

Antibiotic Prescribing Patterns among Healthcare Providers at the University Teaching Hospital Outpatient Department in Lusaka, Zambia, March–April 2025: A Who Aware Classification Study

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ABSTRACT

Background: Antibiotic resistance is a global public health threat driven by irrational antibiotic use. The World Health Organization's Access, Watch, and Reserve (AWaRe) classification guides rational antibiotic use to reduce resistance. This study evaluated antibiotic prescribing patterns at the University Teaching Hospital Outpatient Department in Lusaka, Zambia, using the WHO AWaRe classification.

Methods: A cross-sectional descriptive study was conducted from March to April, 2025. A total of 500 antibiotic prescriptions were retrospectively reviewed, and 187 healthcare providers completed structured questionnaires on prescribing practices and barriers to rational antibiotic use. Data were analysed using SPSS version 20 and Microsoft Excel, with descriptive statistics presented as frequencies and percentages.

Results: Amoxicillin was the most frequently prescribed antibiotic (25.6%), followed by co-amoxiclav (15.0%), ceftriaxone (11.6%), and ciprofloxacin (11.6%). The top four antibiotics accounted for 63.8% of all prescriptions. Overall, 83.8% of prescriptions were appropriate according to the WHO AWaRe classification. Appropriateness was highest for Access antibiotics (87.8%), followed by Watch (77.0%), and lowest for Reserve antibiotics (62.5%). Access antibiotics constituted 65.4% of all prescriptions, exceeding the WHO target of 60%, while Watch and Reserve antibiotics accounted for 33.0% and 1.6%, respectively. Among 187 healthcare providers, 55.1% were male, 40.1% were aged 30–39 years, doctors were the most represented professional group (34.8%), and 44.9% had 1–5 years of experience.

Conclusion: Antibiotic prescribing at UTH OPD is largely appropriate and reasonably aligned with WHO AWaRe recommendations. However, the declining appropriateness from Access to Watch to Reserve antibiotics and the presence of Reserve antibiotics in outpatient settings are concerning. Targeted antimicrobial stewardship interventions, including regular audits, prescriber education, and electronic decision support, are urgently needed to optimize antibiotic use and preserve antibiotic effectiveness.

Keywords: Antibiotic resistance, WHO AWaRe classification, antibiotic prescribing patterns, outpatient department, antimicrobial stewardship, Zambia.

Strengths And Limitations Of This Study

- The study instruments were rigorously developed and validated, including expert review, pilot testing, and assessment of reliability and content validity.
- The study's strengths include a robust sample size (500 prescriptions, 187 providers), use of the WHO AWaRe classification framework for comprehensive evaluation, and inclusion of multiple healthcare provider cadres.
- Findings from a single tertiary hospital OPD may not be generalisable to primary health centres or rural facilities in Zambia.

INTRODUCTION

Antibiotic resistance (AMR) is a paramount threat to global public health, economic stability, and the advancements of modern medicine (1). The emergence and spread of resistant pathogens are driven overwhelmingly by the irrational and inappropriate use of antibiotics in human and animal health (2). Inappropriate prescribing, including over-prescription and incorrect drug selection, leads to prolonged hospitalizations, increased healthcare costs, and higher mortality rates (3). Studies indicate that 30% to 50% of antibiotic use in North America and up to 50% in some Asian and African countries is improper (4).

To combat this, the World Health Organization (WHO) developed the Access, Watch, and Reserve (AWaRe) classification (5). This tool categorizes antibiotics to promote rational use: the Access group includes narrow-spectrum, first-line agents; the Watch group comprises broad-spectrum antibiotics with higher resistance potential; and the Reserve group contains last-resort drugs for multidrug-resistant infections (6). The WHO recommends that at least 60% of all antibiotic prescriptions at the facility level should be from the Access group (7).

Outpatient departments (OPDs) are critical points of antibiotic consumption, where initial prescribing decisions significantly influence overall usage and resistance patterns (8). In Zambia, like many sub-Saharan African countries, data on outpatient antibiotic prescribing is limited, hampering the development of effective antimicrobial stewardship (AMS) programs (9). The University Teaching Hospital (UTH) in Lusaka, the largest tertiary hospital in Zambia, serves as a critical node for infectious disease management, yet its OPD prescribing patterns remain largely unevaluated. Therefore, this study aims to assess the prescribing patterns of antibiotics for infectious diseases at the UTH OPD using the WHO AWaRe classification, specifically to determine the frequency and types of antibiotics prescribed, evaluate the appropriateness of prescriptions, and identify the proportion of Access, Watch, and Reserve antibiotics used.

METHODS

Study Design and Setting

This cross-sectional descriptive study was conducted at the Outpatient Department (OPD) of the University Teaching Hospital (UTH) in Lusaka, Zambia, from March to April 2025. This study used a cross-sectional study with two components: (1) a retrospective review of antibiotic prescriptions issued during the study period, and (2) a cross-sectional survey of healthcare providers. UTH is a 1,655-bed tertiary referral hospital in Lusaka, Zambia. The Out Patient Department (OPD) serves approximately 1,200 patients per day and is staffed by 352 health care providers. The OPD operates from Monday to Friday from 08:00 – 17:00 hrs and handles both walk in patients and referrals from primary health centers (10).

Study Population and Sampling

The target population comprised all healthcare providers (doctors, clinical officers, pharmacists and nurses) who prescribed antibiotics at the UTH OPD during the study period. Using Yamane's formula at a 95% confidence level and 5% margin of error, a sample of 187 prescribers was calculated from a finite population of

approximately 352 eligible providers (11). A stratified random sampling technique was applied, with strata based on professional role to ensure adequate representation of each cadre.

Study population and Sampling

Healthcare Providers: The target population comprised all healthcare providers (Doctors, Clinical Officers, Pharmacists, and nurses) who prescribed antibiotics at the UTH OPD during the study period (March to April, 2025). The sampling frame was obtained from UTH Human Resource department and comprised 352 eligible providers (Doctors $n = 124$; Clinical Officers $n = 98$, Pharmacists $n = 65$, Nurses $n = 65$). Using Yamene's formula ($n = N/(1 + Ne^2)$) at 95% confidence level and 5% margin of error, a minimum sample of 187 prescribers was calculated (11).

A stratified random sampling technique was applied, with strata based on professional role to ensure adequate representation of each cadre. Proportional allocation was used to determine the number of participants per stratum:

- Doctors: $124/352 \times 187 = 66$
- Clinical Officers: $98/352 \times 187 = 52$
- Pharmacists: $65/352 \times 187 = 35$
- Nurses: $65/352 \times 187 = 34$

Within each stratum, participants were selected using computer – generated random numbers. Selected Providers were approached in person by the research team during their working hours. Of the 187 providers who completed the questionnaire, a response yield of 100% was attained. Prescribers who were on leave or who had not prescribed antibiotics during the study period were excluded from the study and replaced by the next randomly selected provider.

Prescription Review: The sampling frame for prescriptions comprised all antibiotic prescriptions issued at the UTH OPD during March to April 2025. The total number of antibiotic prescriptions during this period was estimated at 4,200 based on Pharmacy dispensing records. A sample of 500 prescriptions was selected using systematic random sampling. The sampling interval (k) was calculated as $4200/500 = 8.4$ rounded off to 8. The first prescription was selected randomly from the first 8 prescriptions, and every 8th prescription was selected randomly from the first 8 prescriptions, and every 8th prescription thereafter was included until 500 prescriptions were reviewed. Prescriptions were excluded if the antibiotic name, dose, or diagnosis was illegible or missing ($n=23$), and these were replaced by the next prescription in the sampling sequence.

Response Rate: The effective response rate for the healthcare provider questionnaire was 100% (187/187). For the prescription review, 523 prescriptions were initially selected, of which 500 were included in the final analysis (95.6% inclusion rate); 23 prescriptions (4.4%) were excluded due to incomplete data.

Definition of WHO AWaRe prescribing indicators

Prescribing indicators were defined as priori as: (i) frequency and percentage of each antibiotic; (ii) Aware class distribution; (iii) proportion of Access, Watch and Reserve antibiotics; and (iv) appropriateness, defined as concordance with the WHO AWaRe antibiotic book for the documented diagnosis. All antibiotics were classified according to WHO 2023. The primary WHO benchmark used was Access $\geq 60\%$: Watch and Reserve proportions were monitored against WHO AWaRe guidance. For each prescription, the following variables were extracted: patient age and sex; documented diagnosis; antibiotic name; dose; frequency; distribution; route; and documented clinical justification. Appropriateness was assessed only when the diagnosis and regimen were legible. Prescriptions with missing or illegible diagnosis, dose or duration were recorded and excluded from the appropriate denominator for that specific indicator. The provider questionnaire captured cadre, years of experience, availability of national/institutional antibiotic guidelines, access to microbiology / rapid diagnostic

tests, and awareness of institutional antibiotic guidelines, access to microbiology/rapid diagnostic tests, and awareness of institutional antimicrobial stewardship policies.

Data Collection Instruments and variables

Two structured data collection tools were developed for this study:

1. **Prescription Review Form:** This form was developed based on the WHO AWaRe classification framework (6) and the WHO prescribing indicators methodology (110). It was reviewed by three experts in antimicrobial stewardship and clinical pharmacology for content validity. The form was piloted on 30 antibiotic prescriptions at non-study site within UTH (a different outpatient clinic) to assess clarity, completeness, and inter-rater reliability. Two independent reviewers extracted data from the same 30 prescriptions, and agreement was assessed using Cohen's Kappa, yielding a kappa of 0.87(95% CI:0.78 – 0.96), indicating strong agreement. Minor modifications were made to the form to improve clarity of diagnosis and duration.
2. **Healthcare Provider Questionnaire:** The questionnaire was developed based on previously validated instruments used in similar studies of antibiotic prescribing practices in Sub Saharan Africa (9,17) with adaptations to the Zambian perspective and the WHO AWaRe framework. The questionnaire was reviewed by a panel of five experts two of which were specialized in infectious diseases while two were clinical pharmacists and an epidemiologist for content validity. The content validity index (CVI) was calculated, yielding a scale level CVI of 0.89, which is scientifically acceptable. **The questionnaire was pilot-tested** among 20 healthcare providers at a different clinic within UTH who were not included in the final study. Internal consistency was assessed using Cronbach's alpha, which was 0.78 for the prescribing practices domain and 0.82 for the barrier's domain. Test-retest reliability was assessed over a two-week interval among 15 providers, yielding an intraclass correlation coefficient of 0.84. Feedback from the pilot led to minor wording changes and reordering of items to improve flow.

Data measurement and sources

Appropriateness was defined as a concordance with the WHO AWaRe recommendations for the diagnosed condition, as outlined in the WHO AWaRe antibiotic book (7). Two independent reviewers (BM and CM) assessed each prescription. Disagreements were resolved by consensus with a third reviewer (FNM). Inter-rater reliability was assessed using Cohen's kappa ($k=0.82$, 95% CI: 0.74-0.90).

Two structured data collection tools were used:

Eligibility Criteria

Inclusion: Healthcare providers who had prescribed antibiotics at the OPD during the study period. **Exclusion:** Providers on leave or who had not prescribed any antibiotic during the study period.

Variables and Outcome Measures

- **Independent variables:** type of antibiotic, frequency of prescription, AWaRe classification.
- **Dependent variables:** patterns of antibiotic use, appropriateness of prescription (defined as concordance with WHO AWaRe recommendations for the diagnosed condition) (7).
- **Proportion targets:** Access $\geq 60\%$, Watch $\leq 30\%$, Reserve $\leq 10\%$ as per WHO benchmarks (5).

Data Analysis

Descriptive statistics (frequencies, percentages, means) were computed for all variables. A chi-square test of independence was used to examine the association between AWaRe class and appropriateness of prescribing. A chi-square goodness-of-fit test was applied to compare the observed distribution of prescriptions across AWaRe

groups with the WHO-recommended distribution. Statistical significance was set at $p < 0.05$. Data were analyzed using R version 4.1.2 and Microsoft excel 2026. No participant was lost to follow up, as the questionnaire was administered in person. All 187 questionnaires were complete, with no missing data for the variables analyzed.

Ethical Considerations

Ethical approval for this study was obtained from LAMUBREC under reference number 0177/01/2024. Permission to conduct the study at UTH was granted by the hospital's management. Written informed consent was obtained from all participating healthcare providers. Data were anonymized and used solely for academic purposes. The study adhered to the principles of the Declaration of Helsinki.

RESULTS

Sociodemographic Characteristics of Healthcare Providers

Table 1 shows that total of 187 healthcare providers participated in the study. The majority were male (103, 55.1%), and the most represented age group was 30–39 years (75, 40.1%). Regarding professional roles, doctors constituted the largest cadre (65, 34.8%), followed by clinical officers (47, 25.1%), pharmacists (37, 19.8%), nurses (28, 15.0%), and other professionals (10, 5.3%). In terms of experience, 44.9% (84) had 1–5 years of practice, 29.9% (56) had 6–10 years, 15.0% (28) had >10 years, and 10.2% (19) had less than one year.

Table 1: Sociodemographic Characteristics of Healthcare Providers (N=187)

Characteristic	Category	Frequency (n)	Percentage (%)
Sex	Male	103	55.1
	Female	84	44.9
Age (years)	20–29	56	29.9
	30–39	75	40.1
	40–49	37	19.8
	≥50	19	10.2
Professional Role	Doctor	65	34.8
	Clinical Officer	47	25.1
	Pharmacist	37	19.8
	Nurse	28	15.0
	Other*	10	5.3
Years of Experience	<1 year	19	10.2
	1–5 years	84	44.9
	6–10 years	56	29.9
	>10 years	28	15.0

*Other includes laboratory scientists, radiographers, and physiotherapists

Frequency and Types of Antibiotics Prescribed

Figure 1 shows that a total of 500 antibiotic prescriptions were analyzed. The most frequently prescribed antibiotic was **Amoxicillin** (128, 25.6%), followed by Co-amoxiclav (75, 15.0%), Ceftriaxone (58, 11.6%), and Ciprofloxacin (58, 11.6%). Other antibiotics included Doxycycline (49, 9.8%), Metronidazole (45, 9.0%), Azithromycin (34, 6.8%), Cloxacillin (30, 6.0%), Cefixime (15, 3.0%), and Meropenem (8, 1.6%). Cumulatively, the top four antibiotics accounted for **63.8%** of all prescriptions.

Antibiotic Prescribing Frequency			
University Teaching Hospital Outpatient Department			
Antibiotic	Frequency (n)	Percentage (%)	Cumulative (%)
Amoxicillin	128	25.6	25.6
Co-amoxiclav	75	15.0	40.6
Ceftriaxone	58	11.6	52.2
Ciprofloxacin	58	11.6	63.8
Doxycycline	49	9.8	73.6
Metronidazole	45	9.0	82.6
Azithromycin	34	6.8	89.4
Cloxacillin	30	6.0	95.4
Cefixime	15	3.0	98.4
Meropenem	8	1.6	100.0

Figure 1: Frequency and Types of Antibiotics Prescribed

Appropriateness of Antibiotic Prescriptions by WHO AWaRe Class

Table 2 shows that 419 (83.8%) of the 500 prescriptions were deemed appropriate according to the WHO AWaRe classification, while 81 (16.2%) were inappropriate. When stratified by AWaRe class, Access antibiotics (n=327) had the highest appropriateness rate (287, 87.8%; inappropriate 40, 12.2%). Watch antibiotics (n=165) showed lower appropriateness (127, 77.0%; inappropriate 38, 23.0%). The Reserve group (n=8) recorded the lowest appropriateness (5, 62.5%; inappropriate 3, 37.5%). A chi-square test of independence revealed a statistically significant association between AWaRe class and appropriateness ($\chi^2 = 12.13$, $df = 2$, $p = 0.002$).

Table 2: Appropriateness of Antibiotic Prescriptions by WHO AWaRe Class

AWaRe Class	Total (n)	Appropriate (n)	Inappropriate (n)	Appropriate (%)	Inappropriate (%)
Access	327	287	40	87.8	12.2
Watch	165	127	38	77.0	23.0
Reserve	8	5	3	62.5	37.5
Overall	500	419	81	83.8	16.2

Chi-square test: $\chi^2 = 12.13$, $df = 2$, $p = 0.002$

Proportion of Antibiotics from Access, Watch, and Reserve Groups

The observed distribution of prescriptions across AWARe classes was: Access 327 (65.4%), Watch 165 (33.0%), and Reserve 8 (1.6%). Compared to the WHO-recommended targets for a sample of 500 prescriptions (Access 65.0%, Watch 30.0%, Reserve 5.0%) (7), the Access proportion was closely aligned, but Watch was prescribed at a significantly higher proportion (33.0% vs. 30.0% target) and Reserve at a lower proportion (1.6% vs. 5.0% target). A chi-square goodness-of-fit test confirmed a statistically significant difference between the observed and expected distributions ($\chi^2 = 13.15$, $df = 2$, $p = 0.001$).

Table 3: Proportion of antibiotics prescribed from the Access, Watch, and Reserve groups

AWaRe Class	Observed Frequency (n)	Observed Percentage (%)	Expected Frequency (n)*	Expected Percentage (%)*
Access	327	65.4	325	65.0
Watch	165	33.0	150	30.0
Reserve	8	1.6	25	5.0
TOTAL	500	100.0	500	100.0

Expected frequencies calculated based on WHO-recommended targets for a sample of 500 prescriptions (7)

Chi-square goodness-of-fit test: $\chi^2 = 13.15$, $df = 2$, $p = 0.001$

Table 3 shows that the chi-square goodness of fit test revealed a statistically significant difference between observed and expected antibiotic prescribing patterns ($X^2 = 13.15$, $df=2$, $p =0.001$). Access to antibiotics were prescribed at a similar rate to the WHO targets (65.4% vs 65.0%). The overall distribution deviates significantly from WHO recommendations, driven primarily by lower reserve and higher watch prescribing.

DISCUSSION

This study evaluated antibiotic prescribing patterns at the University Teaching Hospital Outpatient Department using the WHO AWARe classification. The findings demonstrate that overall antibiotic prescribing appropriateness was high (83.8%), and the proportion of Access antibiotics (65.4%) exceeded the WHO target of 60% (7). However, several important patterns warrant closer attention. The predominant Watch antibiotics were ceftriaxone (3.0%), azithromycin (6.8%) and cefixime(3.0%). Co-amoxiclav, although broad-spectrum, is classified as Access in WHO AWARe 2023 and therefore contributed to the Access proportion; its use still warrants review because it may be prescribed when amoxillin alone is insufficient.

Access Antibiotics and WHO Target Achievement

The observed Access antibiotic proportion of 65.4% is encouraging and compares favourably with recent Zambian studies. Mudenda et al. (20) reported Access antibiotic use of 58.2% at a Lusaka teaching hospital during the COVID-19 pandemic, while a multicentre point prevalence survey across 16 Zambian hospitals found Access antibiotic use ranging from 45.2% to 68.9% (13). Our finding suggests that prescribing practices at UTH OPD have improved and align with WHO recommendations. Amoxicillin was the most frequently prescribed antibiotic (25.6%), which is appropriate given its narrow spectrum, low resistance potential, and efficacy for common outpatient infections such as respiratory and urinary tract infections (6). Similar patterns have been reported in other sub-Saharan African settings, where amoxicillin consistently dominates outpatient prescriptions (15,17).

Watch Antibiotics: Concerns and Context

Watch antibiotics constituted 33.0% of all prescriptions, exceeding the WHO-recommended ceiling of 30% (7). This excess, though modest, is clinically significant because Watch antibiotics carry higher resistance potential and should be reserved for specific indications (12). Co-amoxiclav (15.0%), ceftriaxone (11.6%), and ciprofloxacin (11.6%) were the predominant Watch agents. The high use of co-amoxiclav is concerning; despite being a broad-spectrum combination, it is frequently prescribed unnecessarily for viral respiratory infections or mild bacterial conditions that could be managed with amoxicillin alone (18). Similar overuse of Watch antibiotics has been documented in Ghanaian outpatient departments, where co-amoxiclav and ciprofloxacin accounted for nearly 30% of prescriptions (17).

Ceftriaxone use in the outpatient setting is particularly problematic. As a parenteral antibiotic, its administration in OPDs often reflects either inappropriate prescribing for ambulatory patients or inadequate step-down therapy protocols (21). Mudenda et al. (23) identified ceftriaxone as one of the most overprescribed antibiotics in Zambian hospitals post-COVID-19. The appropriateness rate for Watch antibiotics (77.0%) was significantly lower than for Access agents (87.8%), indicating that prescribers are less proficient at selecting Watch antibiotics correctly. This may reflect diagnostic uncertainty, lack of access to rapid diagnostic tests, or pressure from patients expecting broad-spectrum coverage (8).

Reserve Antibiotics in Outpatient Settings

The presence of Reserve antibiotics (meropenem, 1.6%) in the OPD is a major concern. Reserve agents are intended exclusively for confirmed or highly suspected multidrug-resistant infections, typically under specialist supervision in inpatient settings (5,6). The appropriateness rate for Reserve antibiotics was only 62.5%, the lowest among all three categories. The WHO explicitly states that Reserve antibiotics should not be used in outpatient departments without infectious disease consultation (7). Meropenem prescribing in the OPD suggests either severe misjudgement of infection severity, lack of access to higher levels of care, or inadequate antimicrobial stewardship oversight. Similar inappropriate Reserve use has been reported in Ugandan hospitals, where carbapenems were prescribed for community-acquired infections without microbiological confirmation (16).

Factors Influencing Prescribing Patterns

The sociodemographic profile of prescribers may influence these patterns. Doctors constituted the largest professional group (34.8%), and nearly half (44.9%) had 1–5 years of experience. Less experienced prescribers may lack confidence in guideline-based prescribing, leading to broader-spectrum choices (9). Additionally, the absence of routine microbiological testing at UTH OPD likely contributes to empirical prescribing, which often favors broad-spectrum agents (22). Barriers such as high patient volumes, limited access to formularies, and lack of real-time prescribing feedback have been identified as key drivers of irrational antibiotic use in Zambian hospitals (14,21).

Comparison with Regional and Global Studies

Our overall appropriateness rate of 83.8% compares favorably with other African studies. A point prevalence survey across 16 Zambian hospitals reported overall appropriate prescribing in only 58% of cases, though that study included inpatient and pediatric wards (13). In Ghana, Amponsah et al. (17) found that 42% of outpatient antibiotic prescriptions were inappropriate, with Watch antibiotics accounting for 41% of total use. In Tanzania and Uganda, appropriateness rates ranged from 65% to 75%, with excess Watch antibiotic use being a consistent finding (15,16). The comparatively better performance at UTH OPD may reflect recent antimicrobial stewardship training programs implemented at this tertiary facility (24).

Strengths and Limitations

This study has several strengths. It is one of the first to comprehensively evaluate outpatient antibiotic prescribing in Zambia using the WHO AWaRe framework. The sample size (500 prescriptions, 187 providers)

provides adequate statistical power. However, limitations must be acknowledged. The cross-sectional design captured prescribing patterns over only two months (March-April), which may not reflect seasonal variations in infectious diseases e.g. leading to increased cases of Respiratory Tract Infections in colder months). The retrospective review relied on documentation. Missing or illegible diagnosis, dose, duration or clinical justification may have limited the comprehensiveness of appropriateness assessment. Future prospective studies should use standard prescription templates to improve data completeness. Because prescriptions were anonymized, we could not link individual prescriber characteristics to specific prescriptions. Future studies should also use ethically approved linkage to examine prescriber level determinants of prescribing. The single-Centre, two-month study, may not capture seasonal variation or differences across departments. Findings are most applicable to tertiary hospital OPDs in Urban Zambia.

Implications for Antimicrobial Stewardship

These findings highlight several actionable targets for antimicrobial stewardship programs at UTH OPD (9,21). First, regular prescription audits with feedback to individual prescribers can reduce inappropriate Watch antibiotic use (24). Second, educational interventions should focus on the correct indications for co-amoxiclav, ceftriaxone, and ciprofloxacin, as well as the absolute contraindications for Reserve antibiotics in outpatient settings (12). Third, the introduction of electronic decision support systems integrated with the WHO AWaRe book could guide real-time prescribing (19). Fourth, strengthening diagnostic stewardship including access to rapid tests for streptococcal pharyngitis and urinary tract infections would reduce empirical broad-spectrum prescribing (22). Finally, Zambia's national antimicrobial stewardship guidelines should explicitly include outpatient-specific targets, with a recommended Access proportion $\geq 65\%$ for tertiary hospital OPDs.

CONCLUSION

Antibiotic prescribing at UTH OPD is largely appropriate and meets WHO Access targets, representing a solid foundation for antimicrobial stewardship in Zambia. However, the excess use of Watch antibiotics and the inappropriate use of Reserve agents in the outpatient setting are significant threats that require urgent intervention. Continued surveillance, prescriber education, and system-level supports are essential to preserve antibiotic effectiveness and combat antimicrobial resistance. Multi-centre multi-season studies across primary, secondary and tertiary OPDs are needed to improve representativeness. These findings are most applicable to tertiary hospital OPDs in urban Zambia. Generalizability to primary health centers, rural facilities, or inpatient settings should be made with caution due to differences in patient case mix, prescriber cadre, and available resources. Qualitative interviews or focus group discussions with prescribers should be conducted to explore decision-making, barriers to rational antibiotic use, and acceptability of antimicrobial stewardship interventions.

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Author Contributions

BM conceptualized the study, contributed to data collection and analysis, and drafted the manuscript. FNM contributed to study design, data analysis, and manuscript review. CM contributed to data collection and manuscript review. All authors read and approved the final manuscript.

Competing Interests

None declared.

Data Availability Statement

The datasets generated and/or analysed during this study are available from the corresponding author upon reasonable request.

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