Infection and Drug Resistance

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

A Simulated Client Study on Non-Prescription Antibiotic Sales and Counselling Practices in Iraqi Nurse-Led Clinics: Implications for Antimicrobial Resistance

Amanj Kurdi[1–4], Awat Jamal Hasan[5], Ari Jamal Hassan II[6], Ying He[7], Omeed Darweesh[2], Karwan M-Amen[8], Kirmanj I Baker[9], Hardee Karwi[10], Brian Godman[1,4,11]

[1]Strathclyde Institute of Pharmacy and Biomedical Sciences, Strathclyde University, Glasgow, UK; [2]College of Pharmacy, Al-Kitab University, Kirkuk, 36015, Iraq; [3]College of Pharmacy, Hawler Medical University, Erbil, Kurdistan Region, Iraq; [4]Department of Public Health Pharmacy and Management, School of Pharmacy, Sefako Makgatho Health Sciences University, Ga-Rankuwa, 0208, South Africa; [5]College of Nursing, University of Sulaimani, Sulaimani, Kurdistan Region, Iraq; [6]College of Nursing, University of Human Development, Sulaimani, Kurdistan Region, Iraq; [7]Department of Mathematics and Statistics, University of Strathclyde, Glasgow, UK; [8]Department of Nursing, College of Nursing, Hawler Medical University, Erbil, Iraq; [9]Department of Surgery, College of Medicine, University of Kirkuk, Kirkuk, Iraq; [10]Department of Clinical Pharmacy, Azadi Teaching Hospital, Kirkuk Health Directorate, Ministry of Health, Kirkuk, Iraq; [11]Antibiotic Policy Group, Centre for Neonatal and Paediatric Infection, Institute for Infection and Immunity, Antibiotic Policy Group, City St. George's, University of London, London, SW17 0RE, UK

Amanj Kurdi, Strathclyde Institute of Pharmacy and Biomedical Science, University of Strathclyde, 161 Cathedral Street, Glasgow, G4 0RE, UK, Email amanj.baker@strath.ac.uk; Brian Godman, Sefako Makgatho Health Sciences University, Department of Public Health Pharmacy and Management, Ga-Rankuwa, Pretoria, 0208, South Africa, Email brian.godman@strath.ac.uk

Background: The inappropriate use of antibiotics is a major contributor to antimicrobial resistance (AMR), which is a critical issue in low and middle-income countries such as Iraq. Nurse-led clinics in Iraq are a common point of care for patients seeking treatment for infectious diseases; however, they are currently poorly regulated. This study aimed to assess the extent and appropriateness of antibiotic dispensing in this setting, including the quality of dispensing. In these clinics, only two antibiotics are legally permitted for dispensing. These are amoxicillin and erythromycin. The findings can be used to provide future guidance to improve antibiotic use in the country and reduce AMR where there are concerns.

Methodology: A cross-sectional study was undertaken using simulated clients among 235 randomly selected nurse-led clinics in Iraq, presenting with a viral upper respiratory tract infection (URTI). The outcomes included the prevalence, type of antibiotics supplied, including their Access, Watch, and Reserve (AWaRe) classification, as well as the extent and quality of patient counselling. Descriptive statistics were used to summarise dispensing patterns and counselling practices. Multivariable logistic regression was also applied to assess associations between provider's characteristics and inappropriate antibiotic dispensing.

Results: Antibiotics were supplied inappropriately in 60.0% (141/235) of the encounters, with 36.1% (85/235) of them involving antibiotics not legally permitted to be dispensed in these clinics. Amoxicillin/clavulanic acid accounted for 34.0% (48/141) of the antibiotics supplied. Based on their AWaRe classification, 25.5% (36/141) of these were Watch antibiotics. Only 24.8% of providers asked additional clinical questions, and allergy screening occurred in just 7.8% of cases. Clinics with higher-qualified staff were significantly less likely to dispense antibiotics.

Conclusion: Widespread inappropriate and, in many cases, illegal antibiotic dispensing was observed in Iraqi nurse-led clinics, with limited patient assessment. These findings underscore the urgent need for enhanced antimicrobial stewardship, provider education, and regulatory enforcement to address AMR in Iraq.

Plain Language Summary: Antimicrobial resistance (AMR) poses a substantial threat to public health as it reduces the number of effective antibiotics available to combat infections affecting patients as well as increasing costs and deaths. Iraq is a critical country with high and growing rates of AMR, with associated deaths. Consequently, there is a need to address this. Nurse-led clinics are a key part of primary healthcare delivery in Iraq; however, little is known about the management of patients with respiratory infections in these clinics. Our research identified that 60% of patients with mild respiratory infections that do not require antibiotics received them. Healthcare

Received: 25 April 2025
Accepted: 15 October 2025
Published: 30 October 2025

professionals (HCPs) in these clinics are allowed to dispense two antibiotics without a prescription; however, an appreciable number of antibiotics were dispensed outside of these two antibiotics. Of additional concern is that patients were not typically asked key questions during the consultation including any known allergies to penicillin products. Encouragingly, clinics staffed with higher-qualified HCPs were significantly less likely to dispensing antibiotics for mild respiratory infections. Overall, there is a need for appreciable education among patients and HCPs in Iraq to improve the future use of antibiotics alongside a decrease in AMR in the country.

Keywords: antibiotic stewardship, antimicrobial resistance, AWaRe classification, Iraq, nurse-led clinics, non-prescription antibiotic use

Introduction

Antimicrobial resistance (AMR) is a critical global health challenge, projected to cause up to 10 million deaths annually by 2050 if left unaddressed.[1] Its impact is particularly severe in low- and middle-income countries (LMICs), where regulatory oversight, diagnostic infrastructure, and public awareness are often limited.[2–6] The misuse of antibiotics, especially the dispensing of antibiotics without a prescription, remains widespread in LMICs and is a key driver of AMR.[4,6–12], along with high levels of inappropriate antibiotic prescribing among LMICs[13–15] Studies show that a large proportion of antibiotics are prescribed and obtained without prescriptions for self-limiting viral illnesses such as upper respiratory tract infections (URTIs), where antibiotics offer no clinical benefit.[11,18–21]

In Iraq, AMR has become a leading cause of mortality, with 3400 deaths attributable and 2,400 deaths associated with resistant infections in 2019 alone.[22] Despite existing regulations, non-prescription dispensing of antibiotics remains widespread, particularly in community pharmacies, where studies report 100% availability of antibiotics without a -prescription.[23–26] Inappropriate antibiotic use also extends to hospitals and primary healthcare (PHC) settings, where empirical treatment without microbiological testing is common.[27,28] These trends reflect wider regional challenges exacerbated by post-conflict healthcare fragility and under-resourced stewardship systems.[24]

The Iraqi healthcare system currently faces a number of challenges with improving future antibiotic use. Current challenges include inadequate enforcement of regulations surrounding the dispensing of antibiotics without a prescription, concerns with public awareness about antibiotics and AMR, especially regarding administering antibiotics without a prescription, as well as insufficient implementation of antimicrobial stewardship (AMS) and antimicrobial stewardship programs (ASPs).[23,25,26,29,30] There are also concerns that patients or parents stop antibiotics once symptoms improve due to economic reasons.[23] While the Iraqi National Action Plan (NAP) on AMR (2018–2022) emphasizes the need for stricter enforcement of antibiotic regulations and enhanced surveillance,[31] compliance remains limited, particularly in PHC settings. This is a concern going forward, which is similar to other LMICs where there are financial and personnel concerns with implementing NAPs in practice.[32–34] AMR is not only a national issue but a global public health threat, with resistant genes spreading internationally via travel, trade, and environmental routes.[35,36] It is increasingly viewed as the next pandemic unless urgent action is taken.[37] Addressing antibiotic misuse, particularly in LMICs including Iraq, is essential to meet the United Nation's Goal for AMR reduction.[38] In Iraq, reducing inappropriate antibiotic use across all healthcare settings is critical to national health security and achieving the objectives of NAP for AMR, which prioritises surveillance, stewardship, and public awareness in both formal and informal care sectors.[31]

In Iraq, alongside community pharmacies, nurse-led clinics are widely distributed. They were originally established as satellite facilities adjunct to physicians' clinics, primarily to provide nursing services including wound care and post-procedural management. However, due to prevailing public perceptions and cultural beliefs, these clinics are often regarded as the first point of contact for medical care, particularly in rural and underserved areas in the country. As a result, extending their scope beyond initial concepts. Consequently, they now play a key role in Iraq in PHC delivery with currently widespread reliance on such clinics for ambulatory care in many parts of Iraq, including peri-urban and underserved communities.

Nurse-based clinics are legally permitted in Iraq to dispense over-the-counter (OTC) medications to cover a broad range of ailments. These include medicines for pain management and fever relief, ie, paracetamol, aspirin, ibuprofen, as well as for gastrointestinal disorders including dyspepsia, diarrhea, and constipation, incorporating antacids, loperamide, oral rehydration salts and laxatives, antispasmodics for gastrointestinal discomfort, ie hyoscine butylbromide, as well as

guaifenesin and ipecacuanha for acute respiratory conditions including coughs and colds, and loratadine for allergy relief. Moreover, unlike community pharmacies, these clinics are legally permitted to dispense two antibiotics — amoxicillin and erythromycin — without specifying the indications or the rationale. This regulatory flexibility grants nurses the discretion to dispense these two antibiotics based on their clinical judgment. However, this can raise concerns regarding the potential misuse of antibiotics and AMR. This especially given the high prevalence of patients presenting with acute respiratory infections (ARIs) in primary care in LMICs, including Iraq, alongside the considerable expectations among patients, or parents of children, for a prescription for antibiotics for essentially self-limiting conditions.[13,15,39] In addition, concerns regarding the knowledge of antibiotics, AMR and ASPs, among nurse prescribers in LMICs.[15,40] These stewardship challenges are compounded by cultural norms and behavioural drivers common across many LMICs, where antibiotics are often seen by patients as essential to rapid recovery regardless of clinical indication.[6,13,15] Studies from across LMICs have reported that providers face strong pressure to meet patient expectations regarding the prescribing of antibiotics, particularly in settings with limited diagnostic capacity and poor health literacy.[6,13,41] Regulatory enforcement of prescription-only policies remains weak in Iraq, especially in non-pharmacy outlets such as nurse-led clinics. These trends were exacerbated during the COVID-19 pandemic, which disrupted oversight mechanisms and led to a surge in inappropriate antibiotic use across multiple LMICs.[42–45] While our study period (October 2023–April 2024) does not overlap with the height of the pandemic, we include this context to reflect previously observed patterns rather than direct findings from our dataset. Iraq's situation mirrors broader global patterns in fragile healthcare systems, where unregulated antibiotic access and workforce training gaps pose persistent barriers to AMS activities.[6,13] Nurse-led clinics, in particular, are often excluded from national training frameworks, leading to variability in dispensing behaviour and limited awareness of AMR threats.[13,46]

Importantly, despite their critical role in healthcare delivery, the extent and appropriateness of antibiotic dispensing practices in nurse-led clinics currently remains largely unexplored in Iraq. As a result, there is a notable paucity of data regarding whether these clinics dispense the two legally permitted antibiotics appropriately in accordance with clinical guidelines. Alternatively, whether they prescribe and dispense these inappropriately alongside restricted antibiotics beyond current regulations. Addressing possible widespread inappropriate prescribing and dispensing of antibiotics in nurse-led clinics in Iraq is important for the country to achieve the goals in its NAP. This is critical given concerns with existing AMR rates in the country, alongside the recent targets and goals from the United Nations Global Assembly (UN GA) to reduce AMR.[31,38]

Given the global and local urgency with addressing AMR across LMICs including Iraq, understanding the scale and nature of this issue among nurse-led clinics is essential for informing targeted interventions in Iraq aimed at enhancing future responsible antibiotic use. The findings can inform future policy interventions as part of Iraq's NAP to instigate targeted AMS activities in this setting, building on recent research with patients and community pharmacists.[23,25,26[Consequently, this study sought to assess the prevalence and appropriateness of antibiotic prescribing and dispensing practices in nurse-led clinics in Iraq. Specifically, to evaluate the types of antibiotics prescribed, including those from the WHO Watch list, the legality of their dispensing, and the quality of clinical questioning and guidance during these encounters. To the best of our knowledge, no previous studies have examined antibiotic supply or prescribing practices specifically within nurse-led clinics in Iraq. This study therefore fills a critical evidence gap by offering the first empirical insight into this under-researched but widely utilised sector of the Iraqi primary healthcare system.

Method

Study Design and Setting

This study employed a cross-sectional design utilizing the simulated client methodology (SCM) to assess antibiotic dispensing practices among nurse-led clinics within Sulaymaniyah, the largest city in the Kurdistan Region of Iraq (KRI).[47,48] Sulaymaniyah was chosen for this research as it accounts for approximately 41% (2.1 million) of the total population under the jurisdiction of the Kurdistan Regional Government (KRG), and is the third-largest city in Iraq.[28] Consequently, this setting provides a representative context for evaluating antibiotic dispensing patterns within PHC facilities in this region and across Iraq.

Study Population and Sample Size

The study population comprised all registered and licensed nurse-led clinics in Sulaymaniyah, as recognised by the Kurdistan Health Cadres Syndicate, the regulatory authority overseeing allied HCPs in the region. HCPs include nurses with a university degree, nurse assistants, physician assistants and pharmacy technicians.

The sample size was estimated at 235 nurse-led clinics, calculated based on a 95% confidence level (Z-score = 1.96), an assumed 0.5 (50%) prevalence of inappropriate antibiotic dispensing (as no prior data were available in the literature to inform a more precise estimate), and a 5% margin of error.[49] A prevalence of 0.5 was chosen following statistical recommendations and guidelines, as it yields the largest required sample size for survey-based studies.[50,51] Because the study was designed to estimate the prevalence of inappropriate antibiotic dispensing rather than test a hypothesis, a formal power calculation was not required. However, the selected sample size (n=235) ensures sufficient precision to estimate prevalence within ±6.4%, assuming a 50% proportion, which is standard when no prior data exist. A random sampling approach was employed to select the 235 clinics from a comprehensive list of 599 registered nurse-led clinics, obtained from the Kurdistan Health Cadres Syndicate, which served as the sampling frame. While the sample size was calculated assuming simple random sampling and a 50% prevalence estimate to ensure maximum variability, we did not apply a design effect or adjust for clustering by clinic type or area. Since all clinics were located within the same urban region and followed similar operational models, we anticipated minimal intra-cluster correlation; however, the potential impact of clustering on the precision of prevalence estimates should be acknowledged when interpreting confidence intervals.

Study Outcomes: Simulated Client Scenario and Data Collection

The primary outcomes of this study were the extent and practice of dispensing antibiotics with or without a prescription in nurse-led clinics. Data were collected through SCM (Figure 1), with visits conducted between October 2023 and April 2024. The SCM involved trained individuals enacting predefined scenarios to evaluate specific behaviours, providing a more accurate representation of real-world practices while minimizing social desirability bias.[47] This method has been widely used across LMICs to assess the appropriateness of antibiotics prescribed or dispensed.[48,52]

For this study, a simulated scenario was developed based on previous literature (Supplementary File 1),[48,52,53] in which the simulated client presented symptoms of an URTI for their 20-year-old sibling at home. This scenario was selected due to the high prevalence of URTIs in ambulatory care settings, where most cases are viral in nature and do not

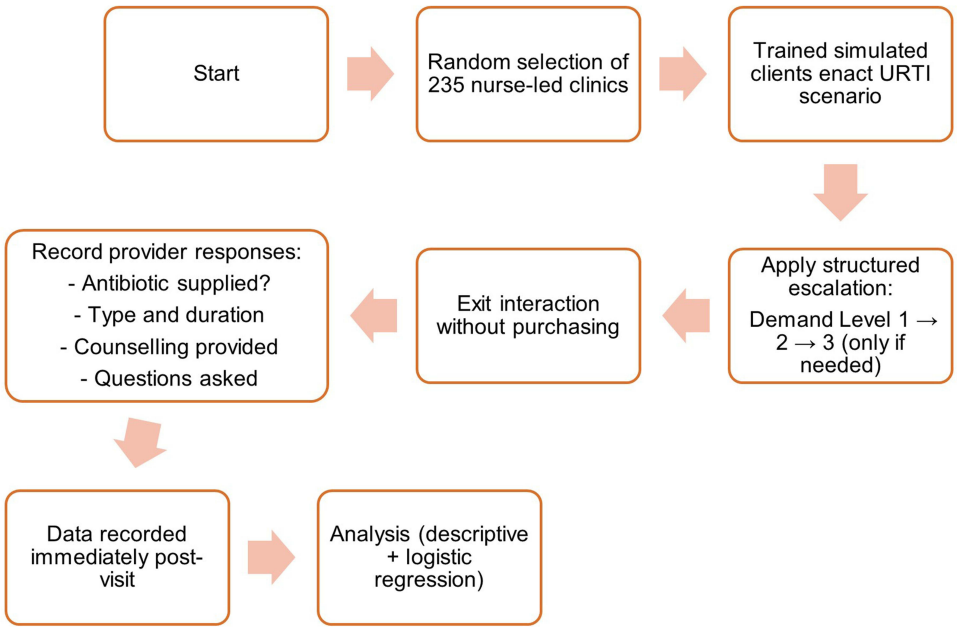

Figure 1 Flowchart summarising the Simulated Client Methodology (SCM) used to assess antibiotic dispensing practices in nurse-led clinics in Iraq.
Notes: NB: The figure outlines clinic selection, scenario deployment, demand level escalation, response capture, and analysis.

require antibiotic treatment, making them a common source of inappropriate antibiotic use in the community.[6,13,54] To assess the threshold at which antibiotics were dispensed, three levels of demand were applied, based on prior research.[55] Consistent with previous SCM studies,[47,52] the question "Are you a nurse?" was included at the end of each visit to prompt the provider to self-identify their professional cadre. Responses were recorded as stated by the provider (eg, "bachelor nurse", "diploma nurse", "medical assistant", or "pharmacy assistant") and documented immediately in the structured SC form (Supplementary File 1). These responses were subsequently categorised into four qualification levels according to the formal educational classifications defined by the Kurdistan Health Cadres Syndicate: (1) bachelor-level nurse (BSc Nursing), (2) diploma nurse, (3) medical assistant (with two-year associate degree), and (4) pharmacy assistant (with pharmacy technician training). This variable was then included as a categorical predictor in the multivariable logistic regression model to examine its association with inappropriate antibiotic dispensing. This approach allowed for an assessment of whether the level of education (as a proxy for knowledge) was associated with the extent and practice of dispensing antibiotics without a prescription. The simulated clients were pharmacy students in their final year who underwent two days of standardised training by a clinical pharmacist and the study supervisor. Training included scenario role-play, instruction on neutral presentation techniques, consistent use of the symptom script, and post-visit data recording procedures. Additionally, to ensure data accuracy including simulated clients' response post-visit, the simulated clients completed the structured questionnaire immediately after each visit, and responses were reviewed by a trained field coordinator who conducted regular debriefings and provided feedback. While audio recordings were not used to preserve discretion, these validation steps helped ensure consistency and protocol adherence across all visits.

Following each simulated client visit, the details of the encounter were systematically recorded using a structured data collection tool, designed to capture study outcomes and relevant study variables (Supplementary File 1). The scenario and data collection tool underwent an initial pilot phase in 15 nurse-led clinics to assess its feasibility, clarity, and completeness. Modifications would have been made if the simulated client had difficulty consistently delivering the scenario, if the clinical staff frequently misinterpreted the presenting symptoms, or if the structured form failed to capture key variables. However, no such issues were observed during the pilot, and the study proceeded without the need for major revisions of the scenario and data collection tool.

To assess the quality of the antibiotics supplied/sold during the study, these were categorized according to the World Health Organization (WHO) AWaRe classification system, which is being increasingly used across countries to assess antibiotic utilization patterns.[56,57] This evidence-based framework stratifies antibiotics based on their resistance potential.[56,57] Access antibiotics are recommended for first-line treatment due to their lower resistance potential, whereas Watch antibiotics are reserved for more severe infections with a higher resistance risk and Reserve antibiotics are intended for last-line treatment of multidrug-resistant infections. This approach is seen as increasingly important given the UN GA target goal that at least 70% of antibiotic utilization in given sectors should be Access antibiotics.[38] Alongside this, we also classified antibiotic utilization patterns under the adapted UK AWaRe classification, which classifies amoxycillin and clavulanic acid as a Watch rather than an Access antibiotic.[58,59] As part of our analysis plan, we included all three AWaRe categories, namely Access, Watch, and Reserve.

To evaluate counselling practices following the dispensing of an antibiotic, data were collected on whether HCPs offered advice regarding the appropriate use of the antibiotic, including the dosage, route of administration, and duration of treatment during the consultation. Additionally, the analysis captured whether providers asked any supplementary questions prior to the antibiotics being dispensed including inquiries about additional symptoms, medical history, allergy status, or other relevant clinical information. In this study, "illegal dispensing" was operationally defined as the supply of any antibiotic without a valid prescription, except for amoxicillin and erythromycin, which are legally permitted to be supplied by nurse-led clinics in Iraq. This definition reflects current national legislation, although we acknowledge that enforcement in practice may be inconsistent. Finally, future guidance to all key stakeholder groups in Iraq is based on the considerable experience of the co-authors in similar circumstances across multiple LMICs.[12,13,60]

Data Analysis

Descriptive statistics were utilized to summarize the study variables, with frequencies and proportions reported for categorical variables, while continuous variables were presented as mean (standard deviation, SD) or median (interquartile range, IQR), as appropriate. The overall prevalence of antibiotic dispensing was calculated and further stratified by the study covariates. A multivariable logistic regression model was used to assess the independent effects of each factor and examine the association between a single binary outcome—whether antibiotics were dispensed or not (dependent variable, outcome)—and key predictor variables, including provider qualification, gender, and area-level deprivation. Only one dependent variable was included in the model. This allowed for the ability to ascertain any potential confounding in the relationship between provider characteristics and antibiotic dispensing practices. Prior to model estimation, we assessed multicollinearity among the independent variables (qualification level, gender, and area deprivation) using variance inflation factors (VIFs), which were all below the threshold of concern, indicating no evidence of multicollinearity. Area-level deprivation was classified into three categories—least deprived, moderately deprived, and most deprived—based on neighbourhood-level socioeconomic data provided by the Sulaymaniyah Directorate of Statistics. This included indicators such as average household income, infrastructure access, and population density. Each clinic was mapped to its corresponding area to assign deprivation status. All statistical analyses in this study were performed using R version 4.4.1.

Results

Prevalence and Characteristics of Nurse-Led Clinics Dispensing Antibiotics Without a Prescription

Of the 235 registered nurse-led clinics visited using the simulated client methodology, all of which were licensed facilities under the Kurdistan Health Cadres Syndicate and did not include any community pharmacies, antibiotics were dispensed without a prescription in 60.0% (95% CI: 53.7%–66.3%) of the encounters (n=141) (Table 1). Of the 141 antibiotics supplied during the simulated visits, 56 (39.7%) were amoxicillin, one of only two antibiotics, along with erythromycin, that is legally permitted for use in nurse-led clinics under current Iraqi regulations. The remaining 85 antibiotics (60.3%) were not legally permitted to be dispensed by nurse-led clinics under current Iraqi regulations. This equates to an overall illegal antibiotic dispensing rate of 36.1% (95% CI: 30.0%–42.4%) (85 out of 235 total encounters).

Table 1 Baseline Characteristics of the 235 Nurse-Led Clinics, Stratified by the Status of Dispensing Antibiotics Without a Prescription

Variables	Total, % (N=235)	Antibiotics Supplied	
		Yes (N=141, 60%)	No (N=94, 40%)
Gender*			
Male	84.3% (198)	83.7% (118)	85.1% (80)
Female	15.7% (37)	19.5% (23)	14.9% (14)
Deprivation level*			
1 (Least deprived)	35.3% (83)	31.0% (44)	41.5% (39)
2	41.7% (98)	45.8% (65)	35.1% (33)
3 (most deprived)	23.0% (54)	22.5% (32)	23.4% (22)
Staff qualification level**			
Bachelor of Nursing	23.0% (54)	7.8% (11)	23.0% (54)
Diploma in Nursing	33.6% (79)	43.3% (61)	33.6% (79)
Medical Assistant	31.1% (73)	33.3% (47)	31.1% (73)
Pharmacy Assistant (technician)	12.3% (29)	15.6% (22)	12.3% (29)

Notes: * indicate statistically non-significant difference (p>0.05); ** indicate statistically significant difference (p<0.05)-obtained from the multivariate logistic regression. NB: The key takeaway message/ higher qualification levels were significantly associated with lower antibiotic dispensing rates, while no significant differences were observed by gender or area deprivation level).

Clinics were predominantly staffed by male personnel (84.3%, n=198), and there were no statistically significant differences in dispensing patterns based on gender ($p > 0.05$) (Table 1). Similarly, no significant associations were found between dispensing proportions and area-level deprivation. Clinics located in moderately deprived areas accounted for the highest proportion of total antibiotic dispensing (45.8%), followed by those in least deprived (31.0%) and most deprived (22.5%) areas. However, a significant difference in the percentage of dispensing an antibiotic with a prescription was observed across staff qualification levels ($p < 0.05$) (Table 1). Clinics managed by bachelor-level nurses supplied antibiotics in only 7.8% (n=11) of cases, compared to a higher proportion observed among diploma nurses (43.3%, n=61) and pharmacy assistants (15.6%, n=22) (Table 1).

Patterns and Quality of Nurse-Led Clinics Dispensing Antibiotics: Types, Duration, and Classification

Among the 141 antibiotics supplied, amoxicillin was the most common (39.7%, n=56), followed by amoxicillin/clavulanic acid (34.0%), azithromycin (21.3%), and smaller proportions of ciprofloxacin, cefixime, and ampicillin (Table 2). Notably, except for amoxicillin, all other agents were not permitted to be prescribed or dispensed by nurse-

Table 2 Characteristics of 141 Antibiotics Dispensed Among the 235 Nurse-Led Clinics

Variables	% (N)
Demand Level	
1	79.4% (112)
2	14.2% (20)
3	6.4% (9)
Antibiotic class type	
Amoxicillin	39.7% (56)
Amoxicillin/clavulanic acid	34.0% (48)
Ampicillin	0.7% (1)
Azithromycin	21.3% (30)
Cefixime	2.1% (3)
Ciprofloxacin	2.1% (3)
AWaRe (WHO)*	
Access	74.5% (105)
Watch	25.5% (36)
AWaRe (UK adaptation)**	
Access	40.4% (57)
Watch	59.6% (84)
Duration of treatment	
≤3 days	65.2% (92)
4-7 days	31.2% (44)
>7 days	1.4% (2)
Not advised	2.1% (3)
Route of administration	
Oral	98.6% (139)
Parenteral	1.4% (2)

Notes: *WHO,[61] **UK.[62] NB: The key takeaway messages: Amoxicillin/clavulanic acid was frequently dispensed despite not being permitted; most antibiotics supplied were for ≤3 days and a relatively high proportion were Watch antibiotics under the AWaRe classification.

https://doi.org/10.2147/IDR.S533590

led clinics, and their dispensing represents regulatory non-compliance. Prescribing and dispensing of antibiotics without a prescription was highly responsive to the level of patient demand. Even in the absence of a specific antibiotic request (Demand Level 1), antibiotics were supplied in 79.4% (n=112) of visits (Table 2). There was no prescribing or dispensing of erythromycin for the SPs with URTIs.

According to the WHO AWaRe framework, 74.5% (n=105) of antibiotics supplied were from the Access group and 25.5% (n=36) from the Watch group. However, classification under the UK AWaRe list revealed a higher proportion of Watch antibiotics (59.6%, n=84) (Table 2). The duration of therapy was also generally sub-optimal. Most antibiotics (65.2%, n=92) were supplied for three days or less, and 31.2% (n=44) were recommended for four to seven days. Only 1.4% (n = 2) of clients were advised to take antibiotics for more than one week. An exploratory univariate analysis using a chi-square test indicated that short-duration antibiotic supply (≤3 days) was most frequently observed with azithromycin (93.3%), followed by amoxicillin (62.5%) and amoxicillin/clavulanic acid (54.2%). In contrast, longer durations (4–7 days) were more commonly observed for cefixime (66.7%) and ciprofloxacin (66.7%). Although these patterns suggest variation in dispensing practices by antibiotic type, the overall association was not statistically significant ($\chi^2(15) = 21.77$, $p = 0.114$), potentially due to small sample sizes within some antibiotic categories limiting statistical power. Oral formulations were predominantly recommended (98.6%, n=139), with only two instances of intravenous antibiotic dispensing (Table 2).

Counselling and Inquiry Practices in Nurse-Led Clinics Dispensing Antibiotics

Counselling regarding antibiotic use was provided in 90.1% (n =127) of antibiotic dispensing cases (Table 3). Advice regarding dosage, frequency, or duration of treatment was provided in 90.1% (n =127) of antibiotic dispensing cases, while 8.9% (n=14) of encounters involved no counselling.

Only 24.8% (n=35) of providers asked additional clinical questions prior to dispensing antibiotics. Among those who did, the most frequently asked questions related to respiratory symptoms (34.3%, n= 12), allergy history (31.4%, n=11), and chronic conditions such as hypertension or diabetes (14.3%, n=5) (Table 3). Queries related to lifestyle factors, gastrointestinal symptoms, or surgical history were rare. Whilst 31.4% (n=11/35) of the 35 providers who asked any additional clinical questions inquired specifically about allergy status, this accounted for only 7.8% of all antibiotic dispensing encounters (n=11/141), highlighting a critical gap in routine safety screening prior to dispensing. We observed a trend toward higher screening rates in clinics staffed by more qualified personnel (Bachelor of Nursing (9.1%),

Table 3 Counselling Practices and Inquiry Patterns for Antibiotics Supplied/Sold Among the 235 Nurse-Led Clinics (Key Takeaway Message/ While Dosage Instructions Were Commonly Provided, Less Than 8% of Providers Screened for Allergy, Posing a Notable Patient Safety Concern)

Variables	% (N)
Advice on how to take the supplied antibiotic	
Yes	90.1% (127)
No	8.9% (14)
Asked any other questions	
Yes	24.8% (35)
No	75.2% (106)
Types of other questions asked (N=35)	
Respiratory Symptoms (eg, fever, dry/wet cough)	34.3% (12)
Allergy and Medication Sensitivity	31.4% (11)
Medical History and Chronic Conditions (eg, hypertension, diabetes)	14.3% (5)
Lifestyle and Behavioural Factors (eg, smoking status, body weight)	11.4% (4)
Surgical and Previous Treatment History (eg, tonsillectomy)	5.7% (2)
Gastrointestinal and Stomach-Related Symptoms (eg, vomiting, diarrhoea)	2.9% (1)

Notes: NB: The key takeaway message/ While dosage instructions were commonly provided, less than 8% of providers screened for allergy, posing a notable patient safety concern.

Diploma of Nursing (3.3%), Medical Assistant (4.3%), Pharmacy Assistant 0.0%) and in clinics located in higher-income areas (4.6%) vs 3.1% in the most deprived areas. However, these observations were based on univariate analyses with small subgroup sizes and were not adjusted for potential confounders such as patient age, antibiotic type, or demand level. Moreover, identifying predictors of allergy screening was not a primary aim of this study and should be explored further in future research.

Among the 94 clinics that declined to dispense antibiotics for a URTI, despite an explicit request by the simulated client (demand level 3), 38.9% (n=35) cited the need for a prescription, 37.8% (n=34) judged the condition as not requiring antibiotics, and 23.3% (n=21) referred the client to a physician. Furthermore, among the clinics that did not dispense antibiotics (n=94), 25.5% (n=24) offered alternative over-the-counter advice for symptom relief.

Discussion

We believe this is the first study of its kind in Iraq to assess current antibiotic prescribing practices in nurse-led clinics, an important provider of public healthcare in Iraq. Overall, this study provides one of the most detailed explorations to date regarding antibiotic prescribing, dispensing and counselling practices among nurse-led clinics in a LMIC context. The findings demonstrate that 60% of the surveyed nurse-led clinics dispensed non-approved antibiotics without a prescription, which is a concern. This is because URTIs, such as acute bronchitis, are typically viral in origin where first-line treatment should not be an antibiotic but symptomatic treatment as documented for instance in the WHO AWaRe Book.[63,64] Among these cases, 36.1% (n=85/235) of antibiotics supplied were deemed illegal under national legal definitions in Iraq, which is also a concern exacerbating AMR in Iraq. Another concern was that 25.5% of dispensed antibiotics were from the Watch category, which increased to 59.6% in the UK adaptation of the AWaRe classification primarily due to the reclassification of amoxicillin/clavulanic acid as a Watch antibiotic.[59] This divergence has major implications for stewardship strategies, especially in countries that use any modified AWaRe list to monitor current utilisation practices. Both the WHO and UK AWaRe classifications were applied in this study to provide a comparative framework for assessing antibiotic use. While the WHO list offers a global benchmark, the UK adaptation adopts a more conservative stance, reclassifying certain antibiotics such as amoxicillin/clavulanic acid from Access to Watch. Given Iraq's high usage rates and increasing resistance to broad-spectrum antibiotics, adopting a similar stewardship perspective may be more appropriate for guiding local policy, even though Iraq does not yet have a national AWaRe adaptation.

Whilst erythromycin is legally permitted for dispensing by nurse-led clinics, it was not supplied in any encounter. This likely reflects its lower demand due to tolerability concerns, particularly gastrointestinal side effects, which are more common with erythromycin compared to other broad-spectrum agents such as amoxicillin/clavulanic acid. Additionally, when a macrolide was considered appropriate, providers appeared to favour azithromycin, a second-generation macrolide, possibly due to its more favourable pharmacokinetic and safety profile.[65] Azithromycin offers several clinical advantages over erythromycin, including a longer half-life allowing for once-daily dosing, fewer gastrointestinal side effects, reduced drug–drug interactions, and improved overall tolerability.[65] While both agents are effective protein synthesis inhibitors with overlapping indications, azithromycin is generally preferred in practice, which may explain the absence of erythromycin in our study.[65]

Prescribing or dispensing Watch antibiotics (other than erythromycin) or any antibiotic for self-limiting conditions such as URTIs should be avoided to help curb AMR.[13,54] Instigating prescribing targets based on the WHO AWaRe book should help in this regard going forward, especially among LMICs with no recognized robust guidelines for managing infections typically seen in ambulatory care.[64,66,67] However, this requires suitable IT systems to enable real-time education and monitoring, reducing reliance on time- and resource-intensive paper-based data collection. While most nurse-led clinics in Iraq currently operate without formal IT infrastructure, particularly in informal or peri-urban settings, the development of scalable digital or mobile-based monitoring tools should be considered as part of a phased implementation aligned with Iraq's National Action Plan on AMR. Pilot programmes using low-cost reporting tools or digital registers in high-volume clinics could offer a pragmatic starting point, which is currently being explored.[68] In high-income countries, online access to prescribing data, combined with clear guidance and real-time monitoring, has significantly improved adherence to prescribing standards.[69,70] This provides an exemplar for health authority personnel in Iraq to help meet NAP and UN GA targets.

Suboptimal counselling and failure to check for allergies raise serious patient safety concerns and may contribute to AMR and inadequate treatment. In addition, in 65.2% of encounters, the recommended duration was ≤3 days, which is often insufficient for complete resolution of common bacterial infections, especially RTIs or UTIs of bacterial origin, thereby contributing to sub-therapeutic exposure and resistance development.[63,66] The findings also revealed that only 31.4% (n=11/35) of the HCPs in the nurse-led clinics who asked follow-up questions before dispensing antibiotics queried the allergy status of the SPs. This equates to under 8% of all antibiotic dispensing encounters. This is also a major concern given the known risks of antibiotic allergies, further highlighting patterns of irrational antibiotic prescribing and dispensing in nurse-led clinics. This finding is particularly troubling given that approximately three-quarters of the antibiotics supplied in the nurse-led clinics were penicillin derivatives including amoxicillin and amoxicillin/clavulanic acid. Failure to routinely ask and assess for allergies, especially to beta-lactam antibiotics poses a serious patient safety risk, including the possibility of severe hypersensitivity reactions such as anaphylaxis. This urgently needs to be addressed going forward. This gap reflects a wider lack of proper clinical assessment in Iraq's primary healthcare setting. It highlights the urgent need for structured training and standardised protocols. Implementing WHO AWaRe guidance will be key to ensuring safer and more appropriate antibiotic use (Table 4). Furthermore, the limited provision of symptomatic advice may reflect missed opportunities for promoting appropriate self-care and AMS. However, although infrequent, a few providers offered appropriate non-antibiotic symptom management advice, which included recommending paracetamol or advising on rest and hydration, and this could be leveraged in future AMS programs as positive behavioural anchors for wider capacity-building efforts. Enhancing clinical inquiry, especially allergy screening, should be prioritized in any future intervention or ASPs targeting nurse-led clinics in Iraq and similar LMIC contexts. We know ASPs can be more challenging in LMICs due to personnel and resource issue; however, this is now changing with multiple ASPs successfully introduced in LMICs in recent years including among prescribers, dispensers and patients.[12,13,53,76]

As seen, multivariate analysis revealed significant associations between inappropriate antibiotic dispensing and the level of professional qualifications among the HCPs. Clinics staffed by those with bachelor-level nursing degrees were less likely to dispense antibiotics inappropriately compared to those staffed by diploma or assistant-level personnel. This is similar to HCPs in other LMICs especially when confronted by patients requesting antibiotics to treat essentially viral infections.[13,54,77] No significant differences though were observed based on clinic location or gender of the provider. While the regression model adjusted for qualification, gender, and area-level deprivation, we were unable to account for other potential confounders such as clinic workload or patient demand level due to data limitations. However, it is notable that the majority of antibiotics were supplied at Demand Level 1, the lowest level of patient insistence, indicating that patient pressure may not have been the primary driver of inappropriate dispensing in this context. Nevertheless, other unmeasured structural factors may still influence dispensing behaviours and should be investigated in future studies using more granular operational data. Overall, these collective behaviours pose an appreciable challenge to improve future antibiotic use, and the containment of AMR, in Iraq. These challenges need to be urgently addressed in order to meet the AMR objectives contained in the Iraq NAP for AMR given current high rates of AMR in the country and the mortality implications.[31]

The high prevalence of inappropriate and, in a number of cases, illegal antibiotic dispensing seen in the nurse-led clinics in our study underscores the need for multiple, coordinated approaches, to improve future antibiotic use in Iraq, similar to other LMICs.[13,54,78] Suggested activities start in universities and continue post-qualification for HCPs. They also include greater monitoring of clinic activities and patient education given concerns with patient knowledge and activities across LMICs including Iraq.[6,13,54] Evidence from LMICs demonstrates that culturally tailored public education campaigns can effectively reduce inappropriate antibiotic use and improve community-level practices.[13,15,74] Notable examples among LMICs include Thailand's Antibiotic Smart Use programme and adaptations of the UK's Antibiotic Guardian initiative in South Africa, both of which successfully improved public understanding and reduced misuse.[79,80] Similarly, a multi-country review highlighted how Ghana's public awareness campaigns—incorporating pharmacy posters, radio broadcasts, and school-based materials—enhanced knowledge of AWaRe antibiotics and lowered demand for unnecessary Watch antibiotics.[15] Comparable community-facing strategies could be adapted to Iraq's context through collaboration with local health directorates, media outlets, and educational institutions to promote safer antibiotic use and strengthen public alignment with national AMR goals. Subsequently, Table 4 contains a number of suggested activities

Table 4 Suggested Activities for Key Stakeholders to Reduce Inappropriate Antibiotic Use and AMR in Iraq

Stakeholder Group	Suggested Activity
Health Authorities	• Review and update the NAP to include the role of nurse-led clinics with improving future use of antibiotics given their role in Iraq alongside appreciable concerns with current utilization patterns • Improve the monitoring of nurse-led clinics to reduce inappropriate prescribing and dispensing of antibiotics including for essentially viral infections as well as antibiotics outside of amoxycillin and erythromycin. This should involve: ○ Working with Universities to ensure trainee HCPs likely to work in nurse-led clinics are fully conversant with the WHO AWaRe system as well as WHO AWaRe guidance, locally adapted depending on current antibiotic resistance patterns in Iraq, when qualifying and continued post-qualification.[57,64] Such activities will help achieve the UN GA AMR goal of at least 70% of antibiotics dispensed in given sectors being from the Access list.[61] ○ Working with key organizations to develop pertinent quality indicators based on the WHO AWaRe system and guidance to reduce future inappropriate prescribing and dispensing of antibiotics for essentially viral infections such as URTIs,[66] with adherence to quality indicators increasingly seen as good quality prescribing in LMICs.[71,72] This though will depend on the instigation of appropriate IT systems to collect data in real time rather than through paper-based reviews on an ad-hoc basis. We have seen hand-held devices being used in LMICs to collect prescribing data, including indications, to improve data collection, which may well be applicable in Iraq if such devices are rolled out[73] ○ Encouraging the instigation of appropriate ASPs to improve future prescribing of antibiotics in these clinics as part of the NAP as well as working with local universities to assess their impact. ○ Seek to instigate targeted and appropriate patient education activities given current concerns, including their perceived or actual influence regarding the prescribing and dispensing of antibiotics for essentially viral infections in Iraq and wider. This includes making sure patients understand the language surrounding antibiotics, AMR and AMS given concerns in a number of countries[15,23,74] ○ Subsequently, work with patient groups to assess the impact of any targeted educational campaign given likely limited resources
Healthcare Providers (Nurses, Pharmacists, Physicians)	• Implement continuous professional development on AMR, diagnostic stewardship, the WHO AWaRe classification and guidance. • Promote clinical assessment before antibiotic dispensing, including allergy checks and differential diagnosis, eg, distinguishing between viral vs bacterial infections where possible based on patient history in the absence of any point-of-care testing equipment or facilities • Resist pressure from patients to dispense antibiotics unnecessarily and use structured communication strategies to help manage demand. • Strengthen inter-professional collaboration between nurses and pharmacists to support consistent messages to patients.
Patients, Caregivers, and the General Public	• Increase health literacy about antibiotics and AMR, especially the ineffectiveness of antibiotics for viral infections such as URTIs, to reduce patient pressure on prescribers and dispensers. • Disseminate culturally tailored messages through trusted community channels explaining when antibiotics are needed/ not needed. • Encourage consultation with qualified HCPs rather than relying on self-medication or leftover antibiotics. • Promote adherence to full treatment courses when antibiotics are prescribed, and the rationale for this, alongside initiatives/ activities discouraging dose-skipping or premature cessation once patients feel better. However, issues of affordability need to be addressed through health authority activities where this is a concern. We have seen appreciable price rises for antibiotics among LMICs in recent years, alongside requests for higher prices, which needs to be addressed going forward in Iraq to make antibiotics affordable and accessible to all[62,75]

(*Continued*)

https://doi.org/10.2147/IDR.S533590

Table 4 (Continued).

Stakeholder Group	Suggested Activity
Academic and Research Institutions	• Conduct further studies on knowledge, attitudes, and behaviours related to antibiotic use across healthcare settings, building on recent studies. • Evaluate the effectiveness of public health campaigns and stewardship interventions, including those targeting nurse-led clinics and community pharmacists. • Help evaluate the effectiveness and cost-effectiveness of ASPs among HCPs to improve future prescribing and dispensing activities in PHCs • Generate AMR surveillance data from community settings to inform evidence-based policymaking, building on current initiatives.

Notes: NB: The key takeaway message/ recommendations among health authorities, prescribers, dispensers, patients, and academic institutions, is an emphasis on antimicrobial stewardship training, regulatory reforms, patient education, and monitoring aligned with the WHO AWaRe framework and guidance.

for all key stakeholder groups going forward in Iraq to improve future antibiotic prescribing, which draws on both our study data as well as relevant global guidance to improve future antibiotic use.[6,13,54] As a result, reduce the levels of AMR in Iraq in line with the goals in the NAP.[22,31] Given the legal constraints on antibiotic supply in nurse-led clinics in Iraq, AMS indicators should prioritise counselling quality and regulatory compliance rather than prescribing metrics. Suggested indicators include: (i) % of encounters with no antibiotic supplied without a prescription, (ii) % with documented allergy screening, (iii) % involving non-antibiotic symptomatic advice, and (iv) % of permitted antibiotic supplies given with full duration and clear instructions. These indicators are pragmatic, measurable, and align with Strategic Objective 3 of the Iraq's National Action Plan on AMR, which calls for strengthening surveillance and optimising use, even in informal settings.

The influence of provider knowledge and training was evident in the observed association between qualification level and antibiotic dispensing behaviour. Clinics managed by bachelor-level nurses were significantly less likely to dispense antibiotics compared to those run by diploma-holding nurses or pharmacy assistants. Although we did not directly assess knowledge, educational qualification served as a useful proxy. This suggests that higher levels of clinical training may equip prescribers with a better understanding of antibiotic indications, resistance risks, and the need for appropriate counselling. This is similar with other studies from LMICs linking knowledge gaps among healthcare workers with poor antibiotic stewardship practices.[13,54,81]

Demand level was also a key determinant of dispensing behaviour. Our findings revealed a direct association between the simulated client's level of demand and the likelihood of receiving an antibiotic. Among the 141 clinics which supplied antibiotics, nearly 80% were supplied at Demand Level 1, ie where no antibiotic was requested. This suggests a low threshold for empirical dispensing of antibiotics. These findings mirror those from global studies that identify patient pressure, whether perceived or actual, as a major driver of inappropriate antibiotic provision.[13,14,77] This pattern underscores the complex interplay between provider knowledge, patient expectations, and the structural incentives that shape dispensing behaviour in PHCs. All these complex factors need to be taken into consideration going forward.[13,53,82] We will continue to monitor the situation as Iraq seeks to reduce AMR rates in line with its NAP.

Beyond provider-level factors, the antibiotic dispensing practices observed in this study must also be understood within Iraq's broader socio-economic and healthcare context. It is important to recognise that antibiotic dispensing decisions by providers in nurse-led clinics often occur under considerable systemic and socio-economic pressure. Many such clinics operate in regulatory grey zones with limited access to diagnostic tools, sparse oversight, and high patient loads, particularly in underserved or peri-urban regions. In this environment, HCPs may feel compelled to meet patient expectations for antibiotics, which are often rooted in cultural norms that equate antibiotics with effective treatment, regardless of clinical necessity.[82] These expectations, when coupled with the economic reliance of some clinics on patient satisfaction and repeat visits, can contribute to inappropriate dispensing behaviours even among well-meaning providers.[25] Similar pressures have been documented in other LMICs, where prescribers and dispensers navigate complex trade-offs between financial sustainability, limited infrastructure, and public demand.[6,13,54] Acknowledging these real-world constraints is essential

for designing ASPs that are not only evidence-based but also context-sensitive and implementable It is important to note that while our study did not directly measure systemic pressures such as patient expectations or financial incentives, these factors were inferred based on observed behaviours. To date, to our knowledge, no published studies have explored these influences in nurse-led clinics in Iraq. However, related research in community pharmacy settings has reported that non-prescription antibiotic supply is frequently driven by financial motives and the desire to maintain customer satisfaction.[25] These findings are consistent with our results, particularly as the majority of antibiotics in our study were supplied at Demand Level 1, suggesting that provider-initiated practices, rather than patient pressure, may be the primary driver of inappropriate dispensing in this context. Collectively, it is important, therefore, to note that while the simulated client method allowed for objective observation of dispensing practices and counselling behaviours, these observed actions likely reflect deeper systemic and structural drivers. Factors such as limited enforcement of regulations, economic dependence on medicine sales, lack of structured clinical training for informal providers, and barriers to accessing formal healthcare all contribute to the widespread misuse of antibiotics. These systemic issues cannot be fully captured through behavioural observation alone but are essential to understanding the context in which such practices occur. As such, our findings should be interpreted as a reflection not only of individual provider decision-making but also of broader structural constraints that shape practice norms in under-regulated primary care settings in Iraq.

We believe this study offers a number of unique strengths that contribute valuable insights into a critically under-studied are in Iraq, with an appreciable impact on AMR in Iraq. Firstly, to the best of our knowledge, we believe this is the first investigation in Iraq to systematically examine antibiotic prescribing behaviour in nurse-led clinics in Iraq. Given, as mentioned, the widespread reliance on such clinics for primary care in many parts of Iraq, including peri-urban and underserved communities, this study captures a real-world dimension of antibiotic access and use that has been largely overlooked in national surveillance and stewardship efforts to date. Second, the use of simulated client methodology allows for a realistic and standardised assessment of provider behaviour in actual practice, reducing the risk of response bias commonly associated with interviews or self-reported data.[38] This approach enabled us to observe dispensing patterns, counselling behaviour, and clinical decision-making in a controlled yet naturalistic context, offering a high degree of ecological validity.

However, certain limitations should also be acknowledged. Firstly, while this study provides important insights into antibiotic dispensing practices in nurse-led clinics in Sulaymaniyah, some caution is warranted when generalising findings to other regions of Iraq. However, given that the regulatory framework governing nurse-led clinics is issued at the national level, and enforcement mechanisms are similarly limited across provinces, it is likely that similar dispensing behaviours will occur elsewhere in the country. Nonetheless, regional differences in provider density, patient demographics, and informal care networks, may influence the extent and nature of antibiotic misuse. Moreover, the study was conducted in urban and peri-urban nurse-led clinics in Sulaymaniyah, and findings may not be fully generalizable to rural areas of Iraq, where resource constraints, staffing limitations, and regulatory enforcement are often more severe. Rural clinics may exhibit different dispensing behaviours—potentially either more or less frequent inappropriate supply—depending on local demand dynamics, health literacy, and oversight. Future research should explore these settings to assess variation in practices across the urban–rural spectrum. Further research is needed to examine whether similar patterns occur in community pharmacies, or other private-sector providers operating under distinct governance frameworks, in Iraq going forward. Secondly, although qualification levels were used as a proxy for provider knowledge, this does not capture the full complexity of clinical reasoning or the influence of ongoing professional development. Future research should incorporate validated, literature-informed[15] instruments to directly assess healthcare providers' knowledge, attitudes, and beliefs (KAB) regarding antibiotic use and antimicrobial resistance (AMR). Approaches such as structured questionnaires, in-depth interviews, and standardised KAP surveys can offer more detailed insights into the behavioural and cognitive drivers underlying antibiotic dispensing practices. Thirdly, the simulated client approach, while valuable for standardisation and reducing bias, may not fully capture the complexities of real-world clinical interactions. The study period encompassed both the peak URTI season in Iraq (October to February) and the spring months (March to April), when infection rates typically decline. This although provides a reasonable representation of antibiotic supply behaviours across different seasonal contexts, it may have influenced provider decision-making. Additionally, all simulated clients were standardised young adult males; dispensing practices may differ for other

demographic groups, such as children, the elderly, or individuals with comorbidities. Real patients may express their needs differently or present with more complex symptoms, potentially influencing providers' decision-making. Future research should consider varying both case profiles and study timing to better capture these contextual influences. Nonetheless, the simulation scenarios were designed to reflect common and recognizable presentations for mild URTIs, a condition widely known to be viral and not requiring antibiotics. As a result, offering a valid test of rational prescribing thresholds. Lastly, while the simulated client approach provides a reliable snapshot of behaviour, it cannot capture internal decision-making processes or systemic pressures such as drug availability, patient load, or financial incentives. Qualitative follow-up studies with different prescribers in Iraq may help to unpack these drivers and offer deeper insights into the motivations behind current antibiotic prescribing and dispensing practices. However, despite these limitations, we believe this study delivers a robust and much-needed contribution to the evidence base on antibiotic use in a critical area of primary-care delivery in Iraq.

Conclusion

This study provides the first in-depth, empirical investigation into the patterns, appropriateness, and counselling practices surrounding antibiotic dispensing in nurse-led clinics in Iraq. Our findings reveal widespread inappropriate and, in many cases, illegal dispensing of antibiotics for conditions that do not warrant their use, reflecting substantial gaps in patient assessment and adherence to national regulations. The results also underscore the vulnerability of primary care settings to systemic drivers such as insufficient provider training, weak enforcement, and patient pressure. These findings have broad implications not only for Iraq's NAP on AMR but also for global efforts to contain AMR. As a result, there is an urgent need for context-specific stewardship policies as well as HCP training and community-level education. In addition, enhanced regulatory monitoring to improve antibiotic use in this important sector in ambulatory care in Iraq. Our findings present an opportunity to inform the ongoing revision and implementation of Iraq's NAP by incorporating measurable AMS indicators tailored to nurse-led clinics. Potential indicators include an agreed percentage of Access-group antibiotic use, routine documentation of allergy screening, and an agreed adherence target to standardized treatment protocols for URTIs building on the WHO AWaRe guidance. Embedding such indicators into Iraq's stewardship monitoring frameworks would not only enhance accountability but also support resource allocation and capacity-building efforts in one of the country's most widespread, yet least regulated, primary care settings. Providers with lower qualifications were more likely to dispense antibiotics inappropriately, suggesting that strengthening clinical education and regulatory literacy is imperative to improve future antibiotic use. The frequent dispensing of Watch antibiotics highlights a misalignment with the WHO AWaRe framework and guidance further underscoring the need for targeted prescribing protocols alongside agreed quality indicators. Furthermore, providers often responded to patient pressure during simulated demand escalation indicating the importance of empowering staff with communication tools to manage inappropriate requests. In the short term, measures such as structured training, public education campaigns, and stewardship indicators specific to primary care could be implemented with minimal disruption. However, policymakers should also anticipate and mitigate unintended consequences. For example, by ensuring that regulatory crackdowns are accompanied by support systems to avoid pushing inappropriate dispensing into informal channels. By addressing these dynamics in a coordinated and context-sensitive manner, Iraq can move closer to realising its AMR containment goals. Aligning our findings with Iraq's NAP implementation priorities would therefore enhance the country's ability to meet the AMR containment targets set by the United Nations and the WHO.

Ethics Statement Regarding Informed Consent

This study employed a SCM, a well-established and ethically accepted approach for evaluating real-world healthcare practices, particularly in settings where regulatory compliance is weak or where self-reporting may introduce significant bias. SCM allows for direct observation of provider's behaviour in naturalistic conditions, making it particularly suitable for assessing the inappropriate use of antibiotics including their dispensing without prescription, Such practices that may be concealed if providers are aware of being studied.[47,52] In this context, obtaining informed consent prior to data collection would have undermined the primary objective of the research, ie to assess actual, unprompted behaviour in the routine clinical environment. Disclosure of the study's purpose in advance could also have led to social desirability bias,

and artificially altered practices, as providers may avoid behaviours that are legally or ethically questionable when they know they are being observed.[83,84] The requirement for participant consent was consequently waived by the Ethics Committee of the College of Medicine, University of Sulaimani, Iraq (Approval No. 84) (Supplementary File 2). This decision was based on the minimal risk posed to participants—no personal identifiers were collected, and all the data were anonymised. Due to the legal and behavioural focus of the simulated client design, individual clinic debriefing was not conducted in order to preserve anonymity and avoid influencing provider behaviour or exposing them to punitive consequences. This was approved by the Ethics Committee as part of the consent waiver. However, aggregated, anonymised results will be shared with national health stakeholders to support system-level antimicrobial stewardship efforts. The simulated scenarios involved non-invasive, hypothetical interactions, consistent with international ethical guidelines for observational research using covert methods in public health surveillance. This waiver aligns with ethical precedents in similar SCM-based studies conducted in LMICs to evaluate antimicrobial practices in pharmacies and clinics, which have been instrumental in shaping AMR policy and regulatory enforcement.[14,52,83]

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This paper was not funded.

Disclosure

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

References

1. Murray CJ, Ikuta KS, Sharara F. et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *Lancet*. 2022;399 (10325):629–655. doi:10.1016/S0140-6736(21)02724-0
2. Lewnard JA, Charani E, Gleason A, et al. Burden of bacterial antimicrobial resistance in low-income and middle-income countries avertible by existing interventions: an evidence review and modelling analysis. *Lancet*. 2024;403(10442):2439–2454. doi:10.1016/S0140-6736(24)00862-6
3. Sartorius B, Gray AP, Weaver ND, et al. The burden of bacterial antimicrobial resistance in the WHO African region in 2019: a cross-country systematic analysis. *Lancet Glob Health*. 2024;12(2):e201–e16. doi:10.1016/S2214-109X(23)00539-9
4. Al Masud A, Walpola RL, Sarker M, et al. Understanding antibiotic purchasing practices in community pharmacies: a potential driver of emerging antimicrobial resistance. *Exploratory Res Clin Social Pharm*. 2024;15:100485. doi:10.1016/j.rcsop.2024.100485
5. Laxminarayan R. The overlooked pandemic of antimicrobial resistance. *Lancet*. 2022;399(10325):606. doi:10.1016/S0140-6736(22)00087-3
6. Godman B, Egwuenu A, Haque M, et al. Strategies to improve antimicrobial utilization with a special focus on developing countries. *Life*. 2021;11 (6):528. doi:10.3390/life11060528
7. Malik UR. Misuse of Antibiotics in the Community and Its Implications for the Healthcare Sector–A Narrative Review. *Health*. 2024;1:100001.
8. Hanif MS, Sultan MA, Raza A, et al. Antibiotics Overuse and its Consequences: raising Awareness and Promoting Responsible Use. *History of Medicine*. 2024;10(2):1909–1919. doi:10.48047/HM.10.2.2024.1909-1919
9. Sachdev C, Anjankar A, Agrawal J. Self-Medication With Antibiotics: an Element Increasing Resistance. *Cureus*. 2022;14(10):E30844. doi:10.7759/cureus.30844
10. Mendoza AMB, Maliñana SAA, Maravillas SID, Moniva KC, Jazul JP. Relationship of self-medication and antimicrobial resistance (AMR) in low-and middle-income countries (LMICs): a scoping review. *J Public Health Emergency*. 2025;9:6. doi:10.21037/jphe-23-184
11. Torres N, Chibi B, Middleton L, Solomon V, Mashamba-Thompson T. Evidence of factors influencing self-medication with antibiotics in low and middle-income countries: a systematic scoping review. *Public Health*. 2019;168:92–101. doi:10.1016/j.puhe.2018.11.018
12. Sono TM, Yeika E, Cook A, et al. Current rates of purchasing of antibiotics without a prescription across sub-Saharan Africa; rationale and potential programmes to reduce inappropriate dispensing and resistance. *Exp Rev Anti-Infective Ther*. 2023;21(10):1025–1055. doi:10.1080/14787210.2023.2259106
13. Godman B, Haque M, McKimm J, et al. Ongoing strategies to improve the management of upper respiratory tract infections and reduce inappropriate antibiotic use particularly among lower and middle-income countries: findings and implications for the future. *Curr Med Res Opin*. 2020;36(2):301–327. doi:10.1080/03007995.2019.1700947
14. Auta A, Hadi MA, Oga E, et al. Global access to antibiotics without prescription in community pharmacies: a systematic review and meta-analysis. *J Infect*. 2019;78(1):8–18. doi:10.1016/j.jinf.2018.07.001

15. Saleem Z, Moore CE, Kalungia A, et al. Status and implications of the knowledge, attitudes and practices towards AWaRe antibiotic use, resistance, and stewardship among low-and middle-income countries. *JAC-Antimicrob Resist*. 2025;7(2):dlaf033.
16. Klein EY, Milkowska-Shibata M, Tseng KK, et al. Assessment of WHO antibiotic consumption and access targets in 76 countries, 2000–15: an analysis of pharmaceutical sales data. *Lancet Infect Dis*. 2021;21(1):107–115. doi:10.1016/S1473-3099(20)30332-7
17. Sulis G, Sayood S, Katukoori S, et al. Exposure to World Health Organization's AWaRe antibiotics and isolation of multidrug resistant bacteria: a systematic review and meta-analysis. *Clin Microbiol Infect*. 2022;28(9):1193–1202. doi:10.1016/j.cmi.2022.03.014
18. Wise MG, Karlowsky JA, Mohamed N, et al. Global trends in carbapenem-and difficult-to-treat-resistance among World Health Organization priority bacterial pathogens: ATLAS surveillance program 2018–2022. *J Global Antimicrob Resist*. 2024;37:168–175. doi:10.1016/j.jgar.2024.03.020
19. Haindongo EH, Ndakolo D, Hedimbi M, Vainio O, Hakanen A, Vuopio J. Antimicrobial resistance prevalence of Escherichia coli and Staphylococcus aureus amongst bacteremic patients in Africa: a systematic review. *J Global Antimicrob Resist*. 2023;32:35–43. doi:10.1016/j.jgar.2022.11.016
20. Roberts T, Dahal P, Shrestha P, et al. Antimicrobial resistance patterns in bacteria causing febrile illness in Africa, South Asia, and Southeast Asia: a systematic review of published etiological studies from 1980-2015. *Inter J Infect Dis*. 2022;122:612–621. doi:10.1016/j.ijid.2022.07.018
21. Bizri AR, El-Fattah AA, Bazaraa HM, et al. Antimicrobial resistance landscape and COVID-19 impact in Egypt, Iraq, Jordan, and Lebanon: a survey-based study and expert opinion. *PLoS One*. 2023;18(7):e0288550. doi:10.1371/journal.pone.0288550
22. Institute for Health Metrics and Evaluation. *The Burden of Antimicrobial Resistance (AMR) in Iraq*. 2019.
23. Darweesh O, Kurdi A, Merkhan M, et al. Knowledge, attitudes, and practices of Iraqi parents regarding antibiotic use in children and the implications. *Antibiotics*. 2025;14(4):376. doi:10.3390/antibiotics14040376
24. Abou Fayad A, Rizk A, El Sayed S, et al. Antimicrobial resistance and the Iraq wars: armed conflict as an underinvestigated pathway with growing significance. *BMJ Global Health*. 2023;7(Suppl 8):e010863. doi:10.1136/bmjgh-2022-010863
25. Alkadhimi A, Dawood OT, Hassali MA. Dispensing of antibiotics in community pharmacy in Iraq: a qualitative study. *Pharmacy Practice*. 2020;18(4):1.
26. Almufty HB, Hayhat LS, Abdal WG, Hussein DS, Merza MA. The Magnitude of Dispensing Unprescribed Antibiotics in Community Pharmacies in Duhok Province; Kurdistan Region of Iraq. *J Contemp Med Sci*. 2023;9(2). doi:10.22317/jcms.v9i2.1324
27. Al-Jumaili AA, Ahmed KK. A review of antibiotic misuse and bacterial resistance in Iraq. *Eastern Mediterranean Health J*. 2024;30(10):663–670. doi:10.26719/2024.30.10.663
28. Kurdi A, Hasan AJ, Baker KI, et al. A multicentre point prevalence survey of hospital antibiotic prescribing and quality indices in the Kurdistan regional government of Northern Iraq: the need for urgent action. *Exp Rev Anti-Infective Ther*. 2021;19(6):805–814. doi:10.1080/14787210.2021.1834852
29. Al-Taie A, Hussein AN, Albasry Z. A cross-sectional study of patients' practices, knowledge and attitudes of antibiotics among Iraqi population. *J Infect Developing Countries*. 2021;15(12):1845–1853. doi:10.3855/jidc.13066
30. Alsayed AR, El Hajji FD, Al-Najjar MA, Abazid H, Al-Dulaimi A. Patterns of antibiotic use, knowledge, and perceptions among different population categories: a comprehensive study based in Arabic countries. *Saudi Pharm J*. 2022;30(3):317–328. doi:10.1016/j.jsps.2022.01.013
31. Ministry of Health/ Environment and Ministry of Agriculture. Iraq Action Plan of Antimicrobial Resistance (2018-2022). 2022. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/nap-library/national-action-plan-iraq.pdf?sfvrsn=8a7c49b1_1&download=true. Accessed Oct 24, 2025.
32. Charani E, Mendelson M, Pallett SJ, et al. An analysis of existing national action plans for antimicrobial resistance—gaps and opportunities in strategies optimising antibiotic use in human populations. *Lancet Glob Health*. 2023;11(3):e466–e74. doi:10.1016/S2214-109X(23)00019-0
33. Godman B, Egwuenu A, Wesangula E, et al. Tackling antimicrobial resistance across sub-Saharan Africa: current challenges and implications for the future. *Expert Opin Drug Saf*. 2022;21(8):1089–1111. doi:10.1080/14740338.2022.2106368
34. Willemsen A, Reid S, Assefa Y. A review of national action plans on antimicrobial resistance: strengths and weaknesses. *Antimicrob Resist Infect Control*. 2022;11(1):90. doi:10.1186/s13756-022-01130-x
35. Okeke IN, Edelman R. Dissemination of antibiotic-resistant bacteria across geographic borders. *Clinl Infect Dis*. 2001;33(3):364–369. doi:10.1086/321877
36. Frost I, Van Boeckel TP, Pires J, Craig J, Laxminarayan R. Global geographic trends in antimicrobial resistance: the role of international travel. *J Travel Med*. 2019;26(8):taz036. doi:10.1093/jtm/taz036
37. Gautam A. Antimicrobial resistance: the next probable pandemic. *JNMA*. 2022;60(246):225. doi:10.31729/jnma.7174
38. United Nations. Political Declaration of the High-level Meeting on Antimicrobial Resistance 2024. Available from: https://www.un.org/pga/wp-content/uploads/sites/108/2024/09/FINAL-Text-AMR-to-PGA.pdf. Accessed Oct 24, 2025.
39. Rose J, Crosbie M, Stewart A. A qualitative literature review exploring the drivers influencing antibiotic over-prescribing by GPs in primary care and recommendations to reduce unnecessary prescribing. *Perspectives Public Health*. 2021;141(1):19–27. doi:10.1177/1757913919879183
40. Adegbite BR, Edoa JR, Schaumburg F, Alabi AS, Adegnika AA, Grobusch MP. Knowledge and perception on antimicrobial resistance and antibiotics prescribing attitude among physicians and nurses in Lambaréné region, Gabon: a call for setting-up an antimicrobial stewardship program. *Antimicrob Resist Infect Control*. 2022;11(1):44. doi:10.1186/s13756-022-01079-x
41. Ramdas N, Meyer JC, Schellack N, Godman B, Turawa EB, Campbell SM. Knowledge, attitudes, motivations and expectations regarding antimicrobial use among community members seeking care at the primary healthcare level: a scoping review protocol. *BMJ open*. 2025;15(1):e088769. doi:10.1136/bmjopen-2024-088769
42. Sefah IA, Ogunleye OO, Essah DO, et al. Rapid assessment of the potential paucity and price increases for suggested medicines and protection equipment for COVID-19 across developing countries with a particular focus on Africa and the implications. *Front Pharmacol*. 2021;11:588106. doi:10.3389/fphar.2020.588106
43. Shrestha AB, Aryal M, Magar JR, Shrestha S, Hossainy L, Rimti FH. The scenario of self-medication practices during the covid-19 pandemic; a systematic review. *Ann Med Surg*. 2022;82:104482. doi:10.1016/j.amsu.2022.104482
44. Bednarčuk N, Golić Jelić A, Stoisavljević Šatara S, et al. Antibiotic utilization during COVID-19: are we over-prescribing? *Antibiotics*. 2023;12(2):308. doi:10.3390/antibiotics12020308
45. Alshaikh FS, Godman B, Sindi ON, Seaton RA, Kurdi A. Prevalence of bacterial coinfection and patterns of antibiotics prescribing in patients with COVID-19: a systematic review and meta-analysis. *PLoS One*. 2022;17(8):e0272375. doi:10.1371/journal.pone.0272375
46. Rakhshani NS, Kaljee LM, Khan MI, et al. A formative assessment of antibiotic dispensing/prescribing practices and knowledge and perceptions of antimicrobial resistance (AMR) among healthcare workers in Lahore Pakistan. *Antibiotics*. 2022;11(10):1418. doi:10.3390/antibiotics11101418
47. Watson MC, Norris P, Granas A. A systematic review of the use of simulated patients and pharmacy practice research. *Int J Pharm Pract*. 2006;14(2):83–93. doi:10.1211/ijpp.14.2.0002

48. Ngyedu EK, Acolatse J, Akafity G, et al. Selling antibiotics without prescriptions among community pharmacies and drug outlets: a simulated client study from Ghana. *Exp Rev Anti-Infective Ther*. 2023;21(12):1373–1382. doi:10.1080/14787210.2023.2283037
49. Raosoft. Sample size calculator. 2024. Available from: http://www.raosoft.com/samplesize.html. Accessed Oct 24, 2025.
50. Lwanga SK, Lemeshow S. *Sample Size Determination in Health Studies: A Practical Manual*. World Health Organization; 1991.
51. Daniel WW, Cross CL. *Biostatistics: A Foundation for Analysis in the Health Sciences*. Wiley; 2018.
52. Mokwele RN, Schellack N, Bronkhorst E, Brink AJ, Schweickerdt L, Godman B. Using mystery shoppers to determine practices pertaining to antibiotic dispensing without a prescription among community pharmacies in South Africa—A pilot survey. *JAC-Antimicrob Resist*. 2022;4(1): dlab196. doi:10.1093/jacamr/dlab196
53. Ahmad T, Khan SA, Mallhi TH, et al. Assessing antibiotic dispensing without prescription through simulated client methodology in developing countries: a comprehensive literature review from 2009 to 2021. *J Public Health*. 2023;2023:1–23.
54. Saleem Z, Mekonnen BA, Orubu ES, et al. Current access, availability and use of antibiotics in primary care among key low-and middle-income countries and the policy implications. *Exp Rev Anti-Infective Ther*. 2025. doi:10.1080/14787210.2025.2477198
55. Alrasheedy AA, Alsalloum MA, Almuqbil FA, et al. The impact of law enforcement on dispensing antibiotics without prescription: a multi-methods study from Saudi Arabia. *Exp Rev Anti-Infective Ther*. 2020;18(1):87–97. doi:10.1080/14787210.2020.1705156
56. Sharland M, Pulcini C, Harbarth S, et al. Classifying antibiotics in the WHO Essential Medicines List for optimal use—be AWaRe. *Lancet Infect Dis*. 2018;18(1):18–20. doi:10.1016/S1473-3099(17)30724-7
57. Sharland M, Gandra S, Huttner B, et al. Encouraging AWaRe-ness and discouraging inappropriate antibiotic use—the new 2019 Essential Medicines List becomes a global antibiotic stewardship tool. *Lancet Infect Dis*. 2019;19(12):1278–1280. doi:10.1016/S1473-3099(19)30532-8
58. Budd E, Cramp E, Sharland M, et al. Adaptation of the WHO Essential Medicines List for national antibiotic stewardship policy in England: being AWaRe. *J Antimicrob Chemother*. 2019;74(11):3384–3389. doi:10.1093/jac/dkz321
59. Bou-Antoun S, Oettle RC, Leanord A, et al. Adaptation of the WHO AWaRe (Access, Watch, Reserve) antibiotic classification to support national antimicrobial stewardship priorities in the UK: findings from a modified Delphi approach to achieve expert consensus. *JAC-Antimicrob Resist*. 2025;7(1):dlae218. doi:10.1093/jacamr/dlae218
60. Saleem Z, Godman B, Cook A, et al. Ongoing efforts to improve antimicrobial utilization in hospitals among African countries and implications for the future. *Antibiotics*. 2022;11(12):1824. doi:10.3390/antibiotics11121824
61. Teague E, Bezuidenhout S, Meyer JC, Godman B, Engler D. Knowledge and perceptions of final-year nursing students regarding antimicrobials, antimicrobial resistance, and antimicrobial stewardship in South Africa: findings and implications to reduce resistance. *Antibiotics*. 2023;12 (12):1742. doi:10.3390/antibiotics12121742
62. Gulumbe BH, Abdulrahim A, Ibrahim MN. Rising antibiotic costs as a potential driver of antimicrobial resistance in Nigeria. *Discover Public Health*. 2025;22(1):8. doi:10.1186/s12982-025-00398-9
63. Reza N, Gerada A, Stott KE, Howard A, Sharland M, Hope W. Challenges for global antibiotic regimen planning and establishing antimicrobial resistance targets: implications for the WHO Essential Medicines List and AWaRe antibiotic book dosing. *Clin Microbiol Rev*. 2024;37(2):e00139–23. doi:10.1128/cmr.00139-23
64. Zanichelli V, Sharland M, Cappello B, et al. The WHO AWaRe (Access, Watch, Reserve) antibiotic book and prevention of antimicrobial resistance. *Bulletin of the World Health Organization*. 2023;101(4):290. doi:10.2471/BLT.22.288614
65. Ashy N, Alharbi L, Alkhamisi R, Alradadi R, Eljaaly K. Efficacy of erythromycin compared to clarithromycin and azithromycin in adults or adolescents with community-acquired pneumonia: a Systematic Review and meta-analysis of randomized controlled trials. *J Infect Chemother*. 2022;28(8):1148–1152. doi:10.1016/j.jiac.2022.04.020
66. Funiciello E, Lorenzetti G, Cook A, et al. Identifying AWaRe indicators for appropriate antibiotic use: a narrative review. *J Antimicrob Chemother*. 2024;79(12):3063–3077. doi:10.1093/jac/dkae370
67. Moja L, Zanichelli V, Mertz D, et al. WHO's essential medicines and AWaRe: recommendations on first-and second-choice antibiotics for empiric treatment of clinical infections. *Clin Microbiol Infect*. 2024;30:S1–S51. doi:10.1016/j.cmi.2024.02.003
68. Cook A, Goelen J, Moore C, Martin J, Pouwels K, Sharland M. A pilot protocol for surveillance of infection and antibiotic prescribing in primary healthcare across the globe: antibiotic Prescribing in Primary Healthcare Point Prevalence Survey (APC-PPS) version 1; peer review: 1 approved, 2 approved with reservations. *Wellcome Open Research*. 2025;10(26). doi:10.12688/wellcomeopenres.23420.1
69. Jamil E, Saleem Z, Godman B, et al. Global variation in antibiotic prescribing guidelines and the implications for decreasing AMR in the future. *Front Pharmacol*. 2025;16:1600787. doi:10.3389/fphar.2025.1600787
70. Gustafsson LL, Wettermark B, Godman B, et al. The 'wise list'–a comprehensive concept to select, communicate and achieve adherence to recommendations of essential drugs in ambulatory care in Stockholm. *Basic Clin Physiol Pharmacol*. 2011;108(4):224–233. doi:10.1111/j.1742-7843.2011.00682.x
71. Niaz Q, Godman B, Massele A, et al. Validity of World Health Organisation prescribing indicators in Namibia's primary healthcare: findings and implications. *Int J Qual Health Care*. 2019;31(5):338–345. doi:10.1093/intqhc/mzy172
72. Campbell SM, Meyer JC, Godman B. Why compliance to national prescribing guidelines is important especially across sub-Saharan Africa and suggestions for the future. *J Biomed Pharmaceut Sci*. 2021;4(6):1.
73. Chigome MA, Vambe MS, Kganyago MK, et al. Point prevalence surveys of acute infection presentation and antibiotic prescribing in selected primary healthcare facilities in North-West and Gauteng provinces of South Africa. *Inter J Infect Dis*. 2025;152:107689. doi:10.1016/j.ijid.2024.107689
74. Sono TM, Schellack N, Godman B. The role of patients with addressing inappropriate dispensing of antibiotics without a prescription especially in developing countries. *Medknow*. 2025;2025:1–4.
75. Abdullah S, Saleem Z, Godman B. Coping with increasing medicine costs through greater adoption of generic prescribing and dispensing in Pakistan as an exemplar country. *Expert Rev Pharmacoecon Outcomes Res*. 2024;24(2):167–170. doi:10.1080/14737167.2023.2280802
76. Cox JA, Vlieghe E, Mendelson M, et al. Antibiotic stewardship in low-and middle-income countries: the same but different? *Clin Microbiol Infect*. 2017;23(11):812–818. doi:10.1016/j.cmi.2017.07.010
77. Li J, Zhou P, Wang J, et al. Worldwide dispensing of non-prescription antibiotics in community pharmacies and associated factors: a mixed-methods systematic review. *Lancet Infect Dis*. 2023;23(9):e361–e70. doi:10.1016/S1473-3099(23)00130-5

78. Rony MKK, Sharmi PD, Alamgir HM. Addressing antimicrobial resistance in low and middle-income countries: overcoming challenges and implementing effective strategies. *Environ Sci Pollut Res*. 2023;30(45):101896–101902. doi:10.1007/s11356-023-29434-4
79. Dar OA, Hasan R, Schlundt J, et al. Exploring the evidence base for national and regional policy interventions to combat resistance. *Lancet*. 2016;387(10015):285–295. doi:10.1016/S0140-6736(15)00520-6
80. Waleekhachonloet O, Rattanachotphanit T, Limwattananon C, Thammatacharee N, Limwattananon S. Effects of a national policy advocating rational drug use on decreases in outpatient antibiotic prescribing rates in Thailand. *Pharmacy Practice*. 2021;19(1)1.
81. Haenssgen MJ, Charoenboon N, Zanello G, et al. Antibiotic knowledge, attitudes and practices: new insights from cross-sectional rural health behaviour surveys in low-income and middle-income South-East Asia. *BMJ open*. 2019;9(8):e028224. doi:10.1136/bmjopen-2018-028224
82. Melaku T, Assegid L. Prescription in peril: the sociology of antibiotics and antimicrobial resistance in low resource settings. *Discover Social Science and Health*. 2025;5(1):71. doi:10.1007/s44155-025-00225-1
83. Wulandari LPL, Khan M, Liverani M, et al. Prevalence and determinants of inappropriate antibiotic dispensing at private drug retail outlets in urban and rural areas of Indonesia: a mixed methods study. *BMJ Global Health*. 2021;6(8):e004993. doi:10.1136/bmjgh-2021-004993
84. Kwan A, Boone CE, Sulis G, Gertler PJ. Do private providers give patients what they demand, even if it is inappropriate? A randomised study using unannounced standardised patients in Kenya. *BMJ open*. 2022;12(3):e058746. doi:10.1136/bmjopen-2021-058746