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The Role of Antimicrobial Stewardship and Systematic Evaluation of Antibiotic Misuse in Healthcare Facilities in the Southern Governorates of Palestine

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ABSTRACT:

Antimicrobial resistance (AMR) represents a critical global public health challenge, particularly in fragile and resource-constrained settings where health systems face structural and operational limitations. Primary healthcare (PHC) services in the Gaza Strip are especially vulnerable to inappropriate antibiotic use due to empirical prescribing practices, limited diagnostic capacity, disrupted supply chains, and weakened infection prevention and control infrastructure. These conditions contribute to antibiotic misuse and increase the risk of multidrug-resistant infections, ultimately affecting healthcare quality and system performance.

This study aimed to assess healthcare providers' knowledge, attitudes, and practices (KAP) regarding antibiotic use and resistance in governmental PHC clinics in the Gaza Strip, identify individual, organizational, and system-level 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 (physicians, nurses, pharmacists, and pharmacy technicians). The second phase implemented a pre–post educational intervention among 102 physicians. Data were collected using a validated multidimensional KAP and antimicrobial stewardship questionnaire and analyzed using descriptive statistics, independent-samples t-tests, one-way ANOVA, correlation analysis, and pre–post comparisons at a significance level of $p < 0.05$.

The findings indicated generally high levels of knowledge and positive attitudes toward antimicrobial stewardship; however, prescribing practices remained moderate, with persistent gaps in culture-guided therapy and the routine use of local resistance data. Major barriers included limited diagnostic resources, recurrent antibiotic shortages, heavy workload, and inadequate training. The educational intervention resulted in significant improvements in physicians' knowledge, attitudes, and self-reported prescribing practices. These findings underscore the need for integrated antimicrobial stewardship strategies that combine continuous professional education with strengthened diagnostics, prescribing governance, and health-system support to optimize antibiotic use in PHC settings.

Keywords: Antimicrobial resistance; Antibiotic stewardship; Primary healthcare; Prescribing practices; Educational intervention; Gaza Strip.

-Introduction

Antimicrobial resistance (AMR) has emerged as one of the most pressing global health challenges, threatening the effectiveness of modern medicine and undermining decades of progress in the management of infectious diseases. Current global evidence indicates that bacterial AMR is associated with millions of deaths annually, with the greatest burden disproportionately affecting low- and middle-income countries where health systems often face significant structural and resource constraints (Hayat et al., 2022; Cureus, 2025; The Lancet, 2024). In recognition of its growing magnitude, the World Health Organization has consistently identified AMR as one of the most critical public health threats facing humanity and has repeatedly warned about the increasing resistance to commonly prescribed antibiotics worldwide (WHO, 2015; WHO, 2021; WHO, 2025). Infections caused by resistant pathogens are frequently associated with prolonged illness, higher rates of clinical complications, and increased mortality. Patients with resistant infections are also more vulnerable to secondary infections, particularly following surgical interventions or other invasive medical procedures. These adverse clinical outcomes translate into extended hospitalizations, escalating healthcare expenditures, and substantial socioeconomic burdens that affect individuals, families, health systems, and national economies (Abu Sin et al., 2018; Aslam et al., 2021; Hayat et al., 2022).

From a health systems and management perspective, AMR extends beyond a purely microbiological or clinical issue. It represents a broader challenge related to healthcare system performance, organizational governance, and policy implementation. Inappropriate antibiotic use often reflects systemic weaknesses, including deficiencies in clinical governance structures, prescribing guidelines, workforce training, diagnostic capacity, pharmaceutical supply systems, and surveillance mechanisms (World Health Organization, 2015; Sheikh et al., 2011; Bloom et al., 2018). These institutional and structural factors play a decisive role in shaping prescribing practices and determining the effectiveness of antimicrobial stewardship initiatives, particularly in primary healthcare systems operating in fragile and conflict-affected contexts (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) .And Primary healthcare centres constitute a crucial frontline in addressing antimicrobial resistance, as they manage the majority of common infectious conditions and often represent the initial point of contact for individuals seeking medical care. Healthcare providers working in these settings therefore play a decisive role in determining whether antibiotics are prescribed, how treatment decisions are communicated to patients, and to what

extent opportunities for patient education regarding appropriate antibiotic use and the risks of self-medication are utilized. In this context, prescribing behavior in primary care is not solely a clinical decision but is also shaped by broader organizational and managerial factors, including patient workload, limited consultation time, availability and accessibility of clinical guidelines, supervisory support, and routine systems for performance monitoring and feedback (Sheikh et al., 2011; Bloom et al., 2018). And Evidence from low- and middle-income countries indicates considerable variability in healthcare providers' knowledge, attitudes, and prescribing practices related to antibiotics. Studies consistently demonstrate persistent gaps in antimicrobial stewardship training, inconsistent adherence to evidence-based prescribing guidelines, and limited integration of stewardship principles into routine clinical practice (Haque & Godman, 2021; Zhen et al., 2019; Hayat et al., 2022; Danadneh et al., 2025). Furthermore, research conducted in Palestine and comparable regional contexts highlights the widespread availability of antibiotics without prescription and the common practice of self-medication within communities. Such patterns significantly increase community-level selective pressure for resistant pathogens and pose substantial challenges to the implementation of effective antimicrobial stewardship strategies within primary healthcare systems (Gustafsson et al., 2025; WHO, 2025).

Research Problem

Irrational antibiotic use is a critical public health issue, particularly in low- and middle-income countries, where high infectious disease burden, limited diagnostic capacity, and weak regulatory frameworks facilitate misuse (Haque & Godman, 2021; Zhen et al., 2019; Hayat et al., 2022). Misuse—including prescribing for viral infections, inappropriate dosing, incomplete courses, and over-the-counter access—drives the emergence and spread of antimicrobial resistance (Machowska & Lundborg, 2019; WHO, 2015, 2021). Global stewardship efforts have been insufficient to counteract 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, protracted conflict, economic hardship, and fragile health infrastructure exacerbate these challenges by weakening regulatory enforcement and promoting informal antibiotic use and self-medication (Hammoudeh et al., 2020; OCHA, 2023; WHO, 2024). Surveillance data indicate rising multidrug-resistant infections, while primary healthcare providers demonstrate variable adherence to prescribing guidelines and limited access to structured stewardship training (Hayat et al., 2022; Dalal et al., 2025; Kumar et al., 2025). Notably, there is a scarcity of robust evidence on physicians' and pharmacists' knowledge, attitudes, and practices regarding antibiotic use, as well as the impact of context-specific educational interventions.

Beyond clinical factors, antibiotic misuse reflects systemic health management challenges, including gaps in leadership, workforce capacity, supervision, and organizational support. Understanding prescribing behaviour within this health system and management context is essential for designing effective interventions, optimizing antibiotic use, enhancing service quality, and strengthening the resilience and performance of primary healthcare in vulnerable populations.

Significance of the study

Antimicrobial resistance (AMR) is recognized by the World Health Organization as a global health emergency necessitating urgent interventions to enhance awareness and optimize antimicrobial use, particularly within primary healthcare where the majority of antibiotics are prescribed (WHO, 2015, 2021). In low- and middle-income countries, irrational antibiotic use is driven by high infectious disease burdens, limited regulatory oversight, and insufficient stewardship capacity, with inappropriate prescribing practices and non-prescription access consistently identified as major contributors to resistance (Haque & Godman, 2021; Machowska & Lundborg, 2019; Hayat et al., 2022).

Investigating healthcare providers' knowledge, attitudes, and practices (KAP) in primary healthcare centers addresses a critical leverage point identified in the WHO Global Action Plan: ensuring rational antimicrobial use through informed prescribing. The Gaza Strip represents an extreme yet under-explored context for this challenge. Its fragmented, donor-dependent health system, recurrent conflict, disrupted supply chains, and weak enforcement of prescription-only regulations facilitate easy access to antibiotics without medical oversight and result in minimal stewardship infrastructure (Hammoudeh et al., 2020; Kafri et al., 2020; UNRWA, 2020a; WHO, 2018).

Recent surveillance data indicating rising multidrug-resistant infections in Gaza underscore 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). However, there remains a notable paucity of systematically collected evidence on the KAP of physicians and pharmacists regarding antibiotics, their perceptions of self-medication, and the influence of socio-demographic and professional factors on prescribing behaviour.

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

1.6.1Antibiotics

Antibiotics are pharmacological agents employed for the prevention or treatment of bacterial infections. In this study, the term encompasses all systemic antibacterial agents that are commonly prescribed or dispensed within primary healthcare centers in the Gaza Strip.

1.6.2Antibiotic Resistance (AMR)

Antibiotic resistance refers to the capacity of bacterial pathogens to survive or proliferate despite exposure to antibiotics that would ordinarily inhibit or eradicate them. In this study, AMR is assessed through healthcare providers' knowledge, attitudes, and perceptions using a structured, validated questionnaire.

1.6.3 Healthcare Providers

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

1.6.4 Primary Healthcare Centers (PHCs)

Primary healthcare centers are first-level healthcare facilities that deliver outpatient preventive and curative services. These include diagnosis and management of common illnesses, maternal and child health services, and the dispensing of medications, including antibiotics.

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 underpinning the present study and provides a comprehensive review of the literature on antimicrobial resistance (AMR), antibiotic use, and stewardship within primary healthcare (PHC) settings, with a focus on low- and middle-income countries (LMICs) and conflict-affected contexts. The chapter is structured into two main sections. Section 2.1 outlines the conceptual framework, detailing the theoretical foundations and multilevel determinants of antibiotic prescribing and stewardship. Section 2.2 provides a critical literature review, synthesizing current evidence on the global burden of AMR, healthcare providers' knowledge, attitudes, and practices (KAP), key barriers and facilitators to effective stewardship, and the impact of educational interventions. The chapter concludes by highlighting significant gaps in the existing literature, emphasizing the limited evidence from Gaza's PHC system under conditions of protracted conflict. These gaps underscore the necessity of the present study, which aims to generate context-specific insights to inform interventions and policy strategies targeting rational antibiotic use and antimicrobial stewardship in this vulnerable setting.

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

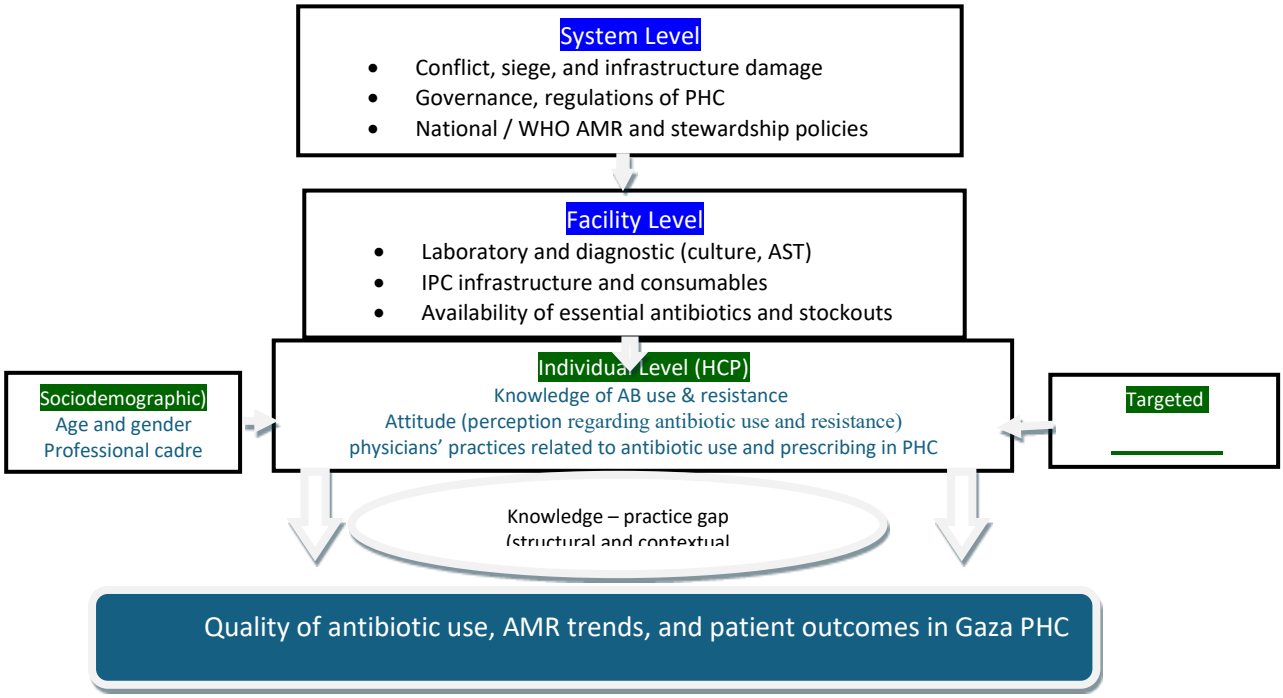
The conceptual framework incorporates a behaviour-change component, positing that targeted educational interventions can enhance healthcare providers' knowledge and attitudes, which in turn influence prescribing practices through cognitive and affective pathways (Arnold & Straus, 2005; Delsors et al., 2021). This approach aligns with implementation science evidence demonstrating that interactive, context-specific training—particularly when delivered through case-based learning, audit and feedback, and integration with local clinical guidelines—can effectively modify prescribing behaviours in primary care settings in low- and middle-income countries (Rocha et al., 2022; Wei et al., 2017).In the current study, the intervention focuses on physicians and aims to increase knowledge of antibiotics and resistance, improve attitudes toward antimicrobial stewardship responsibilities and feasibility, and enhance self-reported prescribing practices, including the use of narrow-spectrum agents, adherence to guidelines, and patient counselling. The framework assumes that educational interventions primarily operate at the individual level by addressing knowledge deficits and reinforcing motivation; however, their impact is moderated by facility-level and system-level conditions (Arnold & Straus, 2005; Michie et al., 2011). Sustained behaviour change therefore requires complementary reinforcement mechanisms, supportive organisational structures, and alignment with broader health system policies and stewardship strategies (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

-**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 (AMR) is widely recognised as one of the most urgent global health challenges of the twenty-first century, imposing significant morbidity, mortality, and economic burdens worldwide (WHO, 2023; Naghavi et al., 2024; UN News, 2025). A landmark 2024 analysis by the Global Research on Antimicrobial Resistance (GRAM) Project reported that in 2021, approximately 4.71 million deaths were associated with bacterial AMR, of which 1.14 million were directly attributable to resistant infections (Naghavi et al., 2024). This comprehensive study, encompassing data from 204 countries and territories over three decades, demonstrates that AMR has claimed at least one million lives annually since 1990. If current trends persist, projections indicate that deaths directly attributable to AMR could reach 1.91 million globally by 2050, with a total of 8.22 million deaths associated with AMR (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 antimicrobial resistance (AMR) disproportionately affects low- and middle-income countries (LMICs), where high infectious disease prevalence, limited diagnostic capacity, weak regulatory oversight, and the over-the-counter availability of antibiotics facilitate inappropriate use and accelerate the emergence of resistance (Haque et al., 2020; Ayukekbong et al., 2017; Godman et al., 2020). In these settings, antibiotics are frequently prescribed for viral or self-limiting conditions, administered at incorrect doses or durations, obtained without prescription from community pharmacies, and sometimes shared among household members, thereby increasing selection pressure for resistant organisms (Machowska & Lundborg, 2019; Harakeh et al., 2015).

Primary healthcare (PHC) serves as the initial point of contact for most patients presenting with common infections and accounts for the majority of antibiotic prescriptions worldwide. In some LMICs, up to 80–90% of total human antibiotic use occurs within primary care settings (Godman et al., 2020; WHO, 2015). Consequently, optimising antibiotic use in PHC is recognised as a central component of the WHO Global Action Plan on Antimicrobial Resistance, which advocates for enhanced awareness, strengthened surveillance, robust infection prevention and control, and the implementation of antimicrobial stewardship programs across all levels of the health system, with particular focus 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).

