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ORIGINAL RESEARCH

# Point Prevalence Survey of Antibiotic Use in Level 1 hospitals in Zambia: Future Prospects for Antimicrobial Stewardship Programs

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**Introduction:** The inappropriate prescribing and use of antibiotics have contributed to the emergence and spread of antimicrobial resistance (AMR). In Zambia, there is a paucity of information on the prescribing patterns and use of antibiotics among hospitalized patients in level 1 hospitals. This study investigated antibiotic use in five level 1 hospitals in Lusaka, Zambia.

**Methods:** This cross-sectional study utilized the World Health Organization (WHO) Point Prevalence Survey (PPS) methodology among in-patients admitted in level 1 hospitals before 08:00 a.m. on the survey day in August 2024. Data were analysed using IBM SPSS version 23.0.

**Results:** The prevalence of antibiotic use among inpatients was 59.0%, with ceftriaxone being the most prescribed. Antibiotics were prescribed mainly for paediatrics and male inpatients. This study found that 53.0% of prescribed antibiotics were from the Access group while 38.2% were from the Watch group of the World Health Organization Access, Watch, and Reserve (AWaRe) classification. Adherence to national treatment guidelines was 36.0%, with most antibiotics prescribed empirically without evidence of culture and sensitivity tests.

**Conclusion:** This study found a high use of antibiotics and low adherence to treatment guidelines in level 1 hospitals in Lusaka, Zambia. The findings of this study demonstrate the need to establish and strengthen antimicrobial stewardship programs and strengthen laboratory capacity to aid clinicians in diagnosing, treating, and managing patients across level 1 hospitals in Zambia.

**Keywords:** antibiotic use, antimicrobial resistance, antimicrobial stewardship, Point Prevalence Survey, Zambia



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## Introduction

Antimicrobial resistance (AMR) is a global public health problem appreciably impacting morbidity, mortality and costs, with the highest burden in sub-Saharan Africa (SSA).[1–6] Despite AMR occurring as a natural phenomenon, it is increased by inappropriate consumption and use of antimicrobials.[7–12] Consequently, measures to improve antibiotic utilization must be developed and implemented to prevent the escalation of AMR as the next global pandemic.[13–15] There have been several global and regional initiatives in recent years to reduce AMR in humans.[13,16–20] These incorporate initiatives by the World Health Organization (WHO) including the launch of the Global Action Plan (GAP) in 2015, which translated into National Action Plans (NAPs),[21–24] as well as initiatives to improve surveillance of AMR.[25,26] It is against this background that this study investigated antibiotic use among in-patients admitted in five level 1 hospitals in Lusaka, Zambia.

Another initiative was the introduction of the Access, Watch and Reserve (AWaRe) classification of antibiotics with an emphasis on reducing the overuse of antibiotics from the "Watch" and "Reserve" lists due to their greater resistance potential.[9,27,28] This is particularly important in low- and middle-income countries (LMICs), including countries in sub-Saharan Africa, with rapid increases in the utilization of "Watch" antibiotics in recent years.[29] The WHO AWaRe classification classifies antibiotics into three categories based on their spectrum of activity and potential to promote resistance.[30–32] The Access group includes antibiotics recommended for first- and second-line treatments of common infections.[30,33,34] The Watch group comprises broad-spectrum antibiotics that carry a higher risk of resistance development.[30,34,35] Finally, the Reserve group consists of last-resort antibiotics, reserved for treating multidrug-resistant infections.[30,34] According to the WHO AWaRe classification, it was recommended that hospitals must be prescribing at least 60% of antibiotics from the Access group.[31,36] Recently, the United Nations General Assembly (UNGA) of 2024 guided that hospitals must be prescribing at least 70% of antibiotics from the Access group.[37] More recently, the WHO AWaRe book was launched providing treatment guidance on a range of infectious diseases seen in ambulatory and hospital care, including alternatives to antibiotics where pertinent to enhance their appropriate use.[30,31,38] Therefore, monitoring the consumption of antibiotics is a necessary first step in developing pertinent strategies to enhance the rational use of antibiotics within healthcare settings.[39–44] However, there have been concerns with implementing NAPs on AMR, especially in sub-Saharan Africa as a result of a shortage of personnel and limited resources.[45–47]

Point prevalence surveys (PPS) have been used to monitor antibiotic use and prescribing patterns, especially in hospitals across countries including many sub-Saharan African countries.[17,39,41,48–50] The WHO PPS and Global PPS have been used extensively globally to monitor the use of antibiotics in many countries building on European initiatives.[39,41,51–56] The basic version of the PPS is used for surveillance of antimicrobial use, hospital-acquired infections (HAI) and AMR. This is essential to help hospitals compare their ongoing antimicrobial utilization patterns with national and regional benchmark figures to improve future antimicrobial prescribing.[39,41,48] Additionally, through a PPS, hospitals can monitor adherence to antibiotic prescribing guidelines including the WHO AWaRe classification, which is used to visualize antibiotic prescribing patterns in healthcare facilities with an initial target of at least 60% of total antibiotic utilization being antibiotics from the 'Access' category.[29,41,51] Adherence to guidelines is increasingly being used across countries to assess the quality of prescribing across sectors including among hospitals.[39,41,49,57,58]

Published studies have shown extensive concerns with the prescribing of antimicrobials in hospitals across sub-Saharan Africa.[41,49,59–61] In Zambia, a PPS conducted among adult in-patients found that antibiotics were prescribed for 59.0% of in-patients, with low adherence to current treatment guidelines.[62] In addition, in the study by D'Arcy et al (2020) involving one hospital from Zambia, antibiotics were prescribed in 57.0% of in-patients.[53] This rate was higher than seen among participating hospitals in Tanzania, Uganda and Ghana at between 30.0%–55.0% of in-patients.[53] Additionally, 58.0% of prescribed antibiotics were in the 'Access' category, similar to the other countries.[53] Other observational studies conducted in Zambia, including during the recent COVID-19 pandemic, have also shown high rates of antibiotic prescribing alongside concerns with adherence to current guidelines among different hospital types, including primary healthcare hospitals, as well as among outpatients.[63–66]

However, there is still a paucity of information on antibiotic use in hospitals in Zambia, especially those predominantly treating the general population including faith-based hospitals, which typically serve more rural areas,[67] as well as level 1 hospitals, which are usually situated in areas of ease of reach and typically the first point of contact with the healthcare system.[62] Level 1 hospitals serve the majority of community members, with patients only typically referred to secondary or tertiary care hospitals for diseases or procedures that cannot be addressed in Level 1 hospitals. However, there are concerns generally with diagnostic capabilities in these hospitals similar to other LMICs.[68–70] Overall, there are concerns with antibiotic prescribing patterns, including in ambulatory care, in Zambia exacerbating AMR rates.[62,64,65,71–74]

Addressing inappropriate antibiotic prescribing practices in Zambia is crucial to attain its NAP goals given concerns generally with attaining NAPs in Africa.[45,47,75] To address the gaps, this study was conducted to investigate current antibiotic use among in-patients admitted in five level 1 hospitals in Lusaka, Zambia, building on earlier studies among all hospital types in Zambia including during the recent COVID-19 pandemic.[62–65,76,77] The study also assessed the commonly prescribed antibiotics, prescribing of antibiotics by WHO AWaRe classification, commonly diagnosed diseases, adherence to national treatment guidelines, and the use of culture and sensitivity in initiating antibiotic therapy. The combined findings can be used to guide future activities among hospitals in Zambia to improve future antibiotic prescribing, which potentially includes Antimicrobial Stewardship (AMS) Programs despite previous concerns in Zambia, which is similar to other LMICs.[78–80] However, this is changing with the increasing instigation of AMS Programs across sub-Saharan Africa guiding hospital groups across Zambia and beyond.[41,81–84]

# Materials and Methods

## Study Design, Period, and Setting

This PPS was conducted in five level 1 hospitals in Lusaka, Zambia in August 2024. Lusaka was chosen as the setting for this initial study since it is the capital city of Zambia housing the five level 1 hospitals. Consequently, if there are problems in the level 1 hospitals in Lusaka, these are likely to be worse in more rural areas and lower levels of practice in Zambia. The five chosen sites were purposively selected to provide a range of bed capacities and catchment areas. They included Kanyama Level 1 hospital, with a bed capacity of 163 and a catchment population of 276, 000, Chilenje Level 1 hospital, with a bed capacity of 87 serving a catchment population of over 500,000, Chawama Level 1 hospital with a bed capacity of 106 and a catchment population of 97,958, Matero Level 1 hospital with a bed capacity of 152 and serving 131,592 people, and Chipata Level 1 hospital with a bed capacity of 76 and a catchment population of over 489,000.

The selected hospitals offer Outpatient Department (OPD) services (medical, dental, physiotherapy, and pharmacy), Inpatient Department services (general medical, maternity, and surgical), and diagnostic services (laboratory and radiology). In-patients who were admitted before or at 08:00 a.m. on the day of the survey were included in the study in line with recommended PPS methods.[51,52,70] The PPS included in-patients who were admitted to Obstetrics and Gynaecology wards, Adults' Medical and Surgical wards, and Children's Medical and Surgical wards.

## Sample Size, Inclusion and Exclusion Criteria

The bed spaces for the surveyed hospitals ranged from 76 to 163. Consequently, based on the WHO PPS methodology, all in-patients that meet the inