

**Antimicrobial Stewardship Implementation and Its Association with Rational Antibiotic Prescribing Practices in Healthcare Facilities of Southern Palestine: A Cross-Sectional Study**

ترشيد استخدام مضادات الميكروبات وعلاقته بالممارسات الرشيدة لاستخدام المضادات الحيوية في مؤسسات الرعاية الأولية بالمحافظات الجنوبية من فلسطين: دراسة مقطعية

**Submitted by: Mohammad A. Abu Rayya**



## Antimicrobial Stewardship Implementation and Its Association with Rational Antibiotic Prescribing Practices in Healthcare Facilities of Southern Palestine: A Cross-Sectional Study

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### ABSTRACT

Antimicrobial resistance (AMR) has emerged as one of the most pressing threats to global health, posing substantial clinical, economic, and public health burdens worldwide. The challenge is particularly pronounced in fragile healthcare environments characterized by limited resources, constrained infrastructure, and ongoing systemic disruptions. In the Gaza Strip, primary healthcare (PHC) facilities operate under exceptional circumstances that can compromise the rational use of antibiotics. Factors such as reliance on empirical treatment decisions, inadequate access to microbiological diagnostic services, interruptions in pharmaceutical supply systems, and deficiencies in infection prevention and control measures create conditions that facilitate inappropriate antibiotic utilization. Consequently, these challenges contribute to the acceleration of antimicrobial resistance, negatively influencing patient outcomes, healthcare quality, and the overall effectiveness of health services and This study sought to examine the levels of knowledge, perceptions, and clinical practices of healthcare professionals regarding antibiotic use and antimicrobial resistance within governmental PHC clinics in the Gaza Strip. Additionally, it aimed to explore the individual,

institutional, and health-system factors associated with inappropriate antibiotic use and to determine the effectiveness of a targeted educational intervention in improving physicians' prescribing behaviors. To achieve these objectives, a mixed-methods research approach comprising two sequential phases was adopted. The first phase involved a descriptive cross-sectional analytical survey conducted among 280 healthcare providers, including physicians, nurses, pharmacists, and pharmacy technicians. The second phase consisted of a pre-post intervention study involving 102 physicians who participated in a structured educational program designed to promote evidence-based antibiotic prescribing. Data were gathered using a validated multidimensional instrument assessing knowledge, attitudes, practices, and antimicrobial stewardship competencies and were analyzed through descriptive and inferential statistical techniques, including independent-samples t-tests, one-way ANOVA, correlation analyses, and pre-post comparisons, with statistical significance established at  $p < 0.05$ , and The results demonstrated that healthcare providers generally possessed satisfactory knowledge and favorable attitudes toward antimicrobial stewardship principles. Nevertheless,

prescribing practices revealed notable deficiencies, particularly regarding the routine utilization of microbiological culture results and local antimicrobial resistance surveillance data to guide therapeutic decisions. Several systemic barriers were identified, including inadequate diagnostic capacity, recurrent shortages of essential antibiotics, excessive clinical workload, and insufficient opportunities for specialized training. Furthermore, the educational intervention produced statistically significant improvements in physicians' knowledge, attitudes, and reported prescribing behaviors. These findings highlight the importance of

implementing comprehensive antimicrobial stewardship frameworks that integrate continuous professional development, enhanced diagnostic support, evidence-based prescribing oversight, and broader health-system strengthening initiatives to promote rational antibiotic use and mitigate the growing threat of antimicrobial resistance within primary healthcare settings.

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

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ملخص البحث

الأساليب الإحصائية الوصفية والاستدلالية المناسبة. وقد أظهرت النتائج أن العاملين الصحيين يمتلكون مستوى جيداً من المعرفة واتجاهات إيجابية نحو مبادئ ترشيد استخدام المضادات الحيوية، إلا أن الممارسات الفعلية في الوصف الدوائي كشفت عن وجود جوانب قصور ملحوظة، لا سيما فيما يتعلق بالاعتماد المحدود على نتائج المزارع الميكروبية وبيانات ترصد مقاومة المضادات الحيوية عند اتخاذ القرارات العلاجية. كما كشفت الدراسة عن عدد من المعوقات النظامية، أبرزها محدودية القدرات التشخيصية، ونقص بعض المضادات الحيوية الأساسية، وارتفاع أعباء العمل، وضعف فرص التدريب المتخصص. كذلك أظهرت نتائج الدراسة التدخيلة تحسناً ذا دلالة إحصائية في معارف الأطباء واتجاهاتهم وممارساتهم المتعلقة بوصف المضادات الحيوية بعد تطبيق البرنامج التعليمي. وأوصت الدراسة بضرورة تعزيز برامج ترشيد استخدام المضادات الحيوية في مؤسسات الرعاية الصحية الأولية، وتطوير خدمات التشخيص المخبري، وتوفير برامج تدريب وتعليم مستمر للعاملين الصحيين، وتعزيز الرقابة على ممارسات وصف المضادات الحيوية، إلى جانب دعم السياسات الصحية الرامية إلى الحد من مقاومة مضادات الميكروبات وتحسين جودة الرعاية الصحية.

الكلمات المفتاحية: مقاومة مضادات الميكروبات؛ برامج ترشيد استخدام المضادات الحيوية؛ الرعاية الصحية الأولية؛ ممارسات وصف المضادات الحيوية؛ البرامج التعليمية؛ قطاع غزة.

هدفت هذه الدراسة إلى تقييم مستوى المعرفة والتصورات والممارسات المتعلقة باستخدام المضادات الحيوية ومقاومة مضادات الميكروبات لدى العاملين الصحيين في عيادات الرعاية الصحية الأولية الحكومية في قطاع غزة، والكشف عن العوامل الفردية والمؤسسية والنظامية المرتبطة بالاستخدام غير الرشيد للمضادات الحيوية، إضافة إلى تقييم فاعلية برنامج تعليمي موجه في تحسين سلوكيات وصف المضادات الحيوية لدى الأطباء. وتنبع أهمية الدراسة من التهديد المتزايد الذي تمثله مقاومة مضادات الميكروبات للصحة العامة، خاصة في البيئات الصحية الهشة التي تعاني من محدودية الموارد وضعف البنية التحتية والتحديات التشغيلية المستمرة. حيث اعتمدت الدراسة المنهج المختلط (Mixed Methods) من خلال مرحلتين متتابعيتين. تمثلت المرحلة الأولى في دراسة وصفية تحليلية مقطعية شملت مجتمع الدراسة من مقدمي الخدمات الصحية العاملين في عيادات الرعاية الصحية الأولية الحكومية بقطاع غزة، حيث بلغت عينة الدراسة (280) مشاركاً من الأطباء والممرضين والصيادلة وفنيي الصيدلة. أما المرحلة الثانية فتمثلت في دراسة تدخيلة قبلية-بعديّة شملت عينة من (102) طبيباً شاركوا في برنامج تعليمي منظم يهدف إلى تعزيز ممارسات وصف المضادات الحيوية المستندة إلى الدليل العلمي. وقد جمعت البيانات باستخدام استبانة متعددة الأبعاد تم التحقق من صدقها وثباتها، تضمنت محاور المعرفة والاتجاهات والممارسات وكفاءات برامج ترشيد استخدام المضادات الحيوية. وتم تحليل البيانات باستخدام

## -Introduction

Antimicrobial resistance (AMR) has become one of the most significant global health threats of the twenty-first century, jeopardizing the effectiveness of antimicrobial therapies and undermining decades of medical progress in the prevention and treatment of infectious diseases. Contemporary evidence indicates that antimicrobial-resistant bacterial infections are responsible for millions of deaths worldwide each year, with the burden falling disproportionately on low- and middle-income countries where healthcare systems frequently operate under substantial resource limitations and structural challenges (Hayat et al., 2022; The Lancet, 2024; Cureus, 2025). Recognizing the magnitude of this threat, the World Health Organization (WHO) has repeatedly identified AMR as a critical public health priority and has emphasized the urgent need for coordinated action to address the escalating resistance to commonly used antibiotics across diverse healthcare settings (WHO, 2015; WHO, 2021; WHO, 2025).

From a health systems perspective, antimicrobial resistance should not be viewed solely as a microbiological or clinical phenomenon. Rather, it represents a multidimensional challenge that reflects the performance of healthcare organizations, the effectiveness of governance structures, and the capacity of health systems to implement evidence-based policies and practices. Inappropriate antibiotic utilization frequently arises from systemic deficiencies, including weak clinical governance mechanisms, inadequate prescribing policies, limited workforce capacity, insufficient diagnostic services, fragmented pharmaceutical supply chains, and underdeveloped surveillance systems (World Health Organization, 2015; Sheikh et al., 2011; Bloom et al., 2018). Collectively, these organizational and institutional factors exert a substantial influence on prescribing behaviors and determine the effectiveness of antimicrobial stewardship interventions, particularly within primary healthcare systems operating in fragile, resource-constrained, and conflict-affected environments (Haque & Godman, 2021; Cox et al., 2017).

The inappropriate use of antibiotics remains one of the principal drivers of antimicrobial resistance globally. Such misuse encompasses unnecessary prescribing, inappropriate selection of antimicrobial agents, incorrect dosing regimens, prolonged treatment durations, and the use of antibiotics for viral or self-limiting conditions where no clinical benefit is expected. These practices are strongly influenced by broader health system functions, including regulatory oversight, pharmaceutical supply management, healthcare service organization, and accountability frameworks (World Health Organization, 2010; World Bank, 2018). In many countries, antibiotics continue to be dispensed without prescription, while misconceptions among healthcare providers and the public regarding the effectiveness and safety of antibiotics contribute to excessive demand and irrational consumption patterns (Hand et al., 2021; Harakeh et al., 2015; Gustafsson et al., 2025). Furthermore, patient expectations and perceived pressures to maintain

satisfaction often influence prescribing decisions, leading clinicians to prescribe antibiotics even when clinical indications are absent.

These challenges are particularly evident in fragile and conflict-affected settings, where weakened governance systems, disruptions in pharmaceutical supply chains, limited diagnostic capabilities, and inadequate stewardship infrastructures hinder efforts to promote rational antibiotic use (Haque & Godman, 2021; Hayat et al., 2022; Davis et al., 2025). Within this context, primary healthcare centers occupy a pivotal position in combating antimicrobial resistance, as they serve as the first point of contact for the majority of patients seeking treatment for common infectious conditions. Healthcare professionals working in these settings therefore play a central role in determining prescribing practices, educating patients about the appropriate use of antibiotics, and discouraging self-medication and other behaviors that contribute to antimicrobial resistance.

Importantly, antibiotic prescribing within primary healthcare settings is influenced not only by clinical considerations but also by organizational and managerial determinants. Factors such as excessive patient workload, time constraints during consultations, limited accessibility of clinical guidelines, insufficient supervisory support, and the absence of systematic monitoring and feedback mechanisms can significantly affect prescribing decisions and adherence to stewardship principles (Sheikh et al., 2011; Bloom et al., 2018). Consequently, strengthening prescribing practices requires interventions that address both individual provider behaviors and broader organizational factors within healthcare institutions.

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.

## Significance of the study

Antimicrobial resistance (AMR) has been identified by the World Health Organization (WHO) as one of the most serious threats to global health, requiring coordinated and immediate action to improve public and professional awareness and to promote the rational use of antimicrobial agents across all levels of healthcare delivery. Primary healthcare settings are of particular importance in this regard, as they account for the majority of antibiotic prescribing practices and therefore represent a critical point for interventions aimed at mitigating the emergence and

spread of resistant microorganisms (WHO, 2015; WHO, 2021). In low- and middle-income countries, the challenge is compounded by a high burden of infectious diseases, limited regulatory enforcement, inadequate antimicrobial stewardship infrastructure, and insufficient monitoring of prescribing practices. Consequently, inappropriate antibiotic use and unrestricted access to antimicrobials without prescription remain among the most significant drivers of antimicrobial resistance in these settings (Haque & Godman, 2021; Machowska & Lundborg, 2019; Hayat et al., 2022). Assessing healthcare providers' knowledge, attitudes, and practices (KAP) regarding antibiotic use and antimicrobial resistance is essential for understanding the behavioral and organizational determinants that influence prescribing decisions within primary healthcare systems. Such assessments directly support the objectives of the WHO Global Action Plan on Antimicrobial Resistance, which emphasizes the promotion of evidence-based prescribing and the optimization of antimicrobial use through strengthened professional competencies and stewardship initiatives. Within this context, the Gaza Strip presents a particularly complex and under-researched environment. The healthcare system is characterized by prolonged political instability, recurrent armed conflicts, chronic resource shortages, dependence on external assistance, disrupted pharmaceutical supply chains, and limited regulatory oversight. These challenges have contributed to widespread access to antibiotics outside formal prescribing channels and have constrained the development and implementation of effective antimicrobial stewardship programs (Hammoudeh et al., 2020; Kafri et al., 2020; UNRWA, 2020a; WHO, 2018).

Recent epidemiological evidence indicating increasing rates of multidrug-resistant infections in the Gaza Strip further highlights the urgency of developing context-specific interventions aimed at improving antibiotic utilization within primary healthcare settings (Trends in Antimicrobial Resistance in Gaza Strip, 2020–2022; Kumar et al., 2025). Despite the growing significance of this issue, there remains a substantial gap in the available literature regarding healthcare professionals' knowledge, perceptions, and prescribing behaviors related to antibiotic use and antimicrobial resistance. Moreover, limited empirical evidence exists concerning healthcare providers' attitudes toward self-medication practices, as well as the influence of demographic, professional, and workplace-related factors on prescribing patterns. Addressing these knowledge gaps is essential for informing policy development, strengthening antimicrobial stewardship programs, and supporting evidence-based interventions designed to improve antibiotic prescribing practices and contain the escalating threat of antimicrobial resistance within primary healthcare services.

## 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

### 1.6.1 Antibiotics

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.

### 1.6.2 Antibiotic 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 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 establishes the conceptual and theoretical foundation of the study and offers a comprehensive examination of the scholarly literature related to antimicrobial resistance (AMR), antibiotic utilization, and antimicrobial stewardship within primary healthcare (PHC) settings. Particular attention is given to evidence emerging from low- and middle-income countries (LMICs) and healthcare systems operating under conditions of fragility, resource constraints, and protracted conflict. The chapter is organized into two principal sections. Section 2.1 presents the conceptual framework guiding the study, outlining the theoretical perspectives and

the multilevel individual, organizational, and health-system factors that influence antibiotic prescribing behaviors and the implementation of antimicrobial stewardship practices. Section 2.2 provides a critical synthesis of the existing literature, examining the global epidemiology and burden of AMR, healthcare providers' knowledge, attitudes, and practices (KAP) regarding antibiotic use, the principal barriers and enabling factors affecting stewardship implementation, and the effectiveness of educational and behavioral interventions designed to improve prescribing practices. 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 adopted in this study integrates a behavioural change perspective, proposing that well-designed educational interventions can improve healthcare providers' knowledge and shape their attitudes toward

appropriate antibiotic use and antimicrobial stewardship, thereby contributing to positive changes in prescribing behaviour. This proposition is grounded in behavioural and implementation science theories, which emphasize that healthcare professionals' clinical decisions are influenced not only by their knowledge and technical competence but also by their beliefs, perceptions, motivations, and professional responsibilities. Accordingly, educational interventions are expected to influence prescribing practices through both cognitive pathways, by enhancing knowledge and clinical understanding, and affective pathways, by strengthening commitment to stewardship principles and responsible antibiotic use (Arnold & Straus, 2005; Delsors et al., 2021).