Recent multi-country studies reinforce the evidence of suboptimal antibiotic prescribing and variable knowledge, attitudes, and practices (KAP) among healthcare workers in low- and middle-income countries (LMICs). In Nigeria, a KAP study conducted in tertiary and secondary hospitals reported moderate levels of knowledge, attitudes, and practices regarding antibiotics and antimicrobial resistance, alongside poor adherence to WHO prescribing guidelines, highlighting the need for enhanced education and awareness initiatives (Onwuegbuzie et al., 2023). Similarly, research in Liberia identified persistent gaps in healthcare providers' KAP, including common misconceptions such as premature discontinuation and reuse of leftover antibiotics (Tamba et al., 2025). A cross-sectional study in the Eastern Mediterranean Region demonstrated variable KAP levels, with prior training on antibiotics and AMR significantly associated with improved knowledge, attitudes, and prescribing behaviours (Danadneh et al., 2023).

Although healthcare workers in LMICs generally express positive attitudes toward antimicrobial stewardship—supporting guideline-based prescribing, favouring narrow-spectrum agents, and acknowledging the risks of AMR—practical constraints often limit implementation. Reported barriers include time-intensive patient education, drug supply shortages, and pressure from patients or families, which can create ethical and practical dilemmas (Machowska & Lundborg, 2019; Harakeh et al., 2015). Self-reported prescribing practices remain suboptimal despite relatively high knowledge and supportive attitudes. Empirical prescribing predominates, laboratory tests are underutilized, and antibiotics are frequently prescribed in response to patient expectations or diagnostic uncertainty (Haque et al., 2020; Zhen et al., 2019; Hand et al., 2021). Systematic reviews indicate guideline non-adherence rates ranging from 30% to over 70%, with broad-spectrum agents often prescribed where narrow-spectrum alternatives would be appropriate (Ayukekbong et al., 2017).

Sociodemographic and Professional Determinants of KAP

Sociodemographic characteristics have been shown to influence healthcare providers' knowledge, attitudes, and practices (KAP) regarding antibiotic use and resistance. Evidence from multiple low- and middle-income countries indicates that older and more experienced clinicians often achieve higher knowledge scores and demonstrate more cautious prescribing behaviour, although in some contexts younger providers exhibit greater guideline adherence, likely reflecting more recent training exposure (Hayat et al., 2022; Zhen et al., 2019). Gender differences have also been observed, with female clinicians in certain studies showing more conservative prescribing patterns, stronger compliance with guidelines, and a greater emphasis on patient communication and shared decision-making (Hayat et al., 2022; Danadneh et al., 2023).

Professional cadre represents an additional key determinant. Pharmacists frequently demonstrate superior factual knowledge regarding drug mechanisms, spectra of activity, and resistance patterns owing to their specialised pharmaceutical training. In contrast, physicians' and nurses' practices are influenced by their clinical decision-making authority, patient-facing responsibilities, and diagnostic and treatment roles (Haque et al., 2020; Godman et al., 2020). Pharmacy technicians and non-physician clinicians, while often receiving more limited formal training on AMR and stewardship, nonetheless play essential

roles in medication dispensing and patient counselling within primary care settings in LMICs (Alhomoud et al., 2023).

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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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).

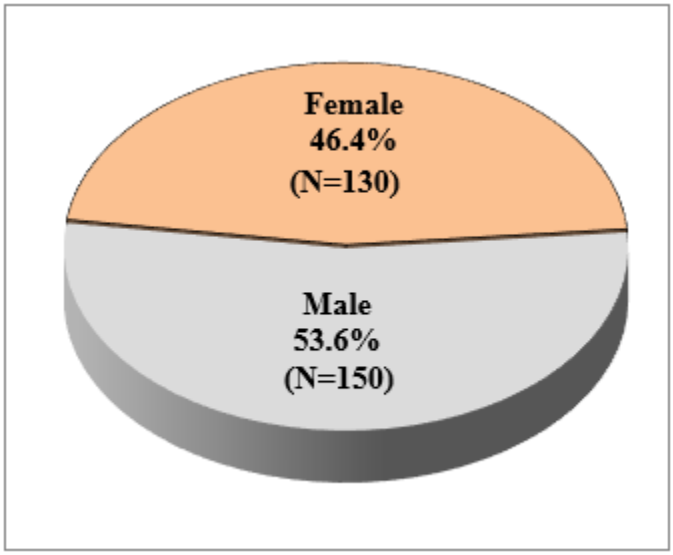

Figure (4.1): Distribution of Gender Among Study Participants

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.

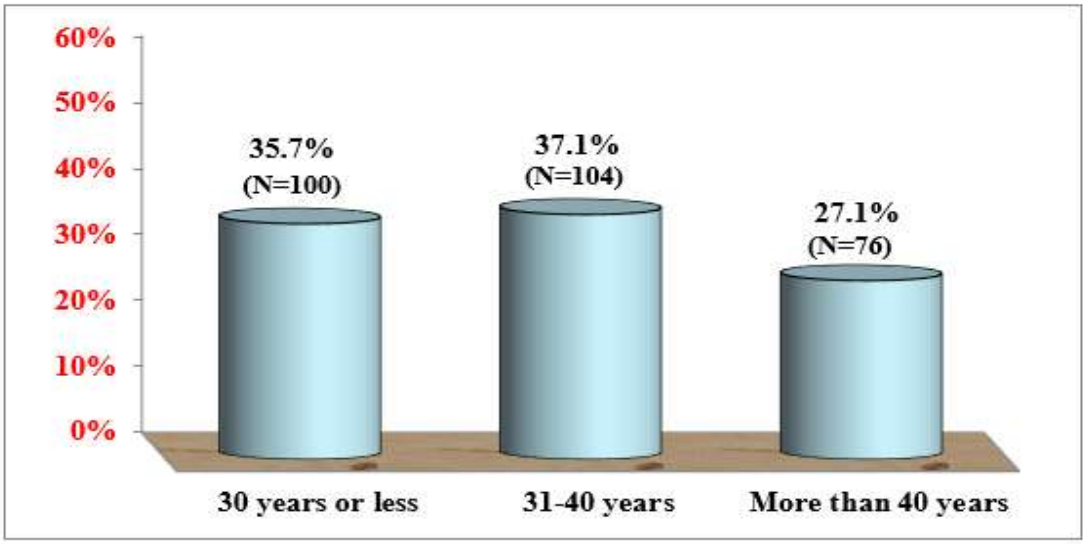

Figure (4.2): Distribution of Age Among Study Participants

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

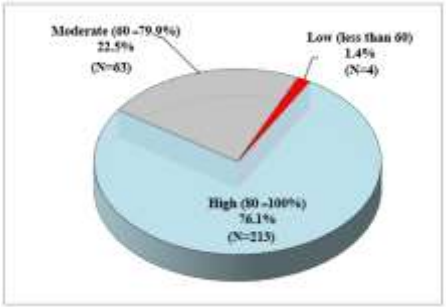

Figure (4.3): Level of Knowledge about Antibiotics Among the Study Participants

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

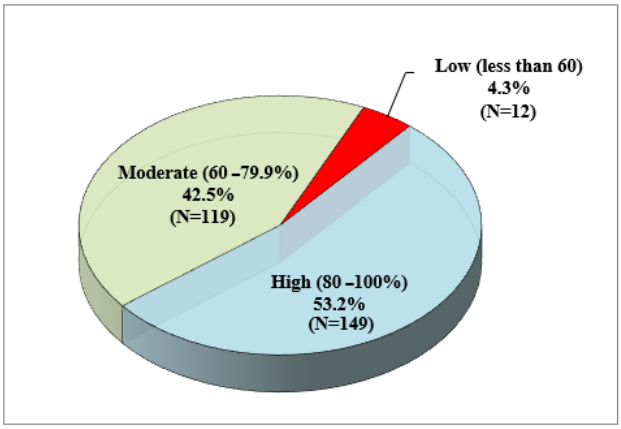

Figure (4.4): Level of Antibiotic Resistance Among the Study Participants

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%				
6. Patients' expectations often pressure me to prescribe antibiotics unnecessarily. ®	N	9	20	20	117	114	4.09	1.02	81.80	4
	%	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%				
	N	12	19	30	109	110	4.02	1.07	80.40	9

Attitudes toward Antibiotic Use and Antibiotic Stewardship (N=280)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD	% Mean	Rank
8. Narrow-spectrum antibiotics should be preferred over broad-spectrum when appropriate.	%	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%				
14. Healthcare system factors (staffing, resources, guidelines) affect my prescribing behaviour.	N	12	12	32	90	134	4.15	1.06	83.00	2
	%	4.3%	4.3%	11.4%	32.1%	47.9%				
	N	9	7	29	98	137	4.23	0.96	84.60	1

Attitudes toward Antibiotic Use and Antibiotic Stewardship (N=280)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD	% Mean	Rank
15. I feel confident in my ability to manage common infections without antibiotics when appropriate.	%	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

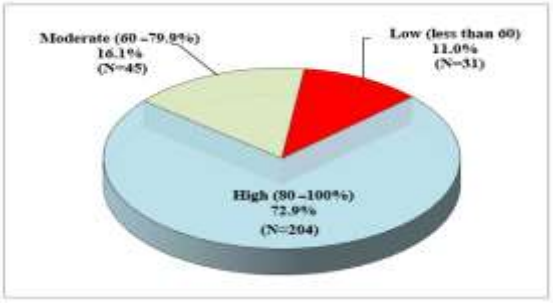

Figure (4.5): Level of Attitudes toward Antibiotic Use and Antibiotic Stewardship Among the Study Participants

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 single agent would suffice. ®	N	0	0	29	42	31	3.01	0.77	75.25	2
	%	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

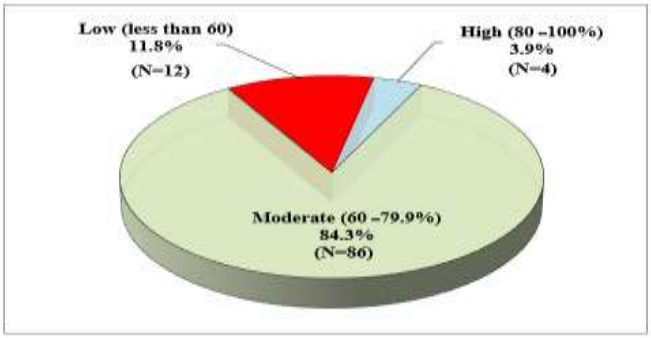

Figure (4.6): Level of Prescribing Practices Among Physicians

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...

-Result and Recommendation:

- Firstly Result:

1. High Knowledge but Moderate Practice: Healthcare providers demonstrated generally high knowledge and positive attitudes toward antibiotics and AMR, yet prescribing practices remained suboptimal, with frequent empirical use and limited adherence to guidelines.
2. Facility-Level Barriers: Limited diagnostic capacity, recurrent drug shortages, weak infection-prevention infrastructure, high workload, and insufficient training were major constraints to rational antibiotic use.
3. System-Level Challenges: Conflict-related disruptions, unstable supply chains, and low prioritization of AMR in health policy hinder effective stewardship in primary healthcare.
4. Sociodemographic and Professional Determinants: Age, gender, and professional cadre significantly influenced KAP scores, with older, female providers and pharmacists showing higher knowledge and more guideline-compliant practices.
5. Effectiveness of Targeted Education: Context-specific, interactive educational interventions improved physicians' knowledge, attitudes, and self-reported prescribing practices, highlighting the potential for behaviour change when integrated with local health system conditions.

-Secondly Recommendations:

1. Institutionalize Stewardship in Health Policy: National authorities should embed antimicrobial stewardship programs (ASPs) and standardized prescribing guidelines into national and emergency health policies, with clear accountability at facility level.
2. Ensure Sustainable Resources and Training: Maintain stable supplies of essential antibiotics and provide mandatory, evidence-based continuing professional development (CPD) in antimicrobial stewardship for all prescribers and dispensers.

3. Integrate Stewardship into Clinical Practice: Providers should apply evidence-based prescribing, favor narrow-spectrum therapy, avoid antibiotics for viral conditions, and accurately document all prescriptions.
4. Enhance Diagnostic Use and Patient Communication: Optimize the use of microbiological data and local resistance patterns for targeted therapy, while strengthening patient counselling on appropriate antibiotic use and adherence.
5. Promote Research and Surveillance: Conduct longitudinal, controlled, and implementation-focused studies, integrating objective prescribing and resistance data to inform scalable, context-specific stewardship interventions in fragile health systems.

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