical resident thought about it:

"At the individual patient level, I have strong control over what I prescribe, and I can counsel patients to avoid antibiotics if they're not needed." [HD-3]

In general, professionals were able to make their own decisions in their own practices, but their overall authority was weakened by problems in the system, such as unregulated pharmacies, quackery, and the strong influence of drug firms. The power dynamics among stakeholders were very important in how AMR policy was put into action. People said that pharmaceutical firms were the most powerful players and used marketing incentives and structural linkages to influence prescribing. People often thought that policymakers and regulators were not doing their jobs or were too busy to do them, so they made rules that only existed on paper. Frontline practitioners still had some power over their own prescriptions, but they felt like their authority was being eroded by systematic flaws that let patients and farmers get antibiotics without medical supervision. These factors combined to make a situation where political and business leaders had a lot of

power, while clinicians and veterinarians oversaw stewardship but didn't get much help from the system.

5.2.4. Inter-professional Collaboration (RQ4)

The fourth focus was on how well doctors, veterinarians, pharmacists, and other professionals worked together to fight antimicrobial resistance (AMR). Respondents from both the human and veterinary sectors consistently reported inadequate collaboration mechanisms, with the majority of interaction taking place informally and seldom facilitated by official platforms. The analysis identified three subthemes: (1) informal collaboration, (2) formal platforms and One Health initiatives, and (3) barriers to collaboration.

Informal Collaboration (RQ4-1) Most people who answered said that teamwork was rare, random, and mostly based on personal initiative. Doctors said that they sometimes asked their coworkers for help with tough situations, but they didn't often make decisions together with pharmacists or lab staff. One doctor said:

"Collaboration is weak overall. Even between doctors it's limited, and with pharmacists, it's almost non-existent. We don't have any strong stewardship systems in place." [HD-2]

This statement makes it clear that cooperation was usually limited to the medical field itself. Most of the time, collaboration meant short talks or informal mentorship instead of formalized collaborative reviews. Such cooperation was helpful in some circumstances, but it wasn't consistent and didn't lead to learning on a larger scale. It was especially important that there were no pharmacists present during these exchanges because they are the only ones who can keep an eye on dispensing and make sure that guidelines are followed. Their absence created a significant void in stewardship, resulting in reasonable prescribing frequently depending largely on the discretion of isolated physicians. A other young doctor made this argument stronger by saying that the keyway to work together was through peer-to-peer guidance within medical hierarchies:

"Among doctors, collaboration is there but mostly informally. Senior doctors guide juniors on rational prescribing. But there's very little collaboration with pharmacists because they're hardly involved in prescription monitoring." [HD-1]

Here, the reliance on senior clinicians led to an uneven transfer of knowledge that depended on how willing each person was to teach. Mentorship may have a favorable impact on younger

physicians, but it did not provide a dependable or uniform system for overseeing antibiotic utilization throughout a hospital. This dependence on personal ties instead of institutional processes shows how professional cultures fill the void left by a lack of stewardship structures. Veterinarians reported analogous trends, frequently seeking counsel from colleagues on an individual basis or depending on informal networks. One person who answered said:

"I stay in contact with pharmacists and other vets, but it's informal and it only about the availability of drugs in our pharmacy, but without a formal system, it's hard to enforce proper use." [VD-3]

One more person said that internet communication tools occasionally took the place of lacking platforms:

"Sometimes I'm in a WhatsApp group with other rural vets where we share advice on tricky cases, including AMR concerns. But it's all informal, there's no official platform." [VD-6]

These stories show how creative practitioners can be when they establish support networks where there weren't any before. But using informal methods like WhatsApp also had its own set of concerns. The advice given wasn't always good, there was no way to hold people accountable, and the information supplied typically came from personal experience instead of evidence-based rules. So, even while informal collaboration helped peers in some ways, it wasn't enough to solve the structural problems of AMR.

Formal Platforms and One Health Initiatives (RQ4-2)

When asked about formal interdisciplinary structures, most people said that these kinds of platforms either didn't exist or weren't common enough to make a difference. Doctors often said that their hospitals didn't have stewardship committees or any other formal ways for people from different fields to assess antibiotics:

"We don't have a formal antibiotic stewardship committee in my facility. Any collaboration is informal, and case based." [HD-7]

Because there were no such committees, each doctor had to make their own decisions about prescription, which meant that there were no group scrutiny or chances for systematic learning. This absence was not only a missed chance, but also a structural flaw, since it took away from

institutions a place where AMR rules could be put into effect every day. Veterinarians also talked about how few established initiatives there are. Some people had been to One Health workshops where doctors, vets, and environmental health experts worked together, but these were considered as one-time activities with little follow-up:

"Occasionally, at One Health workshops with medical doctors, vets, and environmental health experts. But these are very rare and mostly academic exercises." [VD-7]

Others made it plain that there were no permanent constructions at all in the field:

"No formal platform currently exists; a structured One Health approach is needed." [VD-1]

These thoughts show how different policy talk is from actual practice. One Health is often mentioned in policy papers as important for fighting AMR, but in reality, it was mostly only a symbol. Workshops that happened every now and then could enhance awareness, but their effects soon faded without ongoing frameworks for coordination, surveillance, and shared decision-making. The outcome was a disjointed system where several sectors—human health, veterinary practice, and pharmacy—functioned in isolation, despite the fact that the AMR threat intrinsically spanned these areas.

Barriers To Collaboration (RQ4-3)

Respondents identified many obstacles that actively hindered enhanced inter-professional collaboration. The most common problem was not knowing what their roles were and not trusting their coworkers. Doctors frequently indicated that pharmacists and laboratory personnel were restricted to specialized technical functions and were marginalized in decision-making processes:

"We don't have direct contact with pharmacists, and there's no one to consult with on AMR issues. Lab staff just follow the orders; they don't have the knowledge to contribute to AMR discussions." [HD-4]

This perspective embodies a professional hierarchy wherein prescribing authority is only vested in physicians, relegating other professions to a subordinate status. This kind of structure makes it harder for team-based stewardship to grow, which means that checks and balances that could stop misuse are overlooked. Veterinarians also said that structural gaps made it practically impossible for them to work together. One person said:

"*No collaboration exists in my workplace. Any cooperation is usually case-by-case."* [HD-8]

Another person talked about how there aren't enough important specialists in the veterinary field: *"In the private sector, especially for livestock, pharmacists and trained lab staff are almost always absent."* [VD-7]

The absence of pharmacists and trained support personnel in veterinary practice signifies not merely a resource deficiency; it indicates the systemic oversight of the veterinary sector in antimicrobial resistance governance. Veterinarians typically had to make decisions about prescriptions without any help from these professionals, which meant they had to work alone.

In addition to these structural problems, respondents also mentioned practical problems like too much work, not enough time, and a lack of institutional incentives. In crowded outpatient departments, where doctors must treat a lot of patients rapidly, there wasn't much time for group conversations about stewardship. Veterinarians often had to put immediate treatment ahead of working together because of the needs of farm visits and the pressure from clients. Without institutional rules or rewards, collaboration was up to each person's own motivation, which led to quite different ways of doing things. Overall, the people who answered said that inter-professional collaboration on AMR was poor, broken, and not well-developed. Informal collaboration among peers offered limited assistance, proving inconsistent and inadequate for guaranteeing reasonable prescribing. Stewardship committees and One Health programs were examples of formal platforms that were not used very often and were not connected to everyday practice; therefore, they didn't have much of an impact on decision-making. Professional hierarchies, unclear roles, missing pharmacists and lab personnel, and severe workloads made it even harder for people to work together. These findings underscore a significant paradox: although AMR is widely acknowledged as a multisectoral issue necessitating collaborative efforts, stewardship in Punjab persists in depending on solitary actions by individual practitioners. Without institutional changes that make collaboration a normal part of daily work, AMR policies could stay separate and not be able to turn policy awareness into action.

5.2.5 Patient and Client Expectations & Behavior (RQ5)

Respondents consistently identified the behavior of patients and clients regarding antibiotics as a significant concern. Veterinarians and doctors said that social norms and people's actions often

went against the principles of stewardship. Respondents said that patients and farmers thought antibiotics were quick fixes, didn't follow prescribed regimens very well, reused leftover drugs without professional advice, and sometimes urged doctors to change prescriptions. These behaviors were prevalent and were further perpetuated by cultural views, economic limitations, and the accessibility of antibiotics outside of professional avenues. Four subthemes emerged: (1) pressure to prescribe for quick relief, (2) incomplete course adherence, (3) reuse of leftovers, and (4) changed prescriptions due to insistence.

Pressure To Prescribe for Quick Relief (RQ5-1)

People who answered the survey said they were always pushed to give antibiotics, even when they thought they weren't needed. People who were sick typically thought that antibiotics would help them get better quickly and asked for them right away.

"People want quick results and aren't willing to wait for an illness to resolve on its own. Even if I explain it's not necessary, they still push for antibiotics." [HD-2]

This shows how many people in our culture think of antibiotics as "strong" treatments that will quickly help. For doctors, saying no to these kinds of demands could make patients unhappy or lose patients to other providers. A number of responders acknowledged that their clinical autonomy was compromised by the fact that patients could readily circumvent them by procuring antibiotics straight from pharmacies. So, the opportunity to change rational use was limited not just by expectations but also by the fact that OTC antibiotics were not always available. Veterinarians said they had similar experiences. Farmers often asked for antibiotics as a way to avoid or treat problems right away, even if there were other options that didn't need antibiotics.

"When I was new in practice, I use to try educating people not to use antibiotic but than my expertise as a doctor was challenged in the area and I lost my farmers. With the passage of time, I'm also a part of the same system I was trying to fight. Therefore, I do what farmer, or the system expects me to do. Farmers still expect me to prescribe antibiotics for almost every fever or cough. They see antibiotics as a quick fix and don't want to wait for supportive care or lab results." [VD-6]

This pattern shows how both patients and farmers used societal pressure to get professionals to make judgments. Doctors and vets tried to teach their customers, but the need for temporary relief

often surpassed their worries about resistance in the long run. The outcome was a professional setting where expectations, rather than medical necessity, significantly influenced prescribing behavior.

Incomplete Course Adherence (RQ5-2)

Respondents also stressed how common it is for patients and farmers to cease using antibiotics when their illnesses go better. Doctors said this was one of the most common ways people don't follow the rules:

“Especially among those who self-medicate. They’ll stop once they feel better.” [HD-2].

Another doctor said, “Once they feel better, they stop taking the medicine.” [HD-3]

This behavior shows a short-term, symptom-based approach to treatment, where stopping medicine was seen as acceptable because the patient was getting well. From a clinical standpoint, this compromised treatment efficacy and directly fostered resistance, as incomplete regimens heightened the probability of enduring resistant strains. Veterinarians noticed the same thing when they took care of livestock. Farmers often stopped giving medicine to an animal after it seemed to be getting better:

“Rarely do they complete the course. Many stop as soon as the animal looks better, sometimes after just two doses.” [VD-6]

Economic pressures often made this behavior worse. Farmers thought that prolonging therapy after recovery was a waste of money, especially when their livestock revenues were low. In both areas, imperfect adherence underscored the disparity between lay views of recovery and biological interpretations of treatment efficacy.

Reuse of Leftovers (RQ5-3)

Another behavior that hurt stewardship was the repeated use of unused antibiotics. People said that both patients and farmers often retained unfinished courses to use later without asking a specialist.

“They’ll save what's left and use it again without asking me." [VD-3]

This approach was based on both economic practicality and cultural traditions that saw antibiotics as household or farm goods, like painkillers or vitamins, that could be used again as needed. But using leftover medicine often meant giving people too little of it, choosing the wrong medicines, or treating diseases that didn't need them. Doctors indicated that reuse was frequent in cultures where self-medication was acceptable. Patients often thought they were being smart by not having to pay for another consultation. Veterinarians said that farmers even stored "farm boxes" full of half-used or unused medicines that they used on more than one animal. In both situations, the practice made it harder for specialists to help people use things responsibly, which made the gap between policy awareness and everyday life even bigger.

Changed Prescriptions Due To Insistence (RQ5-4)

Finally, the people who answered said that sometimes they changed their prescriptions because patients or farmers insisted, even though they knew it wasn't medically necessary. Doctors said that even though they attempted to resist, there were times when the pressure was so severe that they changed their prescriptions to avoid disagreement.

"I can control my own prescribing in the hospital." But other than that, I don't have much power because people may still buy antibiotics from pharmacies without ever seeing a doctor. [HD-1]

Veterinarians also talked about changing prescriptions to meet client needs. For example, they may choose a gentler antibiotic as a compromise so that clients didn't look for stronger or wrong medications from unlicensed sources. These tactics were practical and meant to reduce harm in situations where clients insisted on something and it was available over the counter, which made professional authority less effective. This theme shows that prescribing is a negotiation, where experts couldn't always strictly follow the rules. Instead, they often had to balance the ideas of stewardship with the way clients actually acted. The result was a type of "compromise prescribing," in which the doctor or veterinarian tried to find a middle ground between making the patient happy and doing their job.

The expectations of patients and clients were identified as a primary barrier to the judicious use of antibiotics. Respondents from both sectors stressed that patients and farmers frequently pressed them to prescribe antibiotics for immediate relief, seldom completed specified regimens, reused leftovers without prior consultation, and occasionally coerced alterations to prescriptions through

perseverance. These behaviors were influenced by cultural perceptions of antibiotics as potent, rapid-acting treatments, economic factors, and the systemic convenience of obtaining medications without prescriptions. For professionals, the outcome was a perpetual challenge to sustain stewardship while preserving confidence and preventing client attrition. These findings highlight that AMR policies cannot be effectively executed without tackling the behavioral and cultural aspects of antibiotic utilization, and without mitigating the structural deficiencies that facilitate self-medication and patient-driven prescribing.

5.2.6. Economic & Infrastructure Constraints (RQ6)

Respondents consistently articulated that economic and infrastructural realities exerted a greater influence on antibiotic use than formal policies. In both human and veterinary medicine, decisions regarding prescribing, adherence, and testing were significantly influenced by cost, availability, and the existence (or lack) of supportive networks. Four main subthemes came up: (1) Economic influence on antibiotic choice, (2) Affordability of diagnostics, (3) Use of human antibiotics in animals, and (4) Lack of funding for training/awareness.

Economic Influence on Antibiotic Choice (RQ6-1)

Both doctors and veterinarians said that the financial situation of the patient or farmer often decided which antibiotic to use. Doctors in human healthcare said that when patients couldn't afford brand-name or newer antibiotics, they gave them cheaper generic ones instead. One doctor said: *"If a patient can't afford expensive options, I prescribe according to their budget."* [HD-6]

This meant that ideas of stewardship often came second to cost. Instead of picking the prescription that was the most clinically suitable or the least expensive, prescribers often had to pick the drug that the patient could actually afford. This did make it easier for some people to get treatment, but it also made them more dependent on broad spectrum and lower-cost generics, which could have long-term effects on resistance. Veterinarians said that farmers put the same pressure on them, asking for cheaper drugs even if they didn't work as well. For poor farmers with little room to spare, keeping their animals alive in the short term was more important than picking the right drugs. This economic reality made it much worse, as short-term financial pressures were stronger than long-term stewardship aims.

Affordability of Diagnostics (RQ6-2)

Another big problem was the high expense of diagnostic tests. People who answered the survey said that even while there might be lab facilities, patients and farmers often skipped tests because they couldn't pay them.

"A blood culture can be six to seven thousand rupees, and most patients have to pay out of pocket since they don't have insurance." [HD-1]

Patients considered these fees superfluous when symptoms could be addressed empirically. Because of this, diagnostic stewardship, or testing before prescribing, was not often done in real life. Doctors said that when diagnostics were too expensive, they had to rely on empirical treatment, which made AMR programs less effective. Veterinarians said the same thing. One vet said that in rural locations, the closest diagnostic lab could be dozens of kilometers away, which would make both cost and distance too high. Farmers thought that testing was a "waste of money and time," thus they wanted to be treated right away. This made empirical prescription habits even stronger and made surveillance mechanisms much weaker, as only a few samples made it to labs for testing.

Use of Human Antibiotics in Animals (RQ6-3)

Several veterinarians pointed out that it is usual to use human antibiotics on animals when veterinary-specific medications are hard to get or too expensive. One person said:

"Honestly, the accessibility is quite limited. The medicines we actually need for specific conditions in small animals are often not available in Pakistan. We end up relying on human medicines because veterinary-specific antibiotics are either unavailable or too expensive." [VD-2]

People thought this change was necessary, not just a choice. But it had some big risks: human formulas didn't always work well with animal physiology, dosing wasn't always accurate, and the approach made it harder to hold people accountable for their stewardship. Respondents said that farmers generally supported this method because human antibiotics were cheaper and easy to find at drugstores. This made it hard to tell the difference between using drugs on people and animals, which made it harder for both groups to control resistance.

Lack of Funding for Training/Awareness. (RQ6-4)

Finally, the people who answered said that a lack of long-term funding for training and awareness was a major structural problem. Both doctors and veterinarians said that refresher courses, CME

sessions, and AMR seminars were either not very common or paid for by the people who took them. One vet said: *"Private vets have to pay for their own training."* [VD-5]

Some people said that farmers who raise chickens and other animals didn't get much or any instruction on AMR. When there were seminars or campaigns, they were usually short-term and donor-driven, with no follow-up after the fact. Because financing was not steady, stewardship knowledge did not circulate widely, and professionals had to rely on old methods or informal peer learning. Respondents stressed that training was not only necessary for their jobs, but also for the public's knowledge. Without paid advertising, patients and farmers didn't know how dangerous it was to not finish their courses, buy drugs over the counter, or use leftover drugs. One doctor said,

"Our government lack interest therefore funding doesn't come this way, that why we lack resource to provide knowledge and awareness about AMR" [HD-6].

Economic and infrastructural limitations surfaced as significant obstacles to the execution of AMR policy. The price of pharmaceuticals affected prescribing, the inability to pay for diagnostic tests, the lack of veterinary supplies made it normal to use human antibiotics in animals, and minimal funding left both experts and the public poorly informed. These results show that stewardship won't work unless we deal with problems at the economic and system levels. AMR policies will stay separate from real life until patients and farmers can pay for tests and the right treatments, and until governments put money into ongoing training and education.

5.2.7 Government and Policymakers' Role (RQ7)

The function of governmental organizations and decision-makers in carrying out AMR policies was a recurrent subject in the interviews. Despite the existence of national frameworks and guidelines, respondents frequently underlined that frontline professionals frequently felt left out of meaningful participation during policy formation and that implementation of these frameworks was inadequate. Stakeholder consultation in policymaking and the execution of AMR policies emerged as two subthemes.

Enforcement of AMR policies (RQ7-1)

Respondents from the veterinary and human sectors emphasized how little or ineffectively AMR policies were enforced. Physicians agreed that Pakistan had federal and provincial guidelines as

well as a National Action Plan, but they were not well implemented in day-to-day practice. One doctor clarified, *"there is hardly any enforcement."* [HD-1]

This claim reflects a more general belief that although policies were written down, they were ineffective. Physicians characterized enforcement as mostly symbolic, lacking systematic oversight of prescribers, hospitals, or pharmacies. There was little indication of oversight or sanctions, and antibiotics were still sold without a prescription. The lack of enforcement measures in the veterinary industry was also emphasized by veterinarians. One veterinarian observed:

"I don't see any enforcement at urban level, and you won't believe the condition in rural areas." [VD-1]

Policymakers were "almost absent from poultry regulation," according to another poultry specialist [VD-8]. These viewpoints demonstrate how enforcement deficiencies were even more noticeable in the field of animal health, where supervision systems were said to be essentially non-existent. Respondents claimed that AMR standards would remain paper-based goals in the absence of obvious enforcement, such as frequent inspections, fines, or prescription monitoring. Everyone agreed that lax enforcement let other players, like drug firms, quacks, and unregistered vendors, control the antibiotic market without any oversight. The absence of regulations severely hampered stewardship initiatives in both industries.

Stakeholder Consultation in Policymaking (RQ6-2)

Participants also brought up the issue of frontline professionals' limited involvement in policy formulation discussions. Despite being in the center workforce, many respondents said that the policies did not fully represent the circumstances faced by practitioners in clinics, hospitals, and farms. One physician clarified:

"We are the backbone if they want to implement these policies and when it comes to policy making, they have owners of pharmaceutical companies on board." [HD-7]

Because of this exclusion, there was a gap between high-level strategies and the real-world obstacles faced by people in charge of putting them into practice. The respondents underlined that field physicians, rural veterinarians, and chemists who closely monitored patient and customer

behaviors were frequently excluded from the top-down drafting of policy. Participants who were veterinarians emphasized this discrepancy especially well. A rural veterinarian argued:

"Veterinarians are not included in enforcement design or given full authority. These are just orders on paper for us, so we treat them as such-nothing practical" [VD-1]

One of the key causes of the policies' continued impracticality and inadequate field-condition adaptation was thought to be this absence. Although their opinions were rarely heard, professionals believed that their knowledge of OTC sales, quackery, diagnostic shortages, and farmer pressures may improve the efficacy of legislation if included. Additionally, other respondents pointed out that consultation was mostly symbolic when it did take place. Stakeholder meetings and workshops were occasionally conducted, but they lacked the means to turn frontline input into laws that could be implemented. Because of this, a lot of policies were seen as being disconnected from the realities on the ground, which led to poor and uneven implementation. In practice, respondents from both sectors characterized the role of policymakers and the government as being mainly ineffectual. Particularly in veterinary and rural contexts, AMR policy enforcement was characterized as inadequate, with little to no monitoring and oversight. Frontline professionals like physicians, veterinarians, and chemists were frequently left out of the policy creation process, and stakeholder consultation was similarly limited. The gap between policy and practice widened even more because of AMR policies remaining merely symbolic texts rather than practical frameworks due to a combination of inadequate enforcement and inadequate consultation.

5.2.8 Suggested Strategies & Solutions (RQ8)

Along with pointing out problems, the people who answered also gave a number of suggestions for how to improve AMR stewardship. These solutions were based on the doctors' and veterinarians' own experiences on the front lines, and they showed what was most needed to close the gap between policy and practice. The suggested solutions were grouped into five subthemes: (1) controlling the sale of antibiotics over the counter, (2) campaigns to raise awareness and education programs, (3) including field professionals in making policy, (4) training and refresher courses, and (5) digital monitoring and tracking of prescriptions.

Control OTC antibiotic sales (RQ8-1)

The most important thing that both groups agreed on was that antibiotics should not be available over the counter. Doctors said the regulations would only succeed if pharmacies were closely watched. A doctor said, *"Completely ban them and punish pharmacies that don't follow the rules."* [HD-1]

Veterinarians agreed, saying that agro-vet stores were still the major problem with stewardship. A vet in a rural area said that guidelines about only giving out prescriptions needed to be followed all the time and backed up with punishments: "Strict enforcement of policies that only allow prescriptions for veterinary antibiotics." [VD-1]

These suggestions show that professionals thought that controlling OTC was the most important part of all other therapies. If this gap isn't closed, patient and farmer pressure, fraud, and not following the rules will keep making rational use less effective. Respondents also stressed that enforcement needed to be clear, with inspections, fines, and licensing requirements, or else the rules would stay on paper.

Awareness campaigns / education programs (RQ8-2)

Another common suggestion was to make people and professionals more aware. Doctors advised big efforts in both mainstream and social media:

"Public campaigns on TV, radio, and social media that explain when antibiotics are needed and what can happen if they are misused." [HD-8]

Veterinarians suggested awareness initiatives for farmers that are specific to the systems used to raise livestock:

"Campaigns to teach farmers about vaccinations, hygiene, and biosecurity to cut down on their use of antibiotics." [VD-1]

Respondents concurred that awareness must be continuous rather than episodic, use accessible outlets that communities trust. People had a lot of wrong ideas about antibiotics being "quick fixes," and it would take a lot of practical instruction to change their minds. For veterinarians, education also meant giving people other options, such encouraging immunization and good hygiene habits that lower the risk of sickness, which in turn lowers the need for medications.

Include Field Professionals in Policymaking (RQ8-3)

The people who answered the survey clearly stressed the necessity for policymaking that includes everyone. Doctors and veterinarians both felt left out of decision-making processes, even though they knew the most about what was going on. One doctor said, *"Frontline experience is very important for making policies that work."* [HD-8]

Veterinarians agreed with this and said that leaving them out made the guidelines too hard to follow:

"Veterinarians should have the power of the law and be able to make decisions about One Health." [VD-1]

The group agreed that policies would stay disconnected from practice unless field practitioners had a say in them. It was thought that including doctors, vets, chemists and even farmers in the process of drafting policy was important for coming up with solutions that could be put into action and that took the local situation into account.

Training & Refresher Courses (RQ8-4f) Respondents kept saying that professionals should have regular, easy-to-find training opportunities to keep them up to date on stewardship principles. A lot of people said that training was hard to get by, self-funded, or not available at all. One doctor said:

"Regular CME sessions, updates on trends in resistance, and training on how to read culture results." [HD-1]

Veterinarians expressed a comparable necessity: *"Mandatory training in antimicrobial stewardship and access to diagnostic tools in the field."* [VD-1]

People thought that not having refresher courses was a big problem that kept the plan from being put into action. People who answered said that ongoing education would not only make prescribing better, but it would also help experts give better advice to patients and farmers, which would help with non-compliance and pressure to prescribe. Training was also seen to get chemists and lab professionals to join stewardship teams, which would make the approach more multidisciplinary.

Digital Monitoring / Prescription Tracking (RQ8-5)

Lastly, people who answered the survey said that digital tools may make accountability better. Doctors advised ways to keep track of and record prescriptions:

"Digital prescription like developed countries, if they were widely used and easy to use, they could cut down on overuse." [HD-8]

Digital prescription tracking was thought to be a means to close the enforcement gap by keeping an eye on antibiotic use, reporting bad prescribing, and giving data for surveillance. Respondents said that these kinds of technologies must be easy to use and available in both cities and rural areas without making people's jobs harder. Veterinarians were also interested in digital tools like prescription logs and applications for monitoring farms. These instruments could aid with oversight, find patterns of usage, and send information to national AMR surveillance systems. Respondents thought that digitalization would be a long-term way to close the gap between knowing about policies and following them.

People who participated in the interview said that a multi-pronged strategy would be best for strengthening AMR stewardship. The most important thing was to strictly limit the sale of antibiotics over the counter. Without this, other steps would not work. They also stressed the importance of efforts to raise awareness among the public and farmers, developing policies that include everyone, and giving professionals ongoing training to keep their expertise up to date. Lastly, they thought that digital prescription monitoring could be a good idea because it could make the system more open and accountable. These ideas showed how important it is to use a mix of rules, education, giving professionals more power, and technology to make AMR policies work in the real world.

This chapter has shared what we learnt from in-depth interviews with doctors and veterinarians, which were based on the eight research topics that guided this study. The findings indicate that although there is awareness of AMR policies in both sectors, this understanding is disjointed and inadequately implemented. Policies are frequently regarded as merely theoretical, with enforcement mechanisms characterized as negligible or nonexistent, especially in veterinary and rural settings. It was discovered that the obstacles of implementation were deeply ingrained in the system and connected to one another. Over-the-counter sales, quackery, and limited diagnostics, along with economic pressures and customer expectations, made it hard to keep rational prescribing going. The interactions among stakeholders made things even more problematic. Pharmaceutical firms were seen as very powerful, legislators were seen as remote or compromised, and frontline

doctors were seen as dedicated but limited in their power. Most of the time, disciplines worked together in an informal and unstructured way, and there weren't many working One Health platforms. Patients and clients behaved in ways that made even the right prescriptions less effective. For example, they wanted immediate relief, didn't follow the instructions completely, and reused leftovers. At the same time, structural problems including the high cost of diagnostics, the lack of veterinary-specific drugs, and not enough money for training made empirical and improper use even more common. Even with these problems, the people who answered also gave specific ideas on how to make things better. These included stronger rules for over-the-counter sales, ongoing public awareness efforts, developing policies that incorporate field workers in decision-making, regular training opportunities, and the creation of computerised systems for tracking prescriptions. These answers suggest a holistic strategy that combines regulation, education, empowerment, and technology. In conclusion, the findings indicate that AMR stewardship in Punjab is impeded not alone by a lack of awareness, but also by structural, cultural, and economic hurdles affecting both human and veterinary sectors. Simultaneously, the perspectives of frontline professionals underscore viable strategies for advancement, stressing the necessity for enhanced governance, improved resource distribution, and enduring behavioral transformation. The next chapter will put these findings in the context of the larger body of work, showing what they mean for policy, practice, and future study.

6. Discussion

6.1. Discussion of Descriptive Statistics

This study presents descriptive statistics that underscore important socio-demographic and professional traits of healthcare professionals in Punjab, Pakistan, offering crucial context for understanding the primary findings. The workforce is primarily composed of younger and mid-career professionals, with 85.36% being under 40 years of age. This demographic profile carries significant implications for antimicrobial stewardship interventions. Torumkuney et al., (2022) found that younger practitioners tend to be more open to adopting guidelines and pursuing continuing education than their older counterparts. Mustafa et al., (2023) observed that during the COVID-19 pandemic, younger staff demonstrated greater adaptability in modifying their prescribing practices to align with the changing evidence. The male predominance in the sample, at 71.79%, mirrors the wider gender imbalance present in Pakistan's healthcare workforce, as highlighted by Ghafoor et al., (2022). While gender did not appear as a major factor affecting perceptions in this study, the representation of gender in healthcare has the potential to shape professional culture, influence decision-making dynamics, and affect interactions between patients and providers. The equitable representation of human and veterinary doctors (47.62% and 52.38% respectively) highlights the significance of the One Health approach to AMR, recognizing the intertwined responsibilities of human and animal health sectors in tackling resistance risks (Founou et al., 2021) The sample included 64.84% of respondents from urban areas, aligning with the distribution of Pakistan's healthcare infrastructure, which is predominantly concentrated in urban centers(Ali et al., 2021). The inclusion of 35.16% rural respondents offers significant insight into the distinct challenges encountered in these environments. Naz et al., (2023)emphasize that rural populations face considerable obstacles to accessing care, such as travel distance, availability of services, and costs, which can influence patterns of antibiotic usage. A mere 27.47% of participants indicated they had undergone formal AMR training, reflecting the findings of Alam et al., (2023), which highlighted a significant lack of organized AMR education for frontline health workers. The lack of training coverage hinders the effective implementation of AMS programs and diminishes understanding of the complex factors contributing to resistance(Inoue, 2019). Interestingly, even with minimal training, a significant 87.55% concurred that socio-economic status affects the misuse of antibiotics.

This significant level of consensus indicates a foundational understanding that can be leveraged through focused, contextually appropriate training programs.

6.2. Discussion of Regression Analysis

The analysis using multivariable logistic regression revealed four key factors that significantly influence perceptions regarding the socio-economic impact on inappropriate antibiotic use: years of professional experience, work setting, type of location, and training in antimicrobial resistance. These associations yield practical insights for crafting focused interventions. Extensive professional experience revealed a significant pattern: those in the early stages of their careers tended to recognize socio-economic influences more readily than those in the middle of their careers. This observation aligns with the findings of Rizvi et al. (2022), which indicated that junior clinicians in Lahore demonstrated a greater tendency to ask about patients' economic limitations prior to making prescribing decisions. Ahmed and Abbas (2022) indicate that over time, practitioners might embrace established norms that downplay socio-economic factors, particularly in resource-limited environments where the focus is on time efficiency. The work environment proved to be a crucial element, as those affiliated with hospitals exhibited greater consensus compared to their clinic-based counterparts. This could be attributed to hospitals catering to a wider range of socio-economic backgrounds, frequently involving intricate and severe cases where the financial obstacles to completing treatment are more evident (Abdullah et al., 2014; Ali et al., 2021). Conversely, practitioners operating within clinics might encounter more uniform patient demographics, which could lead to a diminished awareness of significant socio-economic inequalities (Shaikh et al., 2010). The type of location had a notable impact on perceptions, as rural practitioners were considerably more inclined to concur that socio-economic status affects inappropriate antibiotic use. Naz et al. (2023) found that the healthcare-seeking behaviors of women in rural areas are significantly impacted by financial constraints and accessibility issues, resulting in postponed care and insufficient treatment. Similar disparities have been noted in low- and middle-income countries worldwide, where healthcare providers in rural areas often face patients who cannot afford complete medication courses, thereby heightening the risk of antimicrobial resistance (Founou et al., 2021; Ronat et al., 2021). The findings also align with One Health concerns, given that rural communities frequently exhibit overlapping patterns of antibiotic use in both human and veterinary

contexts (Mariappan et al., 2021). The analysis revealed that AMR training emerged as the most significant predictor in the model, boasting an odds ratio of 5.48. This suggests that those who underwent training were considerably more inclined to acknowledge socio-economic influences. Bertagnolio et al. (2024) highlights the importance of training interventions that integrate socio-economic and contextual content in order to effectively alter prescriber behavior. Saleem et al. (2023) reported that AMR training programs in Punjab resulted in enhanced compliance with stewardship guidelines, reinforcing the essential function of education in strategies aimed at mitigating AMR.

6.3. Discussion for interviews

Throughout the interviews, participants uniformly underscored the impact of influential stakeholders on antibiotic utilization. The significant influence of pharmaceutical firms highlighted in this study aligns with international research demonstrating how market incentives affect prescribing patterns in low- and middle-income countries (Sulis et al., 2020; Smith & Coast, 2013). Doctors said that there were incentives and aggressive marketing aimed at prescribers, while veterinarians said that corporate reps were directly approaching farmers with discounts and bundled supplies. Similar results have been seen in India and Vietnam, where pharmaceutical marketing was found to be a major cause of antibiotic misuse in both people and animals (Do et al., 2016; Farooqui et al., 2019). In the context of Punjab, it is remarkable how this effect immediately circumvents professional gatekeeping; veterinarians reported that farmers frequently purchased directly from sales agents, a phenomenon also noted in Kenya's chicken business (Caudell et al., 2020). Participants also perceived policymakers as ineffective enforcers, occasionally hindered by affiliations with pharmaceutical companies. This view is in line with earlier criticisms of AMR governance in South Asia, which said that conflicts of interest and broken regulations made it hard to execute the law (Laxminarayan & Chaudhury, 2016). Global frameworks like the WHO Global Action Plan stress stewardship and surveillance, but research shows that enforcement at the country level is often weak because of lack of resources and political economic issues (Chokshi et al., 2019). By capturing this view across both physicians and veterinarians, the current study provides more evidence of the governance gap in antimicrobial resistance (AMR). Another notable theme was the insufficient collaboration among professionals. Participants characterized interactions as predominantly informal, reflecting conclusions from a multi-country FAO report (2018), which underscored the

lack of organized One Health procedures in LMICs. Research in Pakistan indicates that while human health professionals may occasionally engage with hospital stewardship teams, veterinarians frequently operate in isolation, exhibiting limited integration into antimicrobial resistance governance (Qamar et al., 2020). This study corroborates that narrative, as physicians indicated minimal engagement of chemists, while veterinarians recollected only informal peer discussions. Similar tendencies have been noted in Uganda and Tanzania, where inadequate inter-professional communication hampers coordinated responses to antimicrobial resistance (Ayukekbong et al., 2017). This research demonstrates that juxtaposing human and veterinary experiences highlights how isolated behaviors exacerbate the fragmentation of AMR management in Punjab. Expectations from patients and farmers also had a big impact. Numerous studies have shown that people in low- and middle-income countries (LMICs) often ask for antibiotics, even for minor ailments (Holloway et al., 2017; O'Neill, 2016). Similar studies in Bangladesh and India have demonstrated that patient demand frequently results in inappropriate prescriptions, despite professional understanding (Sulis et al., 2020). Farmers exhibit similar behaviors: the prophylactic use of antibiotics and the repurposing of leftovers are extensively reported in chicken farming throughout South Asia (Ahmed et al., 2020; Caudell et al., 2020). This study introduces a comparative approach, revealing that both human and veterinary experts modified prescriptions to preserve trust with patients and clients, underscoring the influence of social influences on clinical judgement across several sectors. This supports anthropological research indicating that antibiotic consumption is as much a social phenomenon as a medical practice (Willis & Chandler, 2019). Economic and infrastructural limitations were also significant in participants' narratives. The avoidance of diagnostics due to cost mirrors prevalent trends in LMICs, where empirical prescribing is influenced more by resource scarcity than by ignorance (Ayukekbong et al., 2017). Similar results have been observed in Nigeria, Uganda, and India, where both patients and farmers are reluctant to pay for tests (Chokshi et al., 2019). The veterinary industry specifically emphasized that the narrow profit margins in chicken production promote the use of preventative antibiotics, reflecting findings in Vietnam and Kenya (Do et al., 2016; Caudell et al., 2020). These similarities show that stewardship won't work until the economic realities of healthcare and farming are considered. A common topic was anger at the government's lack of action and execution of policies. The respondents' demands for stronger restrictions on over-the-counter sales reflect the policy suggestions put forth by the O'Neill report (2016) and the WHO (2019), both of which have recognized the regulation of antibiotic

distribution as a worldwide imperative. Participants in this study, like those in Bangladesh and Tanzania, observed minimal evidence of effective enforcement (Ahmed et al., 2020; Ochieng et al., 2021). Concerns regarding conflicts of interest between officials and industry signify broader criticisms of pharmaceutical governance in South Asia (Laxminarayan & Chaudhury, 2016). By revealing analogous grievances among human and veterinary experts, this study underscores the extensive mistrust in existing governance frameworks. Even though there were these problems, the people who took part came up with specific plans that are very similar to the best practices used around the world. Their calls to stop over-the-counter sales, control veterinary medication stores, and start prescription monitoring are in line with WHO, FAO, and OIE recommendations for national AMR action plans (WHO, 2019). Recommendations for awareness campaigns, farmer education, and sector-specific guidelines correspond with data from India and Vietnam, where community-level interventions have demonstrated efficacy (Do et al., 2016). The focus on digital tracking systems is a new idea in the area and shows that professionals are aware of new methods for accountability. This study emphasizes the necessity of incorporating practitioners in policy creation by gathering frontline perspectives on solutions, a notion recently emphasized in One Health literature (Graham et al., 2021). When looked at collectively, the qualitative findings both support and add to what is already known. Similar to other LMIC research, they demonstrate that AMR policies are frequently symbolic, enforcement is inadequate, and social and economic factors contribute to overuse. This study offers a comparative analysis of human and veterinary practice in Punjab, illustrating how analogous structural constraints influence prescribing in both domains. This One Health viewpoint emphasizes the necessity for integrated initiatives that concurrently tackle the political economy of antibiotic utilization in both healthcare and agriculture, rather than in isolation.

Implications for future studies.

The findings of this study emphasize the urgent need for further research that moves beyond identifying barriers to the implementation of AMR policies and towards evaluating solutions. While this study highlights the influence of socio-economic and demographic factors, weak enforcement and stakeholder dynamics, future studies should focus on how targeted interventions can change prescribing practice and decrease overuse of antibiotics.

Longitudinal research is needed to assess whether awareness campaigns, digital tracking of prescription or professional training can result in long lasting gains in antibiotic stewardship. In future, we need interventional studies that compare different approaches such as agricultural education in rural areas versus digital prescription monitoring in urban hospitals that may yield insights into the most viable and economically efficient strategies.

Furthermore, there is a significant necessity for research that investigates inter-professional and one-health collaboration. This study investigates that there is an inadequate coordination among physicians, veterinarians and pharmacists, which is a significant gap in implementing AMR policies. Future research may assess pilot initiatives that unite these groups to determine if collaborative stewardship platforms can enhance antibiotic stewardship.

Finally, implementation research should look at political economic sides of AMR policy. Antibiotic use is affected by the role of drug companies, cost of tests, and the expectation of patients and farmers. To make sure that the interventions are both effective and socially and economically sustainable, we need to understand how these factors work together.

7. Strength And Limitation

7.1. Strengths

The main strength of this study is it's One Health design, which incorporates insights from both human and veterinary healthcare professionals. This method recognizes the interrelated aspects of AMR, facilitating a deeper comprehension of socio-economic impacts across various sectors. The inclusion of respondents from both rural and urban areas guarantees that the findings reflect a wide range of experiences and perceptions. The application of multivariable logistic regression enhances causal inference through the control of confounding variables, yielding more dependable estimates of associations. The substantial sample size and equitable distribution across professional categories further strengthen the reliability and representativeness of the results. The study conceptually tackles a significant gap in the literature on AMR by specifically highlighting socio-economic determinants, an area frequently eclipsed by microbiological and pharmacological investigations.

7.2. Limitations

Cross-sectional design restricts the ability to draw causal conclusions, as it does not allow for the establishment of temporal relationships between predictors and perceptions. Self-reported data are naturally prone to social desirability and recall biases, which may lead to inflated agreement rates. The emphasis on Punjab in this study could restrict the applicability of the findings to other provinces that have varying socio-economic and healthcare environments. A further limitation is the lack of prescription audit data, which hinders the ability to validate self-reported perceptions with actual prescribing behaviors. Moreover, the dichotomous nature of the dependent variable (agree/disagree) could potentially oversimplify the complex professional viewpoints regarding socio-economic factors.

8.Conclusions

This study highlights the significance of socio-economic factors as essential influences on the misuse of antibiotics in Pakistan. Key predictors—such as professional experience, work environment, type of location, and AMR training—underscore distinct, actionable targets for intervention. Incorporating socio-economic awareness into AMR training, along with investing in rural healthcare infrastructure and reinforcing regulatory frameworks, can significantly improve stewardship effectiveness. Future strategies should be comprehensive, incorporating One Health principles to tackle AMR risks across human, animal, and environmental sectors. It is essential for those in positions of authority to focus on collaborative efforts across various sectors and engage with communities to effectively manage and contain AMR in a sustainable manner. The results of this study offer compelling support for integrated, context-sensitive policy interventions. It is crucial to observe that certain variables exhibited varying degrees of significance when comparing the bivariate and multivariable analyses. For example, the analysis revealed a significant relationship between age and the dependent variable in the bivariate analysis (*p* = 0.001), indicating that younger professionals exhibited higher agreement rates. However, this relationship lost its significance in the multivariable model after adjusting for additional factors. On the other hand, years of professional experience did not achieve statistical significance in the bivariate analysis (*p* = 0.109), yet it surfaced as a significant predictor in the regression model. This transition underscores the necessity of accounting for confounding variables to reveal independent associations that might be obscured or amplified in analyses that are not adjusted.

The qualitative findings indicated a continuous disparity between the formulation of AMR policy and its execution in Punjab. Healthcare professionals in both human and veterinary fields knew of the National Action Plan, but majority said it was "largely on paper," meaning that it wasn't really being enforced. Some of the biggest problems were that patients and clients wanted immediate relief from antibiotics, that antibiotics were widely available over the counter, that they weren't used for diagnosis because they were too expensive or the infrastructure wasn't good enough, and that economic constraints made people want to use cheaper generics or human antibiotics on animals. Rural veterinary clinics were especially bad off since they had almost no diagnostic help and a lot of fraud. The interactions between stakeholders showed how strong pharmaceutical firms are and how inadequate regulatory enforcement is. Professionals thought they didn't have much power

because patients and farmers could get antibiotics directly from them. Doctors, vets and chemists didn't work together very often, and One Health coordination only happened in schools. Even with these problems, the people who answered the survey came up with useful solutions, such as enforcing prescription-only sales, targeted awareness campaigns (especially for farmers and rural communities), including frontline professionals in policymaking, standardized guidelines, refresher training, and digital prescription monitoring systems. In conclusion, the study demonstrates that while professionals acknowledge the significance of antimicrobial resistance (AMR), institutional obstacles—such as inadequate enforcement, socio-economic limitations, and restricted inter-professional collaboration—persist in hindering successful implementation. To fill these gaps, we need stronger enforcement tools, awareness methods that are appropriate to the situation, and real involvement of practitioners in decision-making.

Declaration of Academic Honesty

Hereby, I declare that I have composed the presented master thesis independently on my own and without any resources other than the ones indicated. All thoughts taken directly or indirectly from external sources are properly denoted as such.

Hamburg, 23-09-2025

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Tamoor Azeem

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Appendix

I. Questionnaire for quantitative data collection
II. Semi-structured interview question for qualitative data collection
III. Consent form
IV. Supplementary results (frequency distribution of remaining variables)
V. QCAmap Coding Results

I. Questionnaire for quantitative data collection

Thank you for participating in this study, which seeks to analyze socio-economic context and stakeholder dynamics in reducing inappropriate use of antibiotics in Punjab, Pakistan. This questionnaire aims to gather information from various stakeholders, human and veterinary doctors. Your responses will be anonymous and will be used solely for research purposes.

Instructions:

Please read each question carefully and select (✓) the answer that best reflects your experience or knowledge. If you have any questions, please do not hesitate to ask.

Section 1: Demographic Information

1. Are you a resident of Punjab Pakistan?
    - Yes
    - No
2. How old are you? (Tick (✓) where appropriate))
    - Less than 30
    - 30-39
    - 40-49
    - 50-59
    - More than 59
3. What is your gender
    - Male
    - Female
    - Other
4. What is your professional role?
    - Human doctor
    - Veterinary doctor
5. what is your specialization?

- General practitioner
- Specialist (please specify:_____)

6. How many years of professional experience do you have?
   - 0-5 years
   - 6-10 years
   - 11-20 years
   - More than 20 years
7. Where do you primarily work?
   - Hospital
   - Clinic
8. which area your hospital/ clinic is located?
   - Rural
   - Urban
   - Semi – urban

Section 2: socio-economic context

9. Have you received any formal training on antibiotic stewardship?
   - Yes
   - No
10. How easy is it to access antibiotics for your patients/clients?
    - Very easy
    - Easy
    - Difficult
    - Very difficult

11. How often does the economic status of patients influence your choice of prescribing antibiotics?
    - Sometimes
    - Rarely

12. How does it effect your prescription?
    - I prescribe smallest pack size available
    - I dispense left overs / returns
13. How often do you prescribe antibiotics based on patient demand?
    - Sometimes
    - Rarely
14. Does economic status of patient effect the choice prescribing antibiotic resistance test
    - yes
    - no
15. In your opinion, how prevalent is the overuse / misuse of antibiotics in your area?
    - Very prevalent
    - Somewhat prevalent
    - Rare
16. Do you believe that the socio-economic status of patients affects the inappropriate use of antibiotics?
    - Agree
    - Disagree

.

II. Qualitative Questionnaire (Stakeholder Dynamics Interviews)

1. **Introduction for Interview:** Thank you for participating in this study. Your insights will help us understand the dynamics of antibiotic use policies in Punjab, focusing on healthcare professionals' roles. The interview will focus on your views about AMR policies and the challenges you face as a doctor.
2. **Interview Questions**:
    - Sociodemographic: Age, gender, occupation, workplace setting, region, years of experience,
    - How do you perceive the effectiveness of current policies aimed at reducing inappropriate antibiotic use in your region?
    - What are the key challenges you face in implementing these policies in your practice?
    - How do you collaborate with other healthcare professionals (e.g., pharmacists, other doctors) to ensure appropriate antibiotic use?
    - What factors, in your opinion, hinder or support effective implementation of AMR policies?
    - Can you describe the power dynamics between different stakeholders (e.g., doctors, policymakers, pharmaceutical companies) that influence antibiotic use?
    - How could these dynamics be changed to improve the outcomes of AMR policies?
    - In your experience, how influential are patients' expectations in your decision-making regarding antibiotic prescription?
    - What strategies do you think should be prioritized to reduce inappropriate antibiotic use in your region?

III. CONSENT FORM

STUDY TITLE

Socio-Economic Context and Stakeholder Dynamics in Reducing Inappropriate Use of Antibiotics in Punjab, Pakistan

PARTICIPANTS' STATEMENT

I acknowledge that I have read or have had the purpose and contents of the Participants' Information Sheet read and all questions satisfactorily explained to me in a language I understand **(*English*)**. I fully understand the contents and any potential

implications as well as my right to change my mind (i.e. withdraw from research) even after I have signed this form.

I voluntarily agree to be part of this research.

Name of Participant……..

Participants' Signature …….

Date:…….

INVESTIGATOR STATEMENT AND SIGNATURE

I certify that the participant has been given ample time to read and learn about the study. All questions and clarifications raised by the participants have been addressed.

Researcher's name…….

Signature …….

Date…….

IV. Supplementary results (frequency distribution of remaining variables)

The following table represents questionnaire variables that were not included in the main results chapter. They are provided here for completeness, showing the frequency (n) and percentage (%) distribution of responses. Total number of responses are same (n=273).

Table 5. Frequency distribution of remaining variables

Variable	Category	Frequency (n)	Percentage (%)
Antibiotic access	1	137	50.18
	2	50	18.32
	3	74	27.11
	4	7	2.56
	5	5	1.83
Economic influence on prescription	Sometimes	206	75.50
	Rarely	67	24.50
Economic effect on prescription	I prescribe smallest pack size available	249	91.21
	I dispense leftovers / returns	24	8.79
Prescribe by demand	Rarely	140	51.28
	Sometimes	133	48.72
Economic effect on antibiotic resistance test	Yes	218	79.85
	No	55	20.15
Antibiotic overuse	Prevalent	253	92.67
	Rare	20	7.33

V. QCAmap Coding Results

This appendix presents the coding results from the QCAmap qualitative analysis. For each research question (RQ1–RQ8), a summary table and a corresponding bar chart are provided. The tables show the number of coded text segments per subcategory, the percentage within the theme, and the number of interviews in which the category appeared. The charts visualize these distributions. Note: multiple coded segments may originate from a single interview, therefore the total counts exceed the number of interviews (n=16).

RQ-1: Policy Awareness and Perception

Table 6: Distribution of coded segments for RQ1 — Policy Awareness & Perception.

Research Question / Theme	Subcategory	No. of Segments	Interviews (out of 16)	% within Theme
RQ1 — Policy Awareness & Perception	RQ1-3	12	16	30.4%
	RQ1-2	16	16	28.6%
	RQ1-4	12	12	21.4%
	RQ1-1	11	11	19.6%

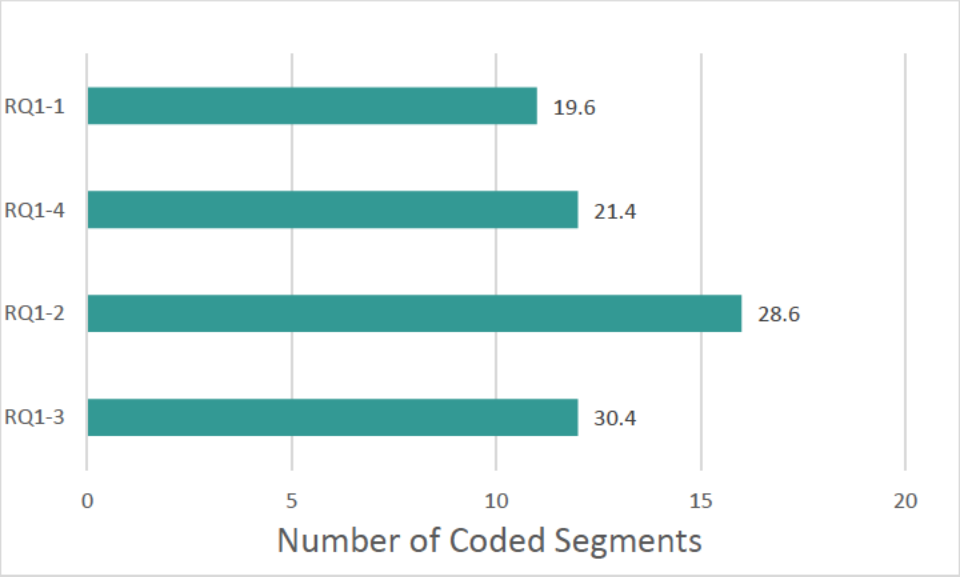

Figure 8: Bar chart of coded segments for RQ1 — Policy Awareness & Perception.

RQ-2 policy implementation challenges

Table 7: Distribution of coded segments for RQ2 — Policy Implementation Challenges.

Research Question / Theme	Subcategory	No. of Segments	Interviews (out of 16)	% within Theme
RQ2 — Policy Implementation Challenges	RQ2-1	22	16	29.3%
	RQ2-2	16	15	21.3%
	RQ2-4	14	14	18.7%
	RQ2-6	9	8	12%
	RQ2-3	8	6	10.7%
	RQ2-5	6	6	8%

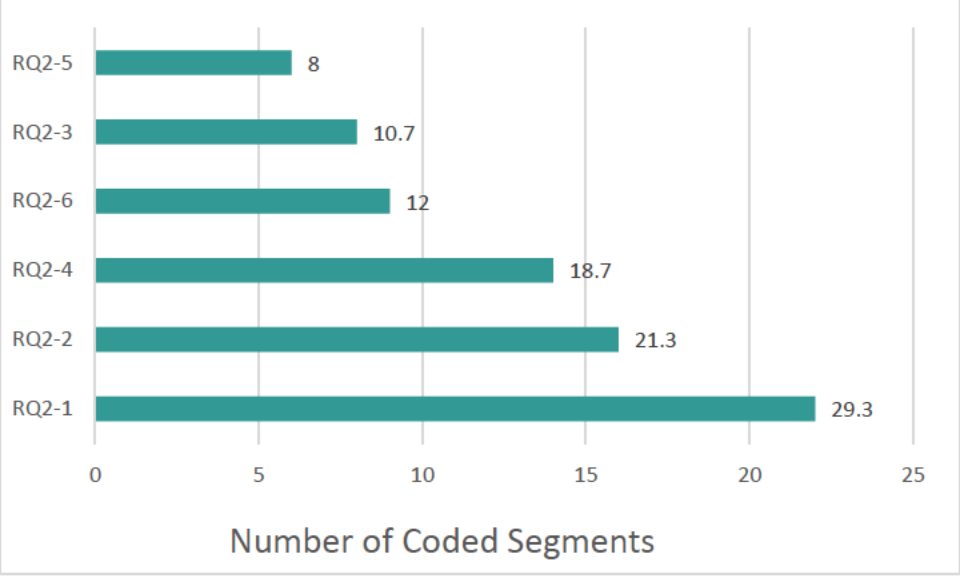

Figure 9: Bar chart of coded segments for RQ2 — Policy Implementation Challenges.

RQ-3 stakeholders power dynamics

Table 8: Distribution of coded segments for RQ3 — Stakeholder Power Dynamics.

Research Question / Theme	Subcategory	No. of Segments	Interviews (out of 16)	% within Theme
RQ3 — Stakeholder Power Dynamics	RQ3-1	15	15	33.3%
	RQ3-2	15	14	33.3%
	RQ3-3	15	14	33.3%

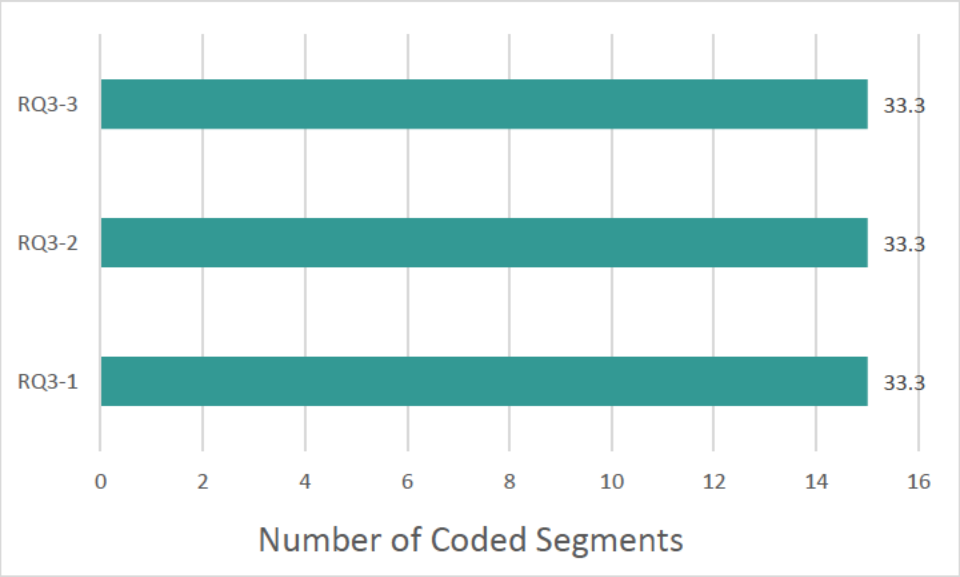

Figure 10: Bar chart of coded segments for RQ3 — Stakeholder Power Dynamics.

RQ-4 inter- Professional collaboration

Table 9: Distribution of coded segments for RQ4 — Inter-professional Collaboration.

Research Question / Theme	Subcategory	No. of Segments	Interviews (out of 16)	% within Theme
RQ4 — Inter-professional Collaboration	RQ4-1	13	13	46.4%
	RQ4-3	11	11	39.3%
	RQ4-2	4	4	14.3%

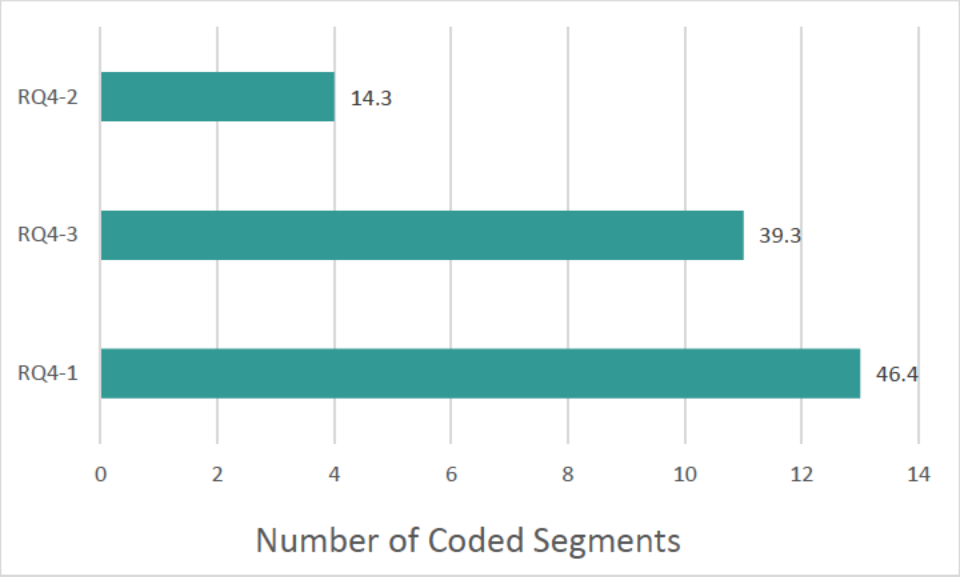

Figure 11: Bar chart of coded segments for RQ4 — Inter-professional Collaboration.

RQ-5 patient/client expectations and behavior

Table 10: Distribution of coded segments for RQ5 — Patient / Client Expectations & Behavior.

Research Question / Theme	Subcategory	No. of Segments	Interviews (out of 16)	% within Theme
RQ5 — Patient / Client Expectations & Behavior	RQ5-4	12	12	29.3%
	RQ5-2	11	11	26.8%
	RQ5-1	10	10	24.4%
	RQ5-3	8	7	19.5%

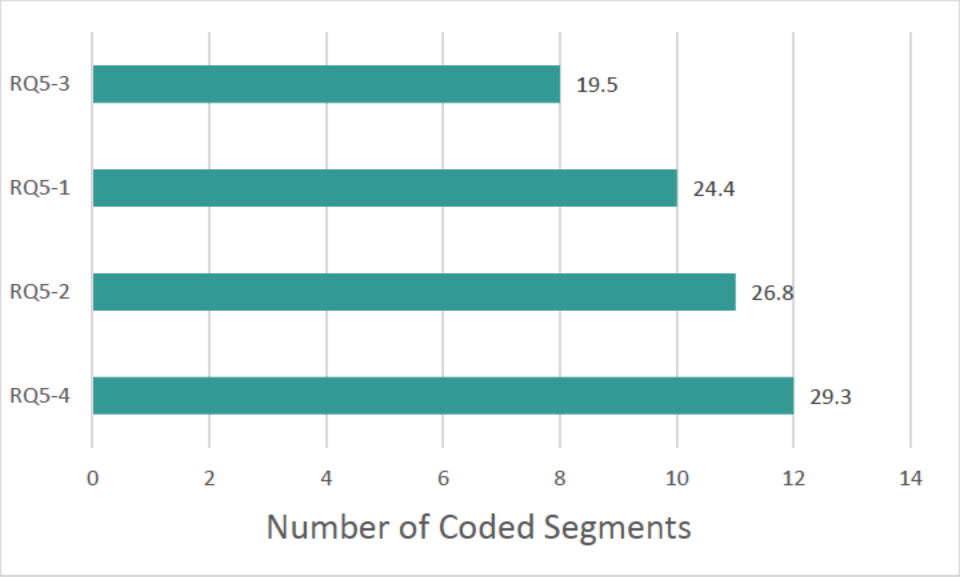

Figure 12: Bar chart of coded segments for RQ5 — Patient / Client Expectations & Behavior.

RQ-6 economic and infrastructure constraints

Table 11: Distribution of coded segments for RQ6 — Economic & Infrastructure Constraints.

Research Question / Theme	Subcategory	No. of Segments	Interviews (out of 16)	% within Theme
RQ6 — Economic & Infrastructure Constraints	RQ6-1	13	13	35.1%
	RQ6-4	12	12	32.4%
	RQ6-2	7	7	18.9%
	RQ6-3	5	5	13.5%

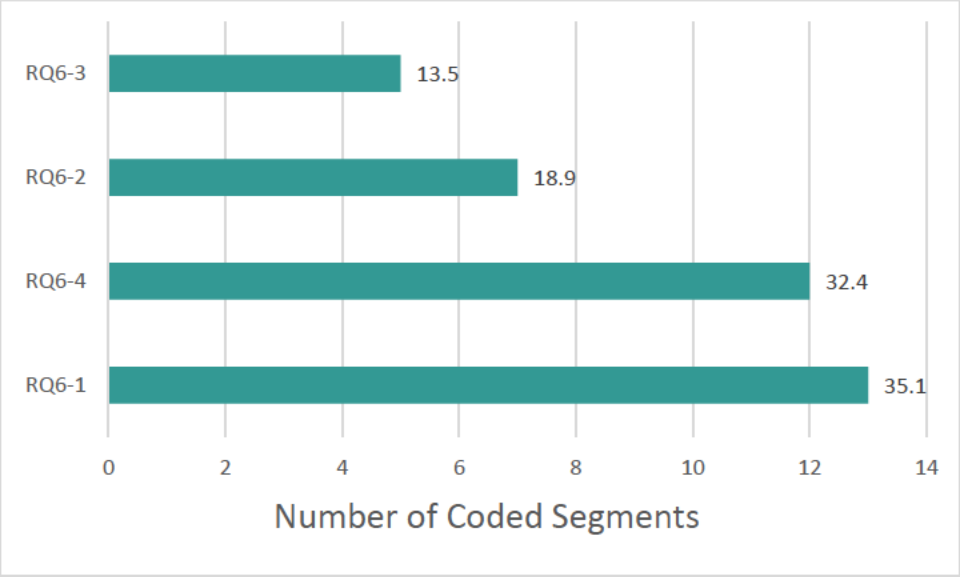

Figure 13: Bar chart of coded segments for RQ6 — Economic & Infrastructure Constraints.

RQ-7 Role of government and policy makers

Table 12: Distribution of coded segments for RQ7 — Role of Government & Policymakers.

Research Question / Theme	Subcategory	No. of Segments	Interviews (out of 16)	% within Theme
RQ7 — Role of Government & Policymakers	RQ7-1	8	8	53.3%
	RQ7-2	7	7	46.7%

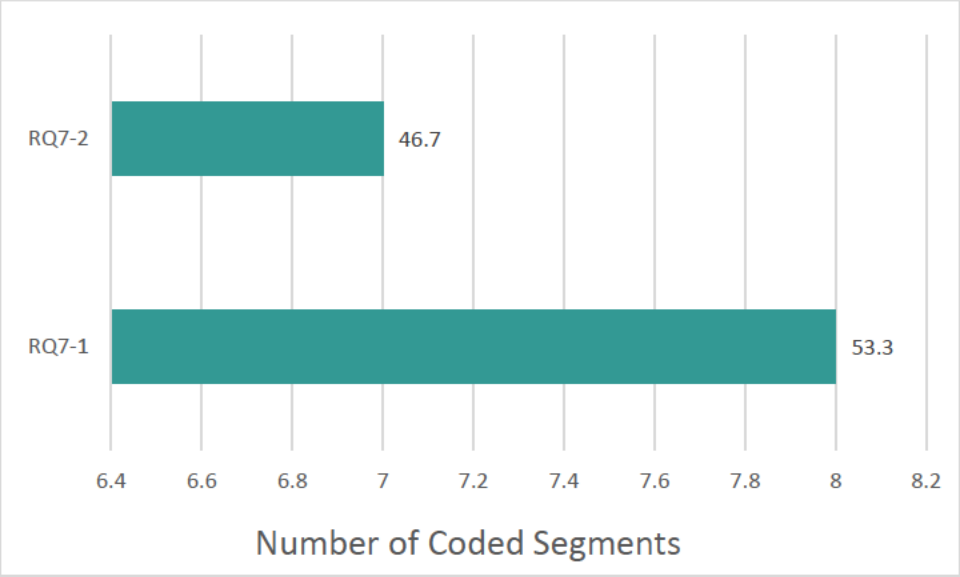

Figure 14 Bar chart of coded segments for RQ7 — Role of Government & Policymakers.

RQ-8 suggested strategies and solutions

Table 13: Distribution of coded segments for RQ8 — Suggested Strategies & Solutions.

Research Question/ Theme	Subcategory	No. of Segments	Interviews (out of 16)	% within Theme
RQ8 — Suggested Strategies & Solutions	RQ8-1	12	12	30%
	RQ8-2	11	11	27.5%
	RQ8-3	6	6	15%
	RQ8-5	6	6	15%
	RQ8-4	5	5	12.5%

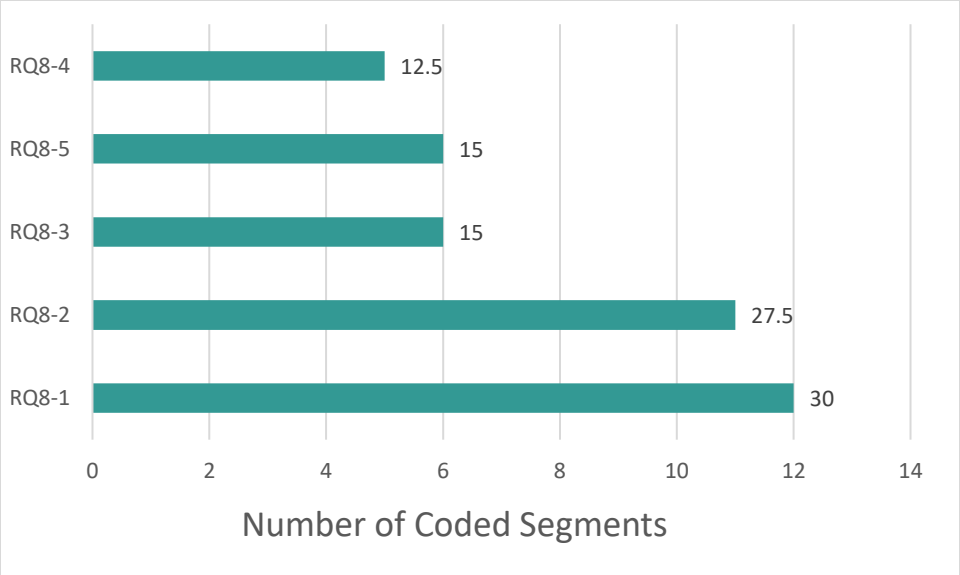

Figure 15: Bar chart of coded segments for RQ8 — Suggested Strategies & Solutions.