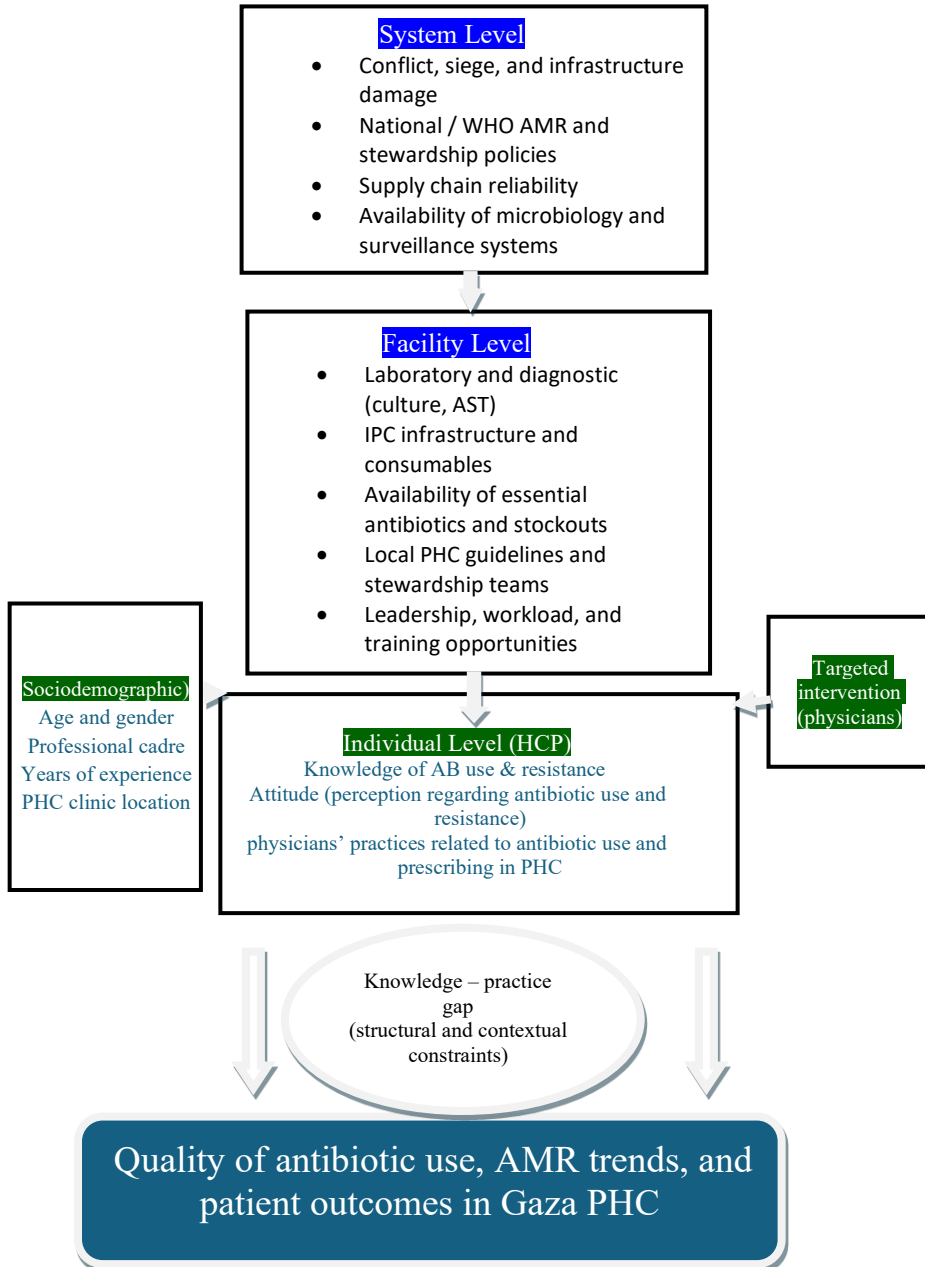
This perspective is supported by a growing body of evidence demonstrating that interactive and contextually tailored educational strategies can effectively improve prescribing behaviours, particularly within primary healthcare settings in low- and middle-income countries. Interventions that incorporate case-based learning approaches, clinical audit and feedback mechanisms, peer discussion, and alignment with locally relevant treatment guidelines have been shown to produce meaningful improvements in antibiotic prescribing quality and adherence to antimicrobial stewardship principles (Rocha et al., 2022; Wei et al., 2017).

Consequently, while educational interventions constitute a fundamental component of antimicrobial stewardship efforts, their long-term effectiveness depends on the presence of supportive organizational structures and enabling health-system conditions. Sustainable improvements in antibiotic prescribing require a comprehensive and integrated approach that combines continuous professional education with effective governance mechanisms, stewardship infrastructure, performance monitoring systems, and policies that promote rational antimicrobial use across all levels of healthcare delivery (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).

## 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 (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) is particularly severe in low- and middle-income countries (LMICs), where healthcare systems frequently encounter substantial resource limitations and structural challenges that hinder effective antimicrobial management. High rates of infectious diseases, inadequate diagnostic infrastructure, insufficient regulatory enforcement, and widespread access to antibiotics without prescription collectively contribute to inappropriate antimicrobial use and accelerate the development and spread of resistant pathogens (Haque et al., 2020; Ayukekbong et al., 2017; Godman et al., 2020). Within these settings, antibiotics are often prescribed for viral infections and other self-limiting illnesses for which antimicrobial therapy offers little or no clinical benefit. Additionally, inappropriate dosing regimens, prolonged treatment durations, self-medication practices, and the sharing of antibiotics among family members remain common behaviors that increase selective pressure on microbial populations and facilitate the emergence of antimicrobial resistance (Machowska & Lundborg, 2019; Harakeh et al., 2015).

### **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).

## 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).

## Conclusion

This chapter has established the conceptual and theoretical foundation for the present study by examining the multidimensional factors influencing antibiotic use and antimicrobial stewardship within primary healthcare settings. Drawing upon evidence from antimicrobial resistance research, health systems theory, behavioural change models, and implementation science, the chapter developed a comprehensive multilevel conceptual framework that captures the complex interactions among individual, organizational, and health-system determinants of antibiotic prescribing practices. And The framework recognizes that healthcare providers' prescribing behaviours are shaped not only by their knowledge, attitudes, and professional competencies but also by the organizational environments in which they operate and the broader governance and policy contexts that influence healthcare delivery.

## -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.

### • 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.

## 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%)
<b>Total HCPs</b>	<b>986</b>	<b>280</b>

## 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 post 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 ( $\approx 5\%$ ) 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).

**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**

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**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% ( $n = 130$ ).

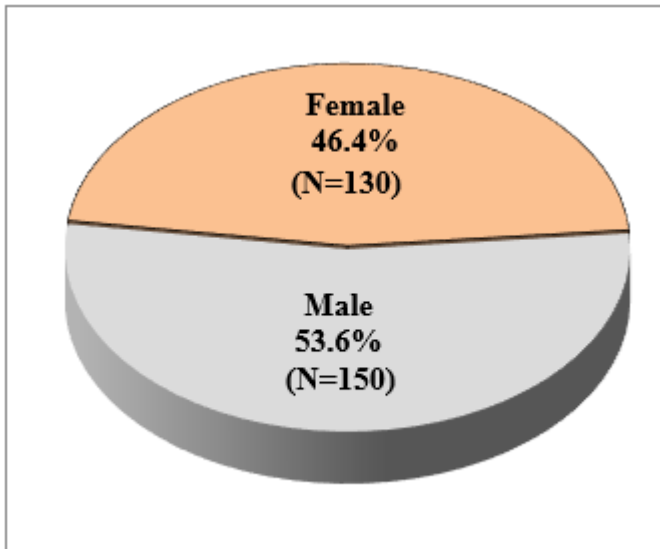


Figure (4.1): Distribution of Gender Among Study Participants

#### 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  $36.03 \pm 8.79$  years, with an age range of 24 to 59 years, reflecting a study sample composed mainly of young to middle-aged adults.

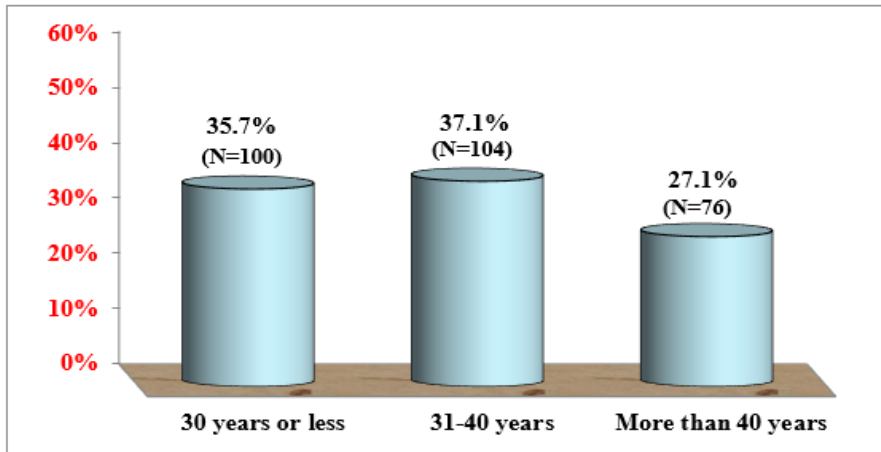


Figure (4.2): Distribution of Age Among Study Participants

## 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
<b>Total</b>	<b>85.05</b>	<b>14.95</b>	

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

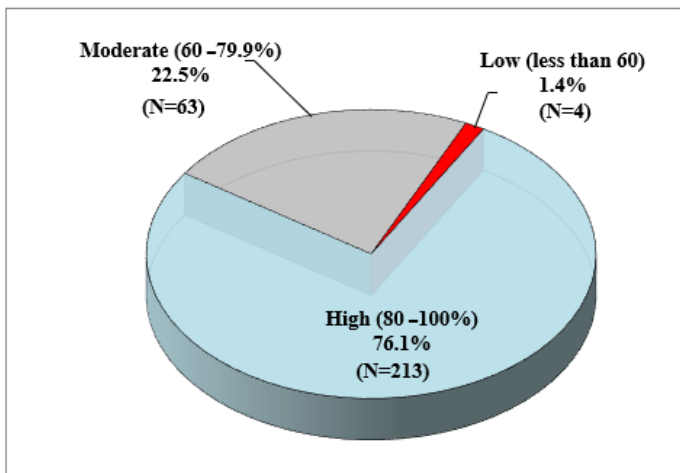
Table 4.4 and Figure 4.3 illustrate the level of knowledge about antibiotics among the study participants. The results indicate that the majority of participants (76.1%) demonstrated a high level of knowledge, while nearly one quarter (22.5%) exhibited a moderate level. In contrast, only a small proportion of participants (1.4%) had a low level of knowledge. The mean knowledge score was  $85.05 \pm 9.08$  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
<b>Knowledge of Antibiotics</b>			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
<b>Total</b>	<b>80.85</b>	<b>19.15</b>	

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

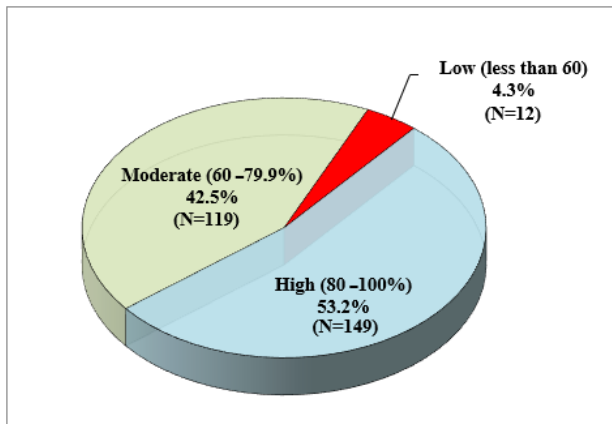
Table (4.6) and Figure (4.4) illustrate the level of knowledge of antibiotic resistance among the study participants. The results show that more than half of the participants (53.2%) demonstrated a high level of knowledge, while a substantial proportion (42.5%) exhibited a moderate level. In contrast, a small percentage of

participants (4.3%) had a low level of knowledge. The mean knowledge score was  $80.85 \pm 13.56$  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
<b>Knowledge of antibiotic resistance</b>			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%				
	N	11	17	33	99	120	4.07	1.06	81.40	6

Attitudes toward Antibiotic Use and Antibiotic Stewardship (N=280)	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD	% Mean	Rank
7. I would benefit from guidance on appropriate antibiotic selection for common infections.	% 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%				
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%				
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%				
<b>Total</b>						4.05	0.70	81.01	

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

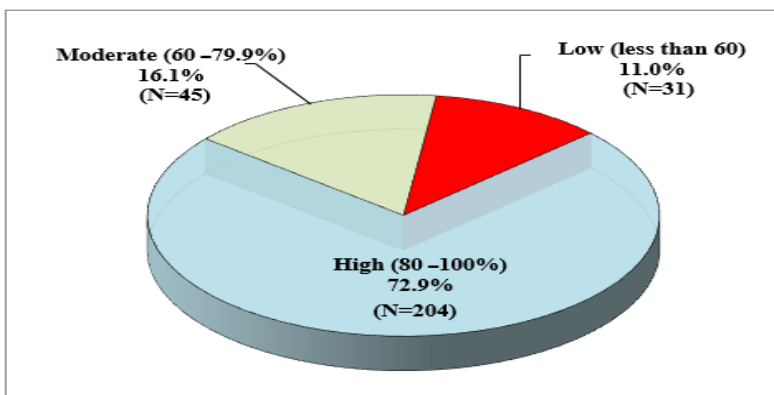
Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Attitudes Toward Antibiotic Use Among the Study Participants

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  $81.01 \pm 14.09$  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	Sometime	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%	2.70%	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%	7.50%	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%	0.80%	29.40%	36.30%	23.50%				

Antibiotic Prescribing Practices Among Physicians (N=102)		Never	Rarely	Sometime	Often	Always	Mean	SD	% Mean	Rank
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%	4.70%	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%	1.80%	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%				
<b>Total</b>							<b>2.73</b>	<b>0.27</b>	<b>68.14</b>	

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

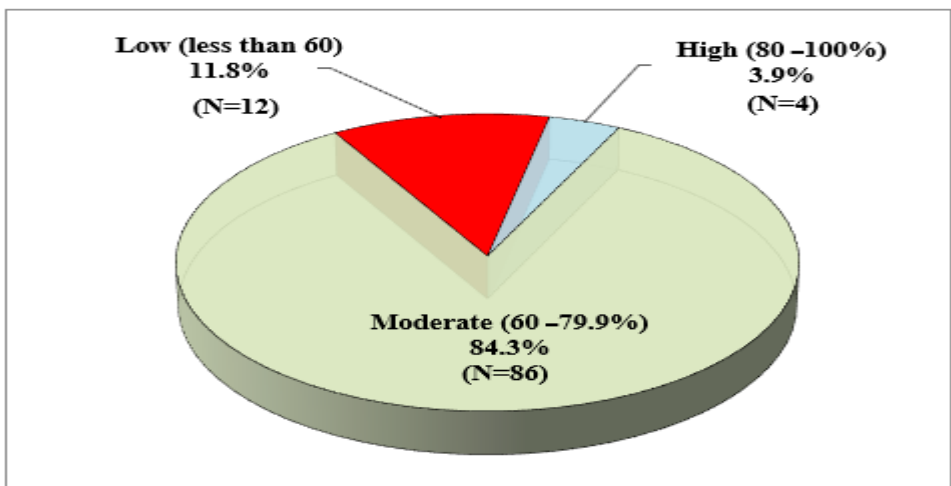
Frequency, Percentage, Minimum and Maximum Score, Mean, and Standard Deviation of Antibiotic Prescribing Practices Among Physicians Among the Study Participants

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  $68.14 \pm 6.83$  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
<b>Prescribing Practices Among Physicians</b>			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 ( $85.05 \pm 9.08$ ), ranking first among the assessed domains, followed by attitudes toward antibiotic use and antibiotic stewardship among healthcare providers, which achieved a mean score of  $81.01 \pm 14.09$  and ranked second. Knowledge of antibiotic resistance ranked third, with a mean score of  $80.85 \pm 13.56$ . In contrast, antibiotic prescribing practices among physicians showed the lowest mean score ( $68.14 \pm 6.83$ ), ranking fourth. Overall, the combined KAP level among physicians and KA level among other healthcare workers yielded a mean score of  $80.60 \pm 11.09$ , 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  $80.60 \pm 11.09$  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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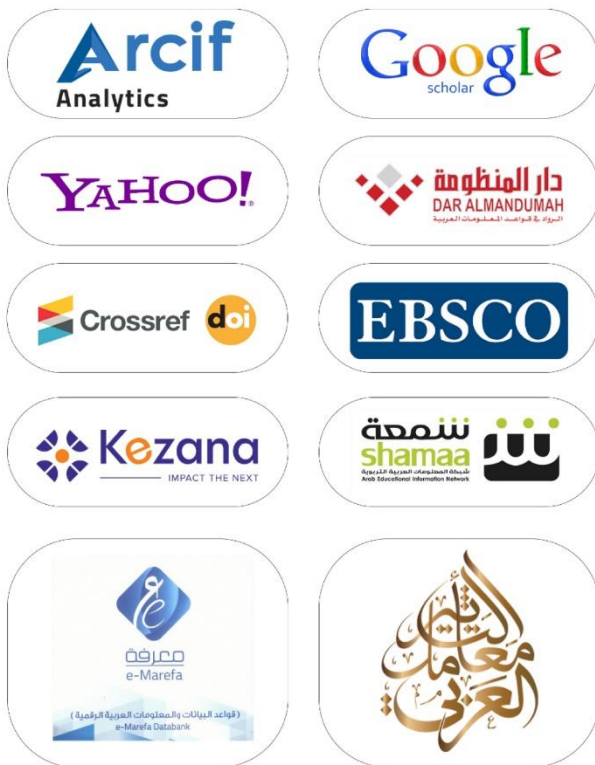
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