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Antibiotic Misuse and Determinants in Primary Healthcare Settings in the Gaza Strip: Baseline Assessment and Intervention Implications

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Abstract:
This study aimed to assess healthcare providers' knowledge, attitudes, and practices (KAP) regarding antibiotic use and antimicrobial resistance in governmental primary healthcare (PHC) clinics in the Gaza Strip, identify multilevel determinants of antibiotic misuse, and evaluate the impact of a tailored educational intervention on physicians' prescribing practices. A mixed-methods, two-phase design was employed. The first phase consisted of a descriptive-analytic cross-sectional survey involving 280 PHC healthcare providers, including physicians, nurses, pharmacists, and pharmacy technicians. The second phase implemented a pre–post educational intervention among 102 physicians. Data were collected using a validated multidomain KAP and antimicrobial stewardship questionnaire with high internal consistency and construct validity. Statistical analysis included descriptive statistics, independent-samples *t*-tests, one-way ANOVA with post-hoc comparisons, correlation analysis, and pre–post comparisons at a significance level of $p < 0.05$, So The findings revealed generally high levels of knowledge and positive attitudes toward antimicrobial stewardship; however, physicians demonstrated only moderate prescribing practices, with notable gaps in culture-guided therapy and the use of local resistance data. Organisational constraints—including limited diagnostic capacity, drug shortages, heavy workload, and inadequate infection-prevention infrastructure—were identified as major barriers to appropriate antibiotic use. The educational intervention produced statistically significant improvements in physicians' knowledge, attitudes, and prescribing practices. The study recommends strengthening antimicrobial stewardship through integrated strategies, including continuous professional training, improved diagnostic services, strengthened infection-prevention systems, and effective prescribing governance within PHC settings.
Keywords: Antimicrobial resistance; Antibiotic stewardship; Primary healthcare; Prescribing practices; Educational intervention; Gaza Strip.

-Introduction

Antimicrobial resistance (AMR) is a rapidly escalating global health threat that undermines decades of progress in the treatment of infectious diseases. Recent global estimates suggest that millions of deaths each year are now associated with bacterial AMR, with the heaviest burden falling on low- and middle-income countries (Hayat et al., 2022; Cureus, 2025; The Lancet, 2024). Reflecting this scale, the World Health Organization has listed AMR among the top ten public health threats to humanity and continues to warn of rising resistance to commonly used antibiotics worldwide (WHO, 2015; WHO, 2021; WHO, 2025). When infections are caused by resistant organisms, patients experience longer illness duration, higher risk of complications and death, and more frequent secondary infections, particularly following surgery or invasive procedures. These clinical consequences translate into prolonged hospital stays, increased healthcare costs, and wider social and economic burdens that affect households, health systems, and national economies (Abu Sin et al., 2018; Aslam et al., 2021; Hayat et al., 2022). From a health management and health systems perspective, antimicrobial resistance is not only a microbiological or clinical problem but also a performance and governance challenge for healthcare organizations and health systems. Inappropriate antibiotic use reflects weaknesses in organizational policies, clinical governance, workforce capacity, supervision, availability of diagnostics, access to essential medicines, and monitoring systems (World Health Organization, 2015; Sheikh et al., 2011; Bloom et al., 2018). These factors influence prescribing behaviours and determine whether antimicrobial stewardship can be implemented effectively in primary healthcare settings, particularly in fragile and conflict-affected systems (Haque and Godman, 2021; Cox et al., 2017).

Misuse and overuse of antibiotics are key drivers of AMR in both high-income and low- and middle-income countries. Such misuse is shaped by health system functions including regulation and enforcement, pharmaceutical supply chain management, service delivery organization, and leadership and accountability mechanisms (World Health Organization, 2010; World Bank, 2018). In many settings, antibiotics are prescribed for viral or self-limiting conditions, used at incorrect doses or durations, or obtained directly from pharmacies without medical supervision (Hand et al., 2021; Harakeh et al., 2015; Gustafsson et al., 2025). Misconceptions among both prescribers and the public, such as the belief that antibiotics are harmless and appropriate for any infection, contribute to unnecessary demand and pressure on healthcare providers to prescribe, with patient satisfaction sometimes perceived as dependent on receiving at least one antibiotic regardless of so These patterns are particularly pronounced in resource-constrained and conflict-affected settings, where weak regulatory frameworks, gaps in stewardship programmes, disrupted supply chains, and fragile governance make rational antibiotic use more difficult to achieve (Haque & Godman, 2021; Hayat et al., 2022; Davis et al., 2025).

Primary healthcare centers are a critical frontline in the fight against AMR because they manage the majority of common infections and are often the first point of contact for patients seeking care. Healthcare providers in these settings play a pivotal role in deciding when antibiotics are prescribed, how they are explained to patients, and whether opportunities for patient education about appropriate use and self-medication are utilized. However, prescribing decisions in primary care are also influenced by managerial and organisational conditions such as workload, consultation time, availability of clinical guidelines, supervision, and routine performance monitoring (Sheikh et al., 2011; Bloom et al., 2018).. Low- and middle-income countries show that knowledge, attitudes, and prescribing practices among primary care providers are highly variable, and that gaps in stewardship training and guideline adherence remain common (Haque & Godman, 2021; Zhen et al., 2019; Hayat et al., 2022; Danadneh et al., 2025). Evidence from Palestine and neighbouring contexts further indicates widespread over-the-counter antibiotic dispensing and self-medication, which intensify community-level selection pressure and complicate efforts to build effective stewardship in primary care (Gustafsson et al., 2025; WHO, 2025).

Research Problem

Use of antibiotics has become a critical public health concern, especially in low- and middle-income countries where high infectious disease burden, limited diagnostics, and weak regulatory systems create fertile conditions for misuse (Haque & Godman, 2021; Zhen et al., 2019; Hayat et al., 2022). Although antibiotics are life-saving and central to modern medicine, their irrational use—such as prescribing for viral illnesses, inappropriate dosing, incomplete courses, and over-the-counter access—accelerates the emergence and spread of antimicrobial resistance (Machowska & Lundborg, 2019; WHO, 2015, 2021; Cureus, 2025). Health systems have responded by issuing stewardship guidelines and promoting rational prescribing, yet these efforts have not kept pace with the rapid rise of resistant organisms, leaving both patients and providers with fewer effective treatment options (Aslam et al., 2021; WHO, 2025; The Lancet, 2024).In the Gaza Strip, this global challenge is intensified by protracted conflict, economic hardship, and fragile health infrastructure, which together weaken regulatory enforcement and encourage informal antibiotic use and self-medication through community pharmacies (Hammoudeh et al., 2020; OCHA, 2023; WHO, 2024; Trends in Antimicrobial Resistance in Gaza Strip, 2020–2022). Surveillance data indicate increasing rates of multidrug-resistant infections, while local and regional studies describe variable adherence to antibiotic guidelines and limited opportunities for structured stewardship training among primary healthcare providers (Hayat et al., 2022; Dalal et al., 2025; Kumar et al., 2025; Davis et al., 2025). Despite this, there is a paucity of robust data on physicians' and pharmacists' knowledge, attitudes, and practices regarding antibiotic use and resistance in Gaza's primary care settings, and little evidence on how tailored educational interventions might improve these outcomes (Afzal et al., 2024; Kafle et al., 2025; Public Health Toxicology, 2024). This gap hampers the design of context-appropriate strategies to optimize prescribing, reduce unnecessary community exposure to antibiotics, and slow the progression of antimicrobial resistance in a highly vulnerable population. In addition to clinical and public health factors, antibiotic misuse reflects broader health system management challenges, including weaknesses in leadership, workforce capacity, supervision, and organizational support. Understanding antibiotic prescribing behaviour from a health management perspective is essential for improving service quality, strengthening health system performance, and supporting evidence-based management decisions.

Significance of the study

AMR is now framed by WHO as a global health emergency requiring concrete action to improve awareness and optimize antimicrobial use, particularly in primary care where most antibiotics are prescribed (WHO, 2015, 2021). In low- and middle-income countries, irrational antibiotic use is driven by high infectious disease burden, weak regulation, and limited stewardship capacity, with inappropriate prescribing and non-prescription access repeatedly identified as key determinants of resistance (Haque & Godman, 2021; Machowska & Lundborg, 2019; Hayat et al., 2022). Focusing on healthcare providers' knowledge, attitudes, and practices in primary healthcare centers therefore addresses a central leverage point within the WHO Global Action Plan: optimizing antimicrobial use through informed prescribers and Gaza represents an extreme but under-studied example of this challenge. A fragmented, donor-dependent health system, recurrent conflict, disrupted supply chains, and weak enforcement of prescription-only policies create a setting where antibiotics can be easily obtained without medical supervision and where stewardship structures are minimal (Hammoudeh et al., 2020; Kafri et al., 2020; UNRWA, 2020a; WHO, 2018). Recent data documenting increasing multidrug-resistant infections in Gaza highlight the urgent need for context-specific strategies to rationalize antibiotic use in primary care (Trends in Antimicrobial Resistance in Gaza Strip, 2020–2022; Kumar et al., 2025). Yet, there is a clear lack of robust, systematically collected evidence on physicians' and pharmacists' antibiotic-related KAP, their perceptions of self-medication, and how these factors vary by socio-demographic and professional characteristics.

General objective:

To assess the level of knowledge, attitudes, and practices (KAP) regarding antibiotic use and antibiotic resistance among healthcare providers in primary healthcare centres, and to evaluate the improvement in physicians' KAP following an educational intervention, while considering the implications for health system performance and management in primary healthcare settings.

Study question:

What are the levels of knowledge, attitudes, and practices regarding antibiotic use and antibiotic resistance among healthcare providers in primary healthcare centres in Gaza, and how do these influence healthcare management and service quality?

1. What are the levels of knowledge and attitudes regarding antibiotic use and antibiotic resistance among healthcare providers in primary healthcare centres, and how may these affect healthcare service delivery?
2. What are the current prescribing practices of physicians regarding antibiotic use in primary healthcare centres, and how do these relate to rational medicine use and clinical governance?

Study hypothesis

Null hypotheses (H0)

- There is no significant association between healthcare providers' socio-demographic characteristics and their knowledge, attitudes, or practices regarding antibiotic use and antibiotic resistance in primary healthcare centers in Gaza.
- There is no significant difference in physicians' knowledge scores about antibiotic use and antibiotic resistance before and after the educational intervention program.
- **Alternative hypotheses (H1)**
- There is a significant association between healthcare providers' socio-demographic characteristics and their knowledge, attitudes, or practices regarding antibiotic use and antibiotic resistance in primary healthcare centers in Gaza.
- Physicians' knowledge scores about antibiotic use and antibiotic resistance are significantly higher after the educational intervention program than before.
- Physicians' attitude scores toward antibiotic use and antibiotic stewardship are significantly more positive after the educational intervention program than before.
- Physicians' practice scores regarding antibiotic use and prescribing are significantly better after the educational intervention program than before.

Operational definitions

Antibiotics

Antibiotics refer to medications used to prevent or treat bacterial infections. In this study, the term includes all systemic antibacterial agents commonly prescribed or dispensed in primary healthcare centers in the Gaza Strip.

Antibiotic Resistance (AMR)

Antibiotic resistance is defined as the ability of bacteria to survive or grow despite exposure to antibiotics that would normally inhibit or kill them. In this study, antibiotic resistance is measured through healthcare providers' knowledge and perceptions assessed using a structured questionnaire.

Healthcare Providers

Healthcare providers include physicians, nurses, pharmacists, and pharmacy technicians working in primary healthcare centers in the Gaza Strip during the study period.

Primary Healthcare Centers (PHCs)

Primary healthcare centers are first-level healthcare facilities providing outpatient preventive and curative services, including diagnosis and treatment of common illnesses, maternal and child health services, and medication dispensing.

Context of the Gaza Strip and Primary Healthcare System

Geographical and Demographical Context

The participants of this study were chosen from the Gaza Strip, Palestine. Palestine (Palestine area about 27000 sq. km) is a geographic region in Western Asia between the Mediterranean Sea and the Jordan River (where the Gaza Strip and the west bank are today) and various adjoining lands. Situated at a strategic point between Europe, Asia, and Africa (World Bank, 2021). Gaza Strip is a narrow strip of land on the Mediterranean coast. It borders the so-called Israel to the east and north and Egypt to the south. It is approximately 41 kilometers long and between 6 and 12 kilometers wide, with a total area of 378 square kilometers (World Bank, 2021).

-Conceptual Framework and Literature Review

Introduction

This chapter presents the conceptual framework that guides the present study and provides a comprehensive review of the literature on antimicrobial resistance (AMR), antibiotic use, and stewardship in primary healthcare (PHC) settings, with particular attention to low- and middle-income countries (LMICs) and conflict-affected contexts. The chapter is organised into two main sections: the conceptual framework (Section 2.1), which outlines the theoretical underpinnings and multilevel determinants of antibiotic prescribing and stewardship; and the literature review (Section 2.2), which synthesises current evidence on the global burden of AMR, knowledge, attitudes, and practices (KAP) among healthcare providers, barriers and enablers to effective antibiotic stewardship, and the effectiveness of educational interventions. The chapter concludes by identifying critical gaps in the literature that justify the present study's objectives and design, with particular emphasis on the understudied context of Gaza's PHC system amid protracted conflict.

Conceptual Framework

Multilevel Determinants of Antibiotic Use and Stewardship

This study is grounded in a multilevel conceptual framework that integrates individual, facility, and system-level determinants of antibiotic prescribing and stewardship outcomes in PHC settings (World Health Organization [WHO], 2015; Cox et al., 2017). The framework builds on health systems research and implementation science literature, which emphasizes that healthcare provider behaviour is shaped not only by individual knowledge and attitudes but also by organisational capacity, resource availability, and broader health-system governance (Bloom et al., 2018; Pulcini et al., 2021). In the context of Gaza's PHC system, this multilevel approach is particularly salient given the documented interplay of conflict-related disruption, infrastructure collapse, and chronic resource constraints (Hammoudeh et al., 2020; WHO, 2024).

Sociodemographic and Professional Modifiers of KAP

Within this multilevel structure, the framework incorporates sociodemographic and professional characteristics including age, gender, professional cadre (physician, nurse, pharmacist, pharmacy technician), years of experience, and PHC clinic location—as important modifiers of KAP and perceptions of barriers (Hayat et al., 2022; Danadneh et al., 2023). Older and more experienced providers may have higher knowledge scores and more consistent prescribing practices due to cumulative clinical exposure, repeated participation in training programmes, and greater professional confidence (Zhen et al., 2019). Gender differences in prescribing behaviour have been documented, with female clinicians in some contexts demonstrating more guideline-adherent prescribing and greater emphasis on patient communication (Hayat et al., 2022). Professional cadre is also relevant: pharmacists often possess higher factual knowledge of drug mechanisms and resistance, whereas physicians' and nurses' practices are shaped by their clinical decision-making authority and patient-facing roles (Haque et al., 2019; Godman et al., 2020).

Educational Interventions as Behaviour-Change Levers

The framework also incorporates a behaviour-change component, in which targeted educational interventions are hypothesised to improve providers' knowledge and attitudes and, through these cognitive and affective pathways, enhance prescribing practices (Arnold & Straus, 2005; Delsors et al., 2021). This is consistent with implementation science literature showing that interactive, context-specific training—particularly when delivered through case-based learning, audit and feedback, and integration with local guidelines—can shift prescribing behaviour in LMIC primary care (Rocha et al., 2022; Wei et al., 2017).

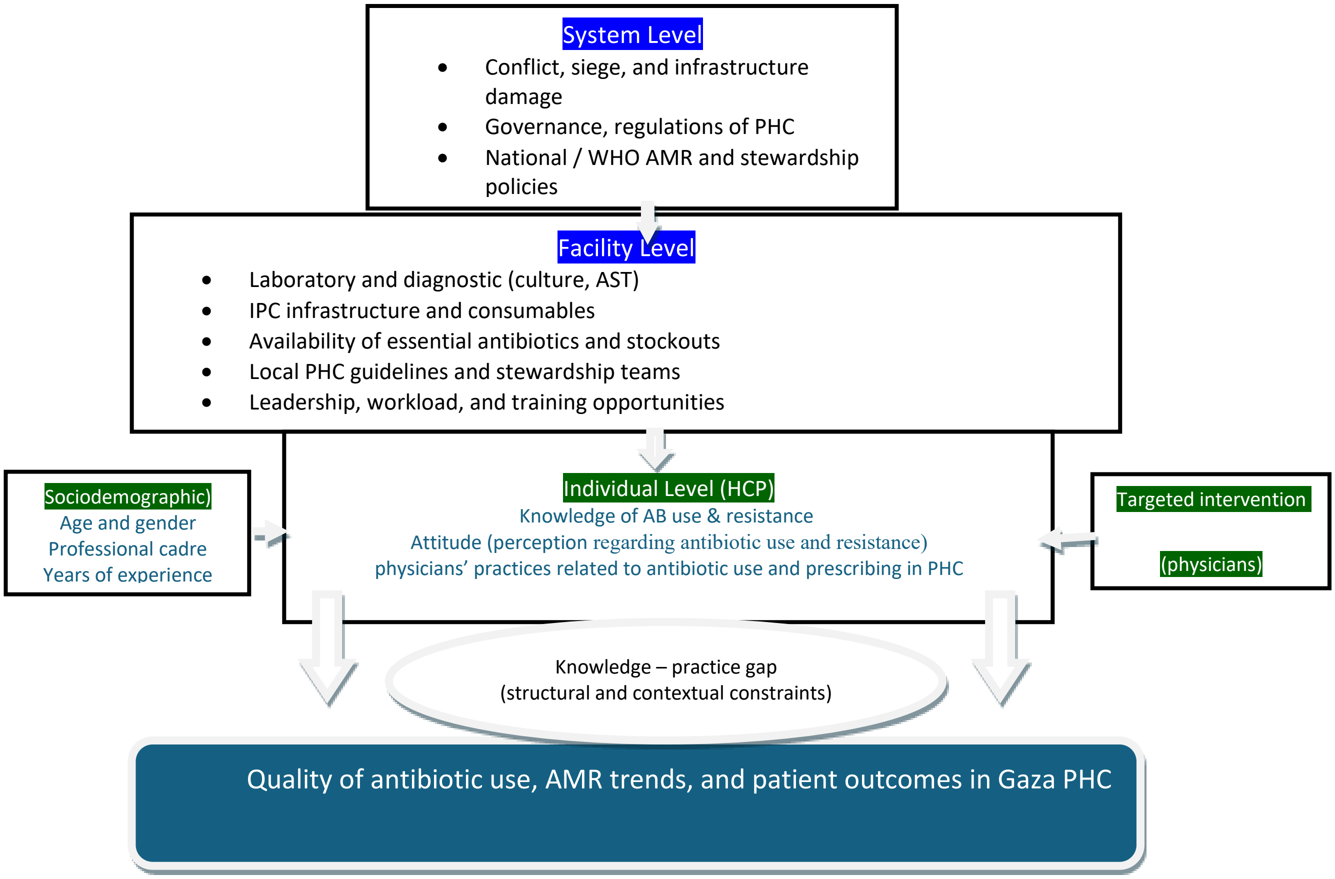
In the present study, the intervention targets physicians and is designed to increase their scores on knowledge of antibiotics and resistance, improve attitudes toward stewardship responsibilities and feasibility, and enhance self-reported prescribing practices such as use of narrow-spectrum agents, guideline adherence, and patient counselling. The conceptual model assumes that educational interventions operate primarily at the individual level by addressing knowledge gaps and strengthening motivation but acknowledges that their effectiveness is constrained by facility and system conditions (Arnold & Straus, 2005; Michie et al., 2011). Sustained behaviour change therefore requires reinforcement mechanisms, supportive organisational structures, and alignment with broader system-level policies (Bloom et al., 2018; Pulcini et al., 2021).

The Knowledge–Practice Gap in Fragile Health Systems

A critical feature of the conceptual framework is its explicit recognition of the knowledge–practice gap, a well-documented phenomenon in LMICs in which healthcare providers possess substantial theoretical understanding of appropriate practices but fail to apply this knowledge consistently in clinical encounters (Das & Hammer, 2014; Daniels et al., 2023). Recent experimental evidence from India demonstrates that this gap is driven primarily by providers' perceptions of patient expectations and contextual pressures rather than by lack of knowledge, with elimination of the know-do gap projected to reduce inappropriate prescribing by 30 percentage points compared to only 6 points if all providers achieved perfect knowledge (Daniels et al., 2023).

In conflict-affected settings such as Gaza, the knowledge–practice gap may be further widened by facility and system constraints that undermine even the most well-intentioned providers' ability to practice rational prescribing. These include diagnostic uncertainty due to lack of laboratory testing, time pressure from overwhelming patient volumes, limited formulary availability forcing reliance on non-preferred agents, stockouts necessitating substitutions, and patient and family pressure for antibiotics amid generalised mistrust and anxiety associated with conflict exposure (Albaroodi et al., 2024; Davis et al., 2025). The framework therefore positions observed prescribing practices as the product of knowledge and attitudes filtered through multiple layers of structural constraint, with the implication that effective stewardship requires interventions at all three levels: individual (education and training), facility (diagnostics, IPC, supply chain, guidelines), and system (governance, financing, conflict resolution).

Summary of the Conceptual Framework



Multilevel conceptual framework for antibiotic use in Gaza PHC – self-developed

In summary, the conceptual framework guiding this study posits that:

-**Healthcare providers' knowledge** of antibiotics and resistance facilitates more rational decision-making, but knowledge alone is insufficient when facility and system constraints are severe.

1. **Positive attitudes** toward stewardship increase providers' motivation to adhere to guidelines and resist inappropriate patient pressure, yet these attitudes may be undermined by resource shortages, lack of diagnostics, and overwhelming workload.
2. **Prescribing practices** are the observable expression of knowledge and attitudes as filtered through facility and system contexts; thus, even highly knowledgeable and motivated providers may report only moderate adherence to best prescribing practices when working in a fragile health system.
3. **Facility-level conditions** such as laboratory capacity, IPC infrastructure, drug availability, guidelines, and leadership support act as critical enablers or barriers to rational antibiotic use.
4. **System-level factors** including conflict, governance, financing, and supply chains shape the broader environment within which individual and organisational actors operate.
5. **Sociodemographic and professional characteristics** (age, gender, cadre, experience, location) modify KAP outcomes and should be assessed to inform targeting of interventions.
6. **Educational interventions** can improve knowledge, attitudes, and practices in the short term, but their sustainability depends on supportive facility and system contexts.

This multilevel framework provides a rationale for the study's five specific objectives: to assess KAP levels among PHC providers, explore sociodemographic determinants, map facility- and system-level barriers, and evaluate whether a targeted educational intervention can improve physicians' KAP within a protracted conflict setting. It also establishes the theoretical foundation for interpreting findings and developing evidence-based recommendations that address individual, organisational, and structural dimensions of antibiotic stewardship in Gaza's PHC system.

Literature Review

Global Burden of Antimicrobial Resistance

Antimicrobial resistance has been recognised as one of the most pressing global health threats of the twenty-first century, associated with substantial morbidity, mortality, and economic burden worldwide (WHO, 2023; Naghavi et al., 2024; UN News, 2025). A landmark 2024 analysis by the Global Research on Antimicrobial Resistance (GRAM) Project established that in 2021, 4.71 million deaths globally were associated with bacterial AMR, including 1.14 million deaths directly attributable to it (Naghavi et al., 2024). This systematic analysis, which examined data from 204 countries and territories across three decades, indicates that antimicrobial resistance has claimed at least one million lives annually since 1990, with projections forecasting 1.91 million deaths attributable to AMR and 8.22 million deaths associated with AMR globally by 2050 if current trends continue (Naghavi et al., 2024; Antimicrobial Resistance Collaborators, 2024).

AMR in Low- and Middle-Income Countries: Primary Care as a Critical Leverage Point

The burden of AMR falls disproportionately on low- and middle-income countries, where high infectious disease burden, limited diagnostic capacity, weak regulatory frameworks, and over-the-counter availability of antibiotics contribute to inappropriate use and accelerated resistance (Haque et al., 2020; Ayukekbong et al., 2017; Godman et al., 2020). In many LMICs, antibiotics are prescribed for viral or self-limiting conditions, used at incorrect doses or durations, obtained without prescription from community pharmacies, and shared among family members, fuelling selection pressure for resistant organisms (Machowska & Lundborg, 2019; Harakeh et al., 2015).

Primary healthcare is the first point of contact for most patients with common infections and accounts for the bulk of antibiotic prescribing internationally—up to 80–90% of total antibiotic use in humans in some LMICs occurs in primary care settings (Godman et al., 2020; WHO, 2015). Consequently, optimising antibiotic use in PHC has been identified as a central pillar of the WHO Global Action Plan on Antimicrobial Resistance, which calls for improved awareness, strengthened surveillance, infection prevention and control, and antimicrobial stewardship across all levels of the health system, with particular emphasis on primary care (WHO, 2015, 2021).

Knowledge, Attitudes, and Practices Regarding Antibiotic Use Among Healthcare Workers in LMICs

Knowledge, attitudes, and practices (KAP) studies among healthcare workers in LMICs have proliferated over the past decade, consistently reporting mixed findings: relatively high awareness of basic AMR concepts alongside persistent misconceptions and substantial gaps in prescribing practice (Hayat et al., 2022; Danadneh et al., 2023; Alhomoud et al., 2023). A systematic review of KAP studies from LMICs found that healthcare workers generally recognised AMR as a serious public health problem and acknowledged the role of overuse in driving resistance, yet substantial proportions held misconceptions such as believing that antibiotics are effective against viral infections, underestimating the importance of hand hygiene and IPC, and showing limited appreciation of the broader societal and economic costs of resistance (Hayat et al., 2022).

Several recent multi-country studies corroborate these findings. In Nigeria, a KAP study among healthcare workers in tertiary and secondary hospitals found moderate knowledge, attitudes, and practices regarding antibiotics and antibiotic resistance, but poor adherence to WHO guidelines on antibiotic prescriptions, prompting calls for increased awareness and education (Onwuegbuzie et al., 2023). Similarly, a study in Liberia identified persistent gaps in healthcare workers' knowledge, attitudes, and practices, with common misconceptions including premature discontinuation and reuse of leftover antibiotics (Tamba et al., 2025). A cross-sectional study in the Eastern Mediterranean Region found variable KAP levels, with training on antibiotics and antibiotic resistance significantly associated with better knowledge, attitudes, and prescribing behaviour (Danadneh et al., 2023).

Regarding attitudes, healthcare workers in LMICs generally express positive orientations toward stewardship in principle, with providers acknowledging concern about AMR, supporting guideline-based prescribing, favouring narrow-spectrum agents when appropriate, and endorsing restrictions on high-risk antibiotics (Danadneh et al., 2023; Hayat et al., 2022). However, attitudinal support for stewardship is often tempered by perceived feasibility barriers: providers report that patient education is important but time-consuming, that supply shortages sometimes force use of non-recommended antibiotics, and that patient and family pressure to prescribe creates ethical and practical dilemmas (Machowska & Lundborg, 2019; Harakeh et al., 2015).

Self-reported practices, meanwhile, remain suboptimal despite relatively high knowledge and positive attitudes. Empirical prescribing is common, laboratory tests are rarely used to guide therapy, and physicians frequently report prescribing antibiotics in response to patient expectations or to compensate for diagnostic uncertainty and challenges with patient follow-up (Haque et al., 2020; Zhen et al., 2019; Hand et al., 2021). A systematic review of antibiotic prescribing in LMICs found that guideline non-adherence rates ranged from 30% to over 70% across different studies and settings, with broad-spectrum agents often prescribed for conditions where narrow-spectrum antibiotics would be appropriate (Ayukekbong et al., 2017).

Sociodemographic and Professional Determinants of KAP

Sociodemographic factors also influence KAP. Evidence from multiple LMICs suggests that older and more experienced clinicians may demonstrate higher knowledge scores and more cautious prescribing, although in some contexts younger providers are more guideline-oriented due to more recent training exposure (Hayat et al., 2022; Zhen et al., 2019). Gender differences in prescribing behaviour have been documented, with female clinicians in some studies exhibiting more conservative prescribing patterns, stronger guideline adherence, and greater emphasis on patient communication and shared decision-making (Hayat et al., 2022; Danadneh et al., 2023).

Professional cadre is another important determinant: pharmacists often demonstrate higher factual knowledge of drug mechanisms, spectra of activity, and resistance patterns due to their specialised pharmaceutical training, whereas physicians' and nurses' practices are shaped by their clinical decision-making authority, patient-facing roles, and responsibility for diagnosis and treatment planning (Haque et al., 2020; Godman et al., 2020). Pharmacy technicians and non-physician clinicians may have more limited training on AMR and stewardship, yet play critical roles in dispensing and patient counselling in many LMIC primary care settings (Alhomoud et al., 2023).

Synthesis and Justification of the Study

The literature reviewed in this chapter underscores several key points that shape the present study's aims, conceptual framework, and design:

1. **AMR is a global health emergency**, with LMICs bearing a disproportionate burden and primary care representing a critical leverage point for stewardship interventions (WHO, 2023, 2025; Naghavi et al., 2024).
2. **Healthcare providers in LMICs possess substantial knowledge** about antibiotics and resistance, yet practice remains inconsistent due to structural and contextual barriers, leading to a persistent **knowledge–practice gap** (Hayat et al., 2022; Daniels et al., 2023; Das & Hammer, 2014).
3. **Facility- and system-level determinants**—including diagnostics, IPC infrastructure, supply chain reliability, governance, and conflict-related disruption—are central to understanding antibiotic misuse, especially in fragile and humanitarian settings (Cox et al., 2017; Wozniak et al., 2018; Davis et al., 2025; Shamas et al., 2023).
4. **Gaza's PHC system** is characterised by high infectious disease burden, rising multidrug-resistant infections, chronic shortages, and health system collapse due to protracted conflict, yet robust

empirical data on PHC providers' KAP and stewardship determinants are limited (Albaroodi et al., 2024; Hammoudeh et al., 2020; WHO, 2024).

Conclusion

This chapter has presented the conceptual framework and literature review underpinning the present study on antibiotic misuse and determinants in primary healthcare settings in the Gaza Strip. The multilevel conceptual framework integrates individual, facility, and system determinants of antibiotic prescribing and stewardship, recognising that healthcare provider behaviour is shaped not only by knowledge and attitudes but also by organisational capacity, resource availability, conflict-related disruption, and broader governance structures. The framework positions the knowledge–practice gap as a central challenge in fragile health systems, where even highly knowledgeable and motivated providers may adopt suboptimal prescribing practices when working under severe structural constraints.

-Materials and Methods

Introduction

This chapter describes the methodological approach used to achieve study objectives. It outlines the study design, setting, population, sampling procedures, data collection methods and tools, data analysis plan, pilot testing, and ethical considerations, as well as procedures to ensure validity and reliability.

Study Design: A mixed-methods design was used. Phase one: cross sectional study and Phase two: pre-post-test intervention design

- **Phase 1 – Quantitative cross-sectional component:** A descriptive analytic cross-sectional survey assessed healthcare providers' knowledge, attitudes, and practices regarding antibiotic use and antimicrobial resistance, as well as perceptions and behaviors related to antibiotic self-medication.
- **Phase 2 – Pre–post intervention component:** A tailored awareness-raising educational intervention on rational antibiotic use was delivered to healthcare providers. The same quantitative questionnaire was administered before and 4–6 weeks after the intervention to assess changes in knowledge and practices.

This design allows triangulation of provider-level survey data with managerial perspectives and assessment of intervention effectiveness over time.

Study Period: The duration of the PhD project is 30 months (2022–2025), including tool development, piloting, baseline data collection, intervention delivery, follow-up data collection, analysis, and thesis writing**.**

Inclusion criteria: Registered physicians (GPs or specialists), nurses and pharmacists & pharmacist technicians employed in governmental PHC clinics. At least 6 months of work experience in their current clinic**.**

- Willing to provide informed consent.

Instruments of the study

Description of the study instruments: The study used a structured, self-administered questionnaire to assess healthcare workers' knowledge, attitudes, practices, and perceived barriers related to antibiotic use and stewardship in Gaza primary healthcare clinics.

Overall instrument structure: The instrument was a multi-domain questionnaire administered to 280 healthcare workers (physicians, nurses, pharmacists, and pharmacy technicians), with prescribing-practice items restricted to physicians (n=102).

- **Knowledge of antibiotics** This domain comprised 12 true/false items on appropriate antibiotic use and basic principles of antibiotic resistance (e.g. use in viral infections, overuse as a driver of resistance, course completion, role of laboratory tests and WHO recommendations). Correct responses were coded and summed to yield a percentage knowledge score.
- **Knowledge of antibiotic resistance** This scale included 8 items addressing transmission, healthcare-associated resistance, IPC, laboratory capacity, drug supply issues, hand hygiene, community misuse, and consequences for morbidity, mortality, and costs. The rating was similar to knowledge of antibiotics

- **Attitudes toward antibiotic use and stewardship**

Attitudes were measured with 15 Likert items (strongly disagree to strongly agree) covering responsibility for stewardship, perception of resistance as a threat, guidelines, training, patient pressure, preference for narrow-spectrum agents, support for restrictions, education, IPC, system factors, and self-confidence in managing infections without antibiotics.

Attitudes toward antibiotic use and stewardship (15 items) used a 5-point Likert scale: strongly disagree, disagree, neutral, agree, strongly agree. For each item, Likert responses were scored, averaged, and transformed into a percentage, then grouped into high, moderate, and low attitude. The score was calculated from 1 to 5

- **Antibiotic prescribing practices among physicians**

A 12-item Likert scale (never to always) assessed prescribing behaviours: reliance on diagnosis and labs, use of broad-spectrum agents, culture-guided therapy, guideline use, patient counselling, completion of courses, combinations, avoidance of symptomatic-only prescribing, review of resistance patterns, tailoring duration, managing patient requests, and non-prescription dispensing.

Prescribing practice items for physicians (12 items) used a 5-point frequency scale: never, rarely, sometimes, often, always, scored and converted to a mean percentage practice score. The score was calculated from 1 to 4

Facility- and system-level stewardship factors

Facility-level barriers (physicians only) were measured with 12 items on a 5-point scale from “major barrier” to “major enabler,” recoded from −2 to +2; negative means indicated barriers (e.g. lack of diagnostics, guidelines, essential drugs, IPC infrastructure, training), while positive means reflected enablers (leadership support, multidisciplinary teams, training access).

System-level and strategic factors were assessed in all participants with 8 Likert items (strongly disagree–strongly agree) about access to essential medicines, conflict and instability, training adequacy, resistance surveillance, strategic priority, IPC resources, inter-facility coordination, and recognition of resistance as a public health emergency, with higher scores indicating greater perceived system-level challenge or support depending on item wording.

-Sampling and Sample Size

The sample size for the survey component was calculated for the primary healthcare (PHC) sector using the Raosoft online sample size calculator, assuming a 5% margin of error and a 95% confidence interval, based on a target PHC population of 986 healthcare providers. This procedure yielded a minimum required sample of 277, which was rounded up to 280 and then distributed proportionally across specialties according to their share in the PHC workforce (359 doctors, 445 nurses, and 182 pharmacists), as shown in Table 3.1; this resulted in subsamples of 102 physicians (36.4%), 126 nurses (45.1%), and 52 pharmacists (18.4%). Within this framework, 102 physicians participated in a structured educational intervention on rational antibiotic use and stewardship, and their pre-intervention and post-intervention KAP scores were compared to assess the effectiveness of the training

Table 3.1: Sampling Strategy

Specialty	**PHC**	
	Population	**Proportional Sample**
Doctors (GPs and specialists)	359	102 (36.4%)
Nurses	445	126 (45.1%)
Pharmacists (diploma, BS)	182 (86 Bs + 96 diploma)	52(18.4%)
Total HCPs	**986**	**280**

The study consisted of three phases:

- The first phase is pre-intervention: Assessment and preparation of the training program and the questionnaire.
- The second phase is intervention: Implementation of the training program.

- The third phase is posting intervention: Evaluation for the effectiveness of the implemented training program (measured by changes in level of knowledge and practice in posttest scores compared to pretest scores).

Pre-intervention phase (pre-test): A pilot study was conducted on a sample of 10 physicians to examine the validity and reliability of the questionnaire. Before the training program, the questionnaire was distributed to each participant to fill it under the researcher guidance to identify the KAPs among all participants.

Intervention phase: Analysis of information collected from the pretest showed low to moderate level of knowledge, attitude and practices in some items. Accordingly, a training program was designed and implemented to equip the physicians with essential knowledge and skills.

Post-intervention phase (post-test)

Filling the questionnaires with the physicians to determine the level of knowledge and skills immediately after the training program.

Validity and Reliability

- Content validity: The questionnaire was reviewed by a panel of experts in public health, clinical pharmacology, and primary care, and refined based on their feedback and pilot testing.
- Construct validity: Factor structure of key domains (knowledge, attitudes, practices) was explored using exploratory factor analysis if sample size permits.
- Reliability: Internal consistency of multi-item scales was assessed using Cronbach's alpha. A subset (≈5%) of questionnaires was double-entered to check data entry accuracy.

Calculation of the Level of Antibiotic Misuse in Primary Healthcare in the Gaza Strip and Its Implications for Intervention

This section describes the procedures used to assess and score participants' knowledge, attitudes, and practices related to antibiotic misuse and antibiotic stewardship in primary healthcare. The levels of knowledge regarding antibiotic use and misuse among the study participants were assessed using true/false items. Participants' responses were coded dichotomously, whereby a correct response was assigned a score of 1 and an incorrect response was assigned a score of 0. Accordingly, the maximum possible score for each knowledge item was 1. Given that the maximum possible score for each knowledge item was 1 and the formula was simplified as follows:

Weighted Mean (%) = (Mean ÷ Maximum Score) × 100

This method enabled the transformation of mean knowledge scores into standardized percentage values, thereby providing a clear and interpretable indication of participants' levels of knowledge regarding antibiotic misuse, as presented in Table (3.1). Attitudes toward antibiotic use were assessed using a five-point Likert scale ranging from strongly agree (coded as 5) to strongly disagree (coded as 1), with corresponding weighted percentages ranging from 100% to 20%, allowing for nuanced evaluation of attitudinal orientations (Table 3.2).

Prescribing practices among physicians were measured using a five-point frequency scale ranging from never (coded as 0) to always (coded as 4), with weighted percentage scores ranging from 0% to 100%, facilitating the quantification of practice patterns related to antibiotic use (Table 3.3).

Table (3.1): Calculation level of knowledge regarding antibiotic use/misuse items

Scale	Correct	Incorrect
Code	1	0
Weight	100%	0%

Table (3.2): Level of Attitudes Toward Antibiotic Use Among the Study Participant

Scale	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Code	5	4	3	2	1
Weight	100%	80%	60%	40%	20%

Table (3.3): Level of Prescribing Practices Among Physicians

Scale	Never	Rarely	Sometimes	Often	Always
Code	0	1	2	3	4
Weight	0%	25%	50%	75%	100%

Table (3.4): Level of Facility-Level Barriers related to antibiotic stewardship

Scale	Major Barrier	Minor Barrier	Not Barrier	Enabler	Major Enabler
Code	-2	-1	0	1	2
Weight	-100%	-50%	0%	50%	100%

Table (3.5): System-level and strategic factors related to antibiotic stewardship

Scale	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Code	5	4	3	2	1
Weight	100%	80%	60%	40%	20%

Pilot study

A pilot study was conducted prior to the commencement of the main data collection to evaluate the feasibility and appropriateness of the research instrument designed to assess knowledge and practices related to antibiotic misuse in primary healthcare in the Gaza Strip. The instrument comprised six domains: Domain 1, knowledge of antibiotics; Domain 2, knowledge of antibiotic resistance; Domain 3, attitudes toward antibiotic use and antibiotic stewardship among healthcare providers; Domain 4, antibiotic prescribing practices among physicians, contributing to the assessment of knowledge, attitudes, and practices (KAP) among physicians and knowledge and attitudes (KA) among other healthcare providers; Domain 5, system-level and strategic factors related to antibiotic stewardship; and Domain 6, facility-level barriers related to antibiotic stewardship. The pilot study involved a convenience sample of 30 healthcare providers working in governmental primary healthcare centers/clinics.

Table (3.1): Calculation level of knowledge regarding antibiotic use/misuse items

Scale	Correct	Incorrect
Code	1	0
Weight	100%	0%

Table (3.2): Level of Attitudes Toward Antibiotic Use Among the Study Participant

Scale	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Code	5	4	3	2	1
Weight	100%	80%	60%	40%	20%

Table (3.3): Level of Prescribing Practices Among Physicians

Scale	Never	Rarely	Sometimes	Often	Always
Code	0	1	2	3	4
Weight	0%	25%	50%	75%	100%

Table (3.4): Level of Facility-Level Barriers related to antibiotic stewardship

Scale	Major Barrier	Minor Barrier	Not Barrier	Enabler	Major Enabler
Code	-2	-1	0	1	2
Weight	-100%	-50%	0%	50%	100%

Table (3.5): System-level and strategic factors related to antibiotic stewardship

Scale	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Code	5	4	3	2	1
Weight	100%	80%	60%	40%	20%

Pilot study

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related to antibiotic misuse in primary healthcare in the Gaza Strip. The instrument comprised six domains: Domain 1, knowledge of antibiotics; Domain 2, knowledge of antibiotic resistance; Domain 3, attitudes toward antibiotic use and antibiotic stewardship among healthcare providers; Domain 4, antibiotic prescribing practices among physicians, contributing to the assessment of knowledge, attitudes, and practices (KAP) among physicians and knowledge and attitudes (KA) among other healthcare providers; Domain 5, system-level and strategic factors related to antibiotic stewardship; and Domain 6, facility-level barriers related to antibiotic stewardship. The pilot study involved a convenience sample of 30 healthcare providers working in governmental primary healthcare centers/clinics..

Table (3.7): Split-Half Reliability of the Questionnaire

Split-Half			R
Cronbach's Alpha	Part 1	Value	0.805
		N of Items	34
	Part 2	Value	0.791
		N of Items	33
	Total N of Items		67
Correlation Between Forms			0.882
Spearman-Brown Coefficient	Equal Length		0.937
	Unequal Length		0.937
Guttman Split-Half Coefficient			0.937

Construct Validity (Evidence from Item–Domain Correlation Analysis)

The present study examined antibiotic misuse in primary healthcare (PHC) in the Gaza Strip and its implications for intervention. The questionnaire assessed healthcare workers' knowledge, attitudes, and practices regarding antibiotic use and antibiotic resistance, as well as perceived system-level and facility-level barriers related to antibiotic stewardship, among healthcare workers operating in PHC clinics in the Gaza Strip.

Construct validity of the questionnaire was evaluated using item–domain correlation analysis, a method that examines the degree to which each item is conceptually aligned with the domain it is intended to measure. This was achieved by calculating Pearson's correlation coefficient (r) between individual item scores and the total score of their corresponding domain.

Sociodemographic Characteristics Among the Study Participants

Distribution of Gender Among the Study Participants

Figure 4.1 presents the gender distribution of the study participants. The results show that male participants had a higher proportion, accounting for 53.6% (n = 150) of the sample, while female participants represented 46.4% (n = 130).

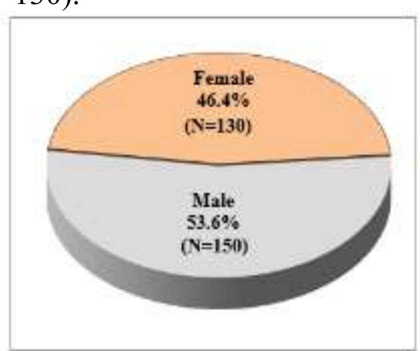

Figure (4.1): Distribution of Gender Among Study Participants

Distribution of Age Among the Study Participants

Figure 4.2 illustrates the age distribution among the study participants. The findings indicate that the largest proportion of participants were aged 31–40 years, accounting for 37.1% (n = 104), followed by those aged 30 years or less, who represented 35.7% (n = 100). The lowest proportion of participants was aged more than 40 years, constituting 27.1% (n = 76) of the sample. The mean age of the participants was 36.03 ± 8.79 years, with an age range of 24 to 59 years, reflecting a study sample composed mainly of young to middle-aged adults.

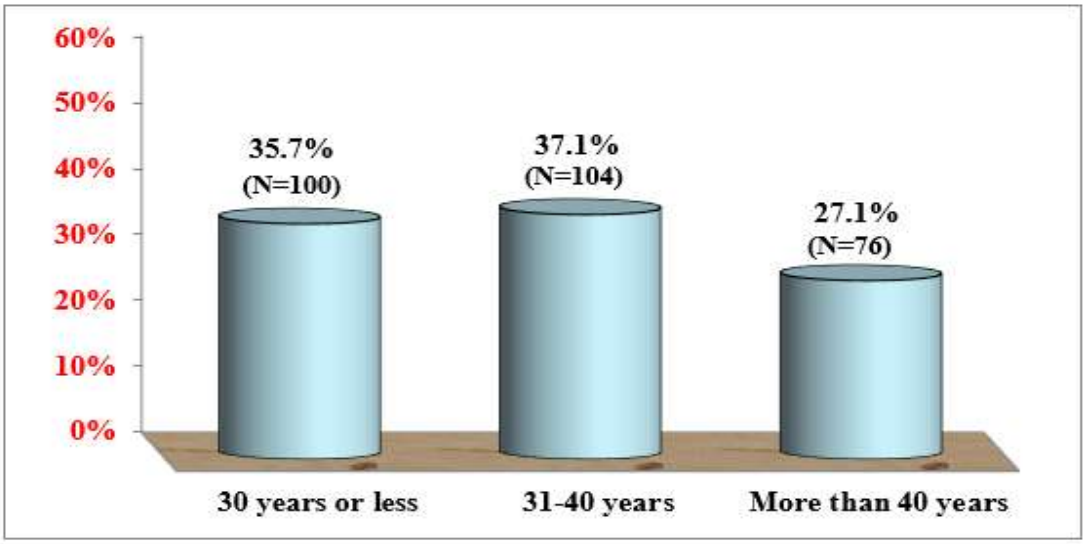

Figure (4.2): Distribution of Age Among Study Participants

Summary Sociodemographic Characteristics Among the Study Participants

Table (4.1): Summary Sociodemographic Characteristics Among the Study Participants

Sociodemographic Characteristics	Categories	N	%	Mean±SD (Min-Max)
Age (years)	30 years or less	100	35.7%	36.03±8.79 (24-59)
	31-40	104	37.1%	
	More than 40	76	27.1%	
Gender	Male	150	53.6%	
	Female	130	46.4%	

N: number of the subjects; SD: standard deviation; Min: minimum, and Max: maximum

Workplace Characteristics Among the Study Participants

Table 4.2 presents the workplace characteristics of the study participants. Regarding the location of the PHC clinics, more than half of the participants were working in the southern governorates (57.5%, n = 161), while 42.5% (n = 119) were employed in the northern governorates.

In terms of professional cadre, nurses constituted the largest proportion of the participants (45.1%, n = 126), followed by physicians (36.4%, n = 102). Pharmacy technicians and pharmacists represented 9.6% (n = 27) and 8.9% (n = 25) of the sample, respectively.

Table (4.2): Workplace Characteristics Among the Study Participants

Workplace Characteristics	Categories	N	%	Mean±SD *(Min-Max)*
Location of PHC clinic	Northern governorates	119	42.5%	
	Southern governorates	161	57.5%	
Professional Cadre	Physician	102	36.4%	
	Nurse	126	45.1%	
	Pharmacist	25	8.9%	
	Pharmacy Technician	27	9.6%	

Years of Experience	5 years or less	132	47.1%	9.14±7.82 (1-30)
	6-10 years	49	17.5%	
	11-15 years	37	13.2%	
	More than 15 years	62	22.1%	

N: number of the subjects; SD: standard deviation; Min: minimum, and Max: maximum

Level of Knowledge about Antibiotics Among the Study Participants

Table 4.3 illustrates the level of knowledge about antibiotics among the study participants. The overall mean percentage of correct responses across all items was 85.05%, indicating a high level of knowledge regarding antibiotic use and resistance among the participants. According to the results, the highest-rated item was item (5), "Prescribing broad-spectrum antibiotics empirically reduces resistance development" with a correct response rate of 90.0%, followed by item (7), "Antibiotic resistance is primarily a problem in low- and middle-income countries" with a correct response rate of 89.6%. In contrast, the lowest-rated item was item (1), "Antibiotic resistance is effective against viral infections such as colds and flu", with a correct response rate of 69.3%, followed by item (2), "Antibiotic resistance occurs when bacteria develop the ability to survive antibiotic exposure", with a correct response rate of 80.7%. These findings indicate that while participants demonstrated strong knowledge regarding appropriate antibiotic use and resistance-related practices, some misconceptions remain, particularly concerning the role of antibiotics in viral infections.

Table (4.3): Level of Knowledge about Antibiotics Among the Study Participants

Knowledge of Antibiotic Items (N=280)	Correct N (%)	Incorrect N (%)	Rank
1. Antibiotic resistance is effective against viral infections such as colds and flu. *	194 (69.3)	86 (30.7)	12
2. Antibiotic resistance occurs when bacteria develop the ability to survive antibiotic exposure.	226 (80.7)	54 (19.3)	11
3. Overuse of antibiotics is a major driver of antibiotic resistance.	245 (87.5)	35 (12.5)	4
4. A complete course of antibiotics should be taken even if symptoms improve.	250 (89.3)	30 (10.7)	3
5. Prescribing broad-spectrum antibiotics empirically reduces resistance development. *	252 (90)	28 (10)	1
6. It is appropriate to use antibiotics as fever/pain relief. *	244 (87.1)	36 (12.9)	5
7. Antibiotic resistance is primarily a problem in low/middle-income countries.	251 (89.6)	29 (10.4)	2
8. Laboratory tests (culture, sensitivity) should guide antibiotic selection when possible	240 (85.7)	40 (14.3)	7
9. Antibiotic prophylaxis before surgery reduces surgical site infections.	234 (83.6)	46 (16.4)	10
10. Patients can share leftover antibiotics if they have similar symptoms. *	241 (86.1)	39 (13.9)	6
11. Duration of antibiotic therapy should be based on clinical guidelines and diagnosis.	239 (85.4)	41 (14.6)	9
12. WHO recommends the restricted use of certain antibiotics to preserve their effectiveness.	240 (85.7)	40 (14.3)	7
Total	**85.05**	**14.95**	

Total indicates the mean percentage of correct responses across items; N: number of subjects: * correct answer false.

Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Knowledge of Antibiotics Among the Study Participants

Table 4.4 and Figure 4.3 illustrate the level of knowledge about antibiotics among the study participants. The results indicate that the majority of participants (76.1%) demonstrated a high level of knowledge, while nearly one quarter (22.5%) exhibited a moderate level. In contrast, only a small proportion of participants (1.4%) had a low level of knowledge. The mean knowledge score was 85.05 ± 9.08 out of 100, with scores ranging from 50.00 to 100.00, reflecting an overall high level of knowledge about antibiotics among the study participants.

Table (4.4): Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Knowledge of Antibiotics Among the Study Participants

Variable and level	N (280)	%	Mean	SD	Min	Max	level
Knowledge of Antibiotics			85.05	9.08	50.00	100.00	High
High (80 –100)	213	76.1%					
Moderate (60 –79.9)	63	22.5%					
Low (less than 60)	4	1.4%					

N: number of the subjects; **SD:** standard deviation; **Min:** minimum, and **Max:** maximum

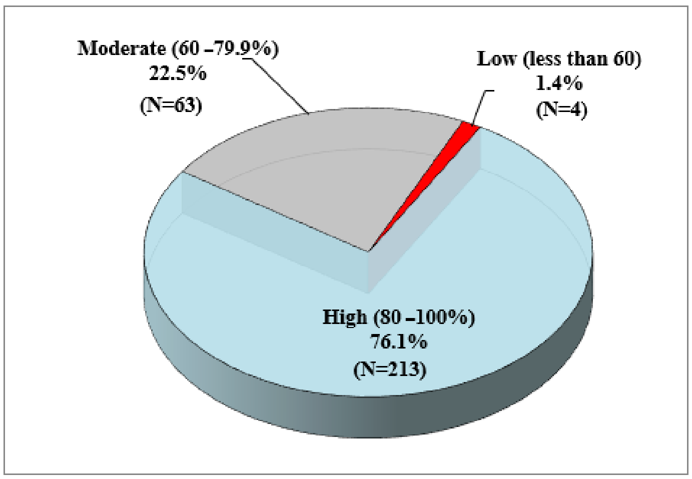

Figure (4.3): Level of Knowledge about Antibiotics Among the Study Participants

Level of Knowledge Antibiotic Resistance Among the Study Participants

Table 4.5 illustrates the level of knowledge about antibiotic resistance among the study participants. The overall mean percentage of correct responses across all items was 80.85%, indicating a high level of knowledge regarding antibiotic resistance among the participants. According to the results, the highest-rated item was item (2), "Healthcare-associated infections are a major source of antibiotic-resistant pathogens, with a correct response rate of 85.4%, followed by item (1), "Antibiotic resistance can spread from person to person, with a correct response rate of 84.6%. In contrast, the lowest-rated item was item (6), "Hand hygiene is as important as antibiotic stewardship in controlling resistance, with a correct response rate of 75.0%, followed by item (8), "Antibiotic resistance increases patient morbidity, mortality, and healthcare costs, with a correct response rate of 76.1%. These findings indicate that participants demonstrated strong awareness of the sources and transmission of antibiotic resistance, while comparatively lower recognition was observed for the role of hand hygiene and the broader consequences of antibiotic resistance.

Table (4.5): Level of Antibiotic Resistance Among the Study Participants

Knowledge of Antibiotic Resistance Items (N=280)	**Correct N (%)**	**Incorrect N (%)**	**Rank**
1. Antibiotic resistance can spread from person to person	237 (84.6)	43 (15.4)	2
2. Healthcare-associated infections are a major source of antibiotic-resistant pathogens	239 (85.4)	41 (14.6)	1
3. Infection prevention and control (IPC) measures reduce antibiotic-resistant infections	228 (81.4)	52 (18.6)	4
4. The Gaza healthcare system lacks adequate laboratory capacity for antimicrobial susceptibility testing	229 (81.8)	51 (18.2)	3
5. Drug supply chain issues can lead to the use of counterfeit/substandard antibiotics	223 (79.6)	57 (20.4)	6
6. Hand hygiene is as important as antibiotic stewardship in controlling resistance	210 (75.0)	70 (25)	8
7. Community-based antibiotic misuse affects hospital-based resistance patterns	226 (80.7)	54 (19.3)	5
8. Antibiotic resistance increases patient morbidity, mortality, and healthcare costs	213 (76.1)	67 (23.9)	7
Total	**80.85**	**19.15**	

Total indicates the mean percentage of correct responses across items & N: number of subjects.

Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Knowledge of Antibiotic Resistance Among the Study Participants

Table (4.6) and Figure (4.4) illustrate the level of knowledge of antibiotic resistance among the study participants. The results show that more than half of the participants (53.2%) demonstrated a high level of knowledge, while a substantial proportion (42.5%) exhibited a moderate level. In contrast, a small percentage of participants (4.3%) had a low level of knowledge. The mean knowledge score was 80.85 ± 13.56 out of 100, with scores ranging from 38.00 to 100.00, indicating an overall high level of knowledge of antibiotic resistance among the study participants.

Table (4.6): Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Knowledge of Antibiotic Resistance Among the Study Participants

Variable and level	**N (280)**	**%**	**Mean**	**SD**	**Min**	**Max**	**level**
Knowledge of antibiotic resistance			80.85	13.56	38.00	100.00	High
High (80 –100)	149	53.2%					
Moderate (60 –79.9)	119	42.5%					
Low (less than 60)	12	4.3%					

N: number of the subjects; SD: standard deviation; Min: minimum, and Max: maximum

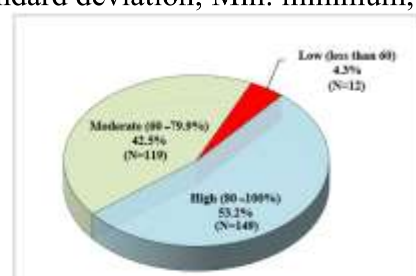

Figure (4.4): Level of Antibiotic Resistance Among the Study Participants

Level of Attitudes toward Antibiotic Use and Antibiotic Stewardship Among the Study Participants

Table 4.7 illustrates the level of attitudes toward antibiotic use and antibiotic stewardship among the study participants. The overall mean percentage across all items was 81.01%, indicating a positive and generally favourable attitude toward appropriate antibiotic use and stewardship practices. According to the results, the highest-rated item was item (15), "I feel confident in my ability to manage common infections without antibiotics when appropriate" with a mean percentage of 84.60%, ranking first, followed by item (14), "Healthcare system factors (staffing, resources, guidelines) affect my prescribing behaviour" which recorded a mean percentage of 83.00%, ranking second. In contrast, the lowest-rated item was item (12), "Patient education about antibiotic use is important but time-consuming", with a mean percentage of 78.40%, ranking last, followed by item (10), "Supply shortages sometimes force me to use non-recommended antibiotics", which had a mean percentage of 79.40%, ranking fourteenth. These findings indicate that while participants expressed strong confidence in managing infections and acknowledged the influence of healthcare system factors on prescribing behaviour, relatively lower attitudes were observed toward the feasibility of patient education and the impact of supply shortages on optimal antibiotic use.

Table (4.7): Level of Attitudes toward Antibiotic Use and Antibiotic Stewardship Among the Study Participants

Attitudes toward Antibiotic Use and Antibiotic Stewardship (N=280)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD	% Mean	Rank
1. I take responsibility for ensuring appropriate antibiotic prescribing/dispensing in my facility.	N	15	19	32	100	114	3.99	1.13	79.80	11
	%	5.4%	6.8%	11.4%	35.7%	40.7%				
2. Antibiotic resistance is a serious threat to public health in Gaza.	N	12	17	31	108	112	4.03	1.06	80.60	8
	%	4.3%	6.1%	11.1%	38.6%	39.9%				
3. My facility has clear antibiotic stewardship guidelines that I follow.	N	12	19	35	109	105	3.98	1.07	79.60	13
	%	4.3%	6.8%	12.5%	38.9%	37.5%				
4. I have received training on antibiotic stewardship and resistance.	N	15	15	33	104	113	4.01	1.1	80.20	10
	%	5.4%	5.4%	11.8%	37.1%	40.3%				
5. It is acceptable to prescribe antibiotics without laboratory confirmation when clinically indicated. ®	N	13	10	32	100	125	4.12	1.05	82.40	3
	%	4.6%	3.6%	11.4%	35.7%	44.7%				
	N	9	20	20	117	114	4.09	1.02	81.80	4

Attitudes toward Antibiotic Use and Antibiotic Stewardship (N=280)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD	% Mean	Rank
6. Patients' expectations often pressure me to prescribe antibiotics unnecessarily. ®	%	3.2%	7.1%	7.1%	41.9%	40.7%				
7. I would benefit from guidance on appropriate antibiotic selection for common infections.	N	11	17	33	99	120	4.07	1.06	81.40	6
	%	3.9%	6.1%	11.8%	35.4%	42.8%				
8. Narrow-spectrum antibiotics should be preferred over broad-spectrum when appropriate.	N	12	19	30	109	110	4.02	1.07	80.40	9
	%	4.3%	6.8%	10.7%	38.9%	39.3%				
9. Antibiotic stewardship is everyone's responsibility (prescribers, dispensers, patients, facility leaders).	N	11	14	39	95	121	4.07	1.05	81.40	5
	%	3.9%	5.0%	13.9%	33.9%	43.3%				
10. Supply shortages sometimes force me to use non-recommended antibiotics. ®	N	13	13	48	101	105	3.97	1.07	79.40	14
	%	4.6%	4.6%	17.1%	36.1%	37.6%				
11. I would support facility-level restrictions on certain high-risk antibiotics.	N	15	16	44	88	117	3.98	1.13	79.60	12
	%	5.4%	5.7%	15.7%	31.4%	41.8%				
12. Patient education about antibiotic use is important but time-consuming. ®	N	11	25	47	88	109	3.92	1.12	78.40	15
	%	3.9%	8.9%	16.8%	31.4%	39.0%				
13. Infection prevention measures (hand hygiene, IPC) can reduce the need for antibiotics.	N	15	14	37	87	127	4.06	1.12	81.20	7
	%	5.4%	5.0%	13.2%	31.1%	45.3%				
	N	12	12	32	90	134	4.15	1.06	83.00	2

Attitudes toward Antibiotic Use and Antibiotic Stewardship (N=280)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD	% Mean	Rank
14. Healthcare system factors (staffing, resources, guidelines) affect my prescribing behaviour.	%	4.3%	4.3%	11.4%	32.1%	47.9%				
15. I feel confident in my ability to manage common infections without antibiotics when appropriate.	N	9	7	29	98	137	4.23	0.96	84.60	1
	%	3.2%	2.5%	10.4%	35.0%	48.9%				
Total							**4.05**	**0.70**	**81.01**	

N: number of the subjects: ®: Reverse items.

Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Attitudes Toward Antibiotic Use Among the Study Participants

Table (4.8) and Figure (4.5) illustrate the level of attitudes toward antibiotic use among the study participants. The results indicate that the majority of participants (72.9%) demonstrated a high level of positive attitudes toward antibiotic use, while 16.1% exhibited a moderate level. In contrast, 11.0% of participants had a low level of attitudes toward antibiotic use. The mean attitude score was 81.01 ± 14.09 out of 100, with scores ranging from 37.40 to 98.60, reflecting an overall high level of positive attitudes toward antibiotic use and antibiotic stewardship among the study participants.

Table (4.8): Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Attitudes Toward Antibiotic Use Among the Study Participants

Variable and level	N (280)	%	Mean	SD	Min	Max	level
Attitudes Toward Antibiotic Use			81.01	14.09	37.40	98.60	High
High (80 –100)	204	72.9%					
Moderate (60 –79.9)	45	16.1%					
Low (less than 60)	31	11.0%					

N: number of the subjects; SD: standard deviation; Min: minimum, and Max: maximum

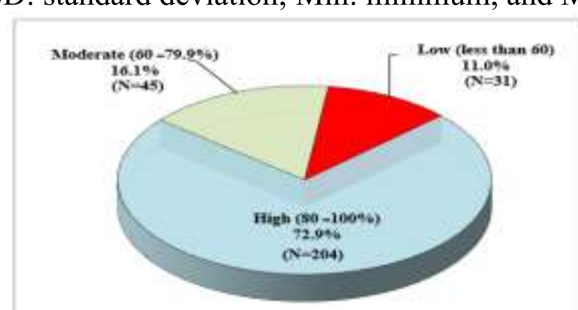

Figure (4.5): Level of Attitudes toward Antibiotic Use and Antibiotic Stewardship Among the Study Participants

Level of Antibiotic Prescribing Practices Among Physicians Among the Study Participants

Table 4.9 illustrates the level of antibiotic prescribing practices among physicians among the study participants. The overall mean percentage across all items was 68.14%, indicating a moderate level of appropriate antibiotic prescribing practices among physicians. According to the results, the highest-rated item was item (1), "I prescribe antibiotics based on both clinical diagnosis and laboratory confirmation" with a mean percentage of 77.75%, ranking first, followed by item (7), "I prescribe antibiotic combinations when a single agent would suffice" which recorded a mean percentage of 75.25%, ranking second. In contrast, the lowest-rated item was item (3), "I prescribe antibiotic therapy based on culture and sensitivity results when available" with a mean percentage of 52.75%, ranking last, followed by item (11), "I do not encounter patients requesting specific antibiotics or leftover medications", which had a mean percentage of 61.00%, ranking eleventh. These findings indicate that while physicians demonstrated relatively better practices related to clinically based prescribing decisions, gaps remain in culture-guided antibiotic use and in managing patient-driven pressures, highlighting areas that require further reinforcement to improve antibiotic stewardship practices.

Table (4.9): Level of Antibiotic Prescribing Practices Among Physicians Among the Study Participants

Antibiotic Prescribing Practices Among Physicians (N=102)		Never	Rarely	Sometimes	Often	Always	Mean	SD	% Mean	Rank
1. I prescribe antibiotics based on both clinical diagnosis and laboratory confirmation.	N	0	7	13	43	39	3.11	0.88	77.75	1
	%	0.00%	6.90%	12.70%	42.20%	38.20%				
2. I use broad-spectrum antibiotics as empirical therapy for specific symptoms.®	N	0	13	25	35	29	2.78	1	69.50	6
	%	0.00%	12.70%	24.50%	34.40%	28.40%				
3. I prescribe antibiotic therapy based on culture and sensitivity results when available.	N	0	28	43	22	9	2.11	0.91	52.75	12
	%	0.00%	27.50%	42.10%	21.60%	8.80%				
4. I consult clinical guidelines or formulary when prescribing antibiotics.	N	0	11	30	37	24	2.72	0.94	68.00	8
	%	0.00%	10.80%	29.40%	36.30%	23.50%				
5. I discuss with patients why an antibiotic is necessary and how to take it correctly.	N	0	5	30	41	26	2.86	0.85	71.50	5
	%	0.00%	4.90%	29.40%	40.20%	25.50%				
6. I recommend completing the full course even if symptoms resolve.	N	0	3	32	42	25	2.87	0.81	71.75	3
	%	0.00%	2.90%	31.40%	41.20%	24.50%				
7. I prescribe antibiotic combinations when a	N	0	0	29	42	31	3.01	0.77	75.25	2

single agent would suffice. ®	%	0.00%	0.00%	28.40%	41.20%	30.40%				
8. I do not prescribe antibiotics for symptomatic relief (fever, pain) without infection.	N	0	4	30	43	25	2.87	0.82	71.75	3
	%	0.00%	3.90%	29.40%	42.20%	24.50%				
9. I review recent antibiotic resistance patterns in my facility when deciding on therapy	N	0	6	33	42	21	2.76	0.84	69.00	7
	%	0.00%	5.90%	32.40%	41.10%	20.60%				
10. I tailor antibiotic duration to clinical response and fixed protocols.	N	0	15	37	38	12	2.46	0.88	61.50	10
	%	0.00%	14.70%	36.30%	37.20%	11.80%				
11. I do not encounter patients requesting specific antibiotics or leftover medications. ®	N	0	12	42	39	9	2.44	0.81	61.00	11
	%	0.00%	11.80%	41.20%	38.20%	8.80%				
12. I dispense/recommend antibiotics without a prescription (if applicable to your role). ®	N	0	9	32	44	17	2.67	0.85	66.75	9
	%	0.00%	8.80%	31.40%	43.10%	16.70%				
Total							**2.73**	**0.27**	**68.14**	

N: number of the subjects; ®: Reverse items.

Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Antibiotic Prescribing Practices Among Physicians Among the Study Participants

Table 4.10 and Figure 4.6 illustrate the level of antibiotic prescribing practices among physicians among the study participants. The results indicate that the majority of physicians (84.3%) demonstrated a moderate level of prescribing practices, while only a small proportion (3.9%) exhibited a high level. In contrast, 11.8% of physicians had a low level of prescribing practices. The mean prescribing practice score was 68.14 ± 6.83 out of 100, with scores ranging from 50.00 to 83.25, reflecting an overall moderate level of antibiotic prescribing practices among physicians.

Table (4.10): Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Antibiotic Prescribing Practices Among Physicians Among the Study Participants

Variable and level	N (102)	%	Mean	SD	Min	Max	level
Prescribing Practices Among Physicians			68.14	6.83	50.00	83.25	Moderate
High (80 –100)	4	3.9%					
Moderate (60 –79.9)	86	84.3%					
Low (less than 60)	12	11.8%					

N: number of the subjects; SD: standard deviation; Min: minimum, and Max: maximum

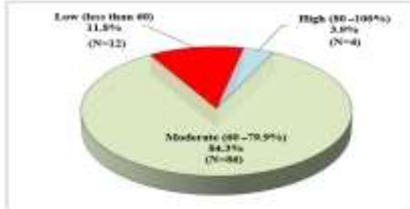

Figure (4.6): Level of Prescribing Practices Among Physicians

KAP levels among physicians and the KA levels among other healthcare workers among the study participants

Table 4.11 illustrates the KAP levels among physicians and the KA levels among other healthcare workers among the study participants. The results indicate that knowledge of antibiotics recorded the highest mean score (85.05 ± 9.08), ranking first among the assessed domains, followed by attitudes toward antibiotic use and antibiotic stewardship among healthcare providers, which achieved a mean score of 81.01 ± 14.09 and ranked second. Knowledge of antibiotic resistance ranked third, with a mean score of 80.85 ± 13.56. In contrast, antibiotic prescribing practices among physicians showed the lowest mean score (68.14 ± 6.83), ranking fourth. Overall, the combined KAP level among physicians and KA level among other healthcare workers yielded a mean score of 80.60 ± 11.09, indicating a generally moderate to high level of knowledge, attitudes, and practices, with comparatively stronger performance in knowledge and attitudes than in prescribing practices.

Table (4.11): KAP of physicians and KA of others Level Among the Study Participants

Domain	**N**	**Mean**	**SD**	**Rank**
Knowledge of antibiotics	280	85.05	9.08	1
Knowledge of antibiotic resistance	280	80.85	13.56	3
Attitudes toward Antibiotic use and antibiotic stewardship among healthcare providers	280	81.01	14.09	2
Antibiotic prescribing practices among physicians	102	68.14	6.83	4
KAP of physicians and KA of others	280	80.60	11.09	

SD: standard deviation

Frequency, Percentage, Minimum and Maximum Scores, Mean, and Standard Deviation of KAP (physicians) or KA (Others) Levels among the Study Participants

Table (4.12) and Figure (4.7) illustrate the levels of KAP among physicians and KA among other healthcare workers among the study participants. The results indicate that more than half of the participants (60.4%) demonstrated a high level of KAP/KA, while nearly one third (31.8%) exhibited a moderate level. In contrast, a small proportion of participants (7.9%) had a low level of KAP/KA. The mean KAP/KA score was 80.60 ± 11.09 out of 100, with scores ranging from 41.80 to 98.67, reflecting an overall high level of KAP/KA among the study participants.

Table (4.12): Frequency, Percentage, Minimum and Maximum Scores, Mean, and Standard Deviation of KAP (physicians) or KA (Others) Levels among the Study Participants

Variable and level	**N (280)**	**%**	**Mean**	**SD**	**Min**	**Max**	**level**
KAP (physicians) or KA (Others) Levels			80.60	11.09	41.80	98.67	High
High (80 –100)	169	60.4%					
Moderate (60 –79.9)	89	31.8%					
Low (less than 60)	22	7.9%					

N: number of the subjects; SD: standard deviation; Min: minimum, and Max: maximum

Level of Facility-Level Barriers to Antibiotic Stewardship Among the Study Participants

Table 4.13 presents participants' perceptions of facility-level barriers and enablers to antibiotic stewardship. Items were scored on a five-point scale ranging from Major Barrier to Major Enabler (coded from −2 to +2). Negative mean values indicate stronger perceived barriers, whereas positive values indicate perceived enablers. Overall, the total mean score (−0.85) suggests that facility-level factors were perceived predominantly as barriers. The overall mean percentage across all items was -42.57%, indicating that participants predominantly perceived multiple factors as barriers rather than enablers to effective antibiotic stewardship at the facility level. According to the results, the highest-rated enabler was item (9), "Facility-level leadership support for antibiotic stewardship" with a mean percentage of 69.00%, ranking first, followed by item (12), "Multidisciplinary team approach to antibiotic stewardship (pharmacists, infection control, physicians)" which recorded a mean percentage of 66.50%, ranking second. In contrast, the most pronounced barrier was item (7), "Inadequate training on antibiotic stewardship and resistance" with a mean percentage of -81.00%, ranking last, followed by item (1), "Lack of diagnostic laboratory capacity (culture, sensitivity testing)" and item (3), "Limited access to essential antibiotics (shortages)" both of which recorded a mean percentage of -80.00%. These findings indicate that while leadership support and multidisciplinary collaboration were perceived as key enablers, substantial structural and capacity-related barriers, particularly inadequate training, limited diagnostic services, and drug supply constraints, continue to hinder the effective implementation of antibiotic stewardship programs.

-Level of Facility-Level Barriers to Antibiotic Stewardship Among the Study Participants

-System-level and Strategic Factors to Antibiotic Stewardship Among the Study Participants

The assessment of facility-level barriers to antibiotic stewardship was restricted to physicians only, given their primary responsibility for antibiotic prescribing and clinical decision-making within primary healthcare settings. Physicians are particularly well positioned to appraise institutional and operational constraints—such as the availability of diagnostic laboratory services, access to essential antibiotics, workload pressures, and managerial support—that directly influence the implementation of antibiotic stewardship practices. Restricting this component to physicians enhances the relevance and interpretability of the findings and explains the smaller sample size for this section relative to the overall study population...

-Recommendations

Recommendations for Policymakers

- **Institutionalize Antimicrobial Stewardship within National Health Governance:**
  National health authorities should formally integrate antimicrobial resistance (AMR) mitigation and antibiotic stewardship into national and emergency health policies, establishing a coordinated governance framework that mandates facility-level antimicrobial stewardship programs (ASPs), standardized prescribing guidelines, and structured accountability mechanisms across primary healthcare (PHC) services.
- **Strengthen System Capacity through Sustainable Supply Chains and Workforce Development:**
  Policymakers should ensure a stable supply of quality-assured essential and narrow-spectrum antibiotics while institutionalizing mandatory, evidence-based continuing professional development (CPD) in antimicrobial stewardship for prescribers and dispensers, thereby enabling rational prescribing practices within resource-constrained health systems.
  6.2.2 Recommendations for Healthcare Providers and PHC Managers
- **Integrate Antimicrobial Stewardship into Routine Clinical Decision-Making:**
  Healthcare providers should systematically apply evidence-based stewardship principles in daily practice by prioritizing clinically justified antibiotic prescribing, favoring targeted narrow-

spectrum therapy whenever feasible, and avoiding antibiotics for viral or self-limiting conditions while maintaining accurate documentation of prescribing indications.

- **Enhance Diagnostic-Guided Prescribing and Patient-Centered Communication:** Clinicians and PHC managers should optimize the use of available microbiological data and local resistance patterns to guide empirical and targeted therapy while strengthening patient counseling strategies that clearly communicate the appropriate use of antibiotics and the importance of adherence to prescribed regimens.

6.2.3 Recommendations for Future Research

- **Conduct Rigorous Longitudinal and Implementation-Focused Research:** Future investigations should employ longitudinal, controlled, and implementation-science methodologies to evaluate the effectiveness, sustainability, and scalability of antimicrobial stewardship interventions within fragile and conflict-affected healthcare systems.
- **Strengthen Surveillance and Multidisciplinary Evidence Generation:** Researchers should integrate objective prescribing indicators, microbiological surveillance data, and mixed-methods approaches to generate robust evidence on resistance trends, prescribing determinants, and context-specific stewardship strategies in primary healthcare settings.

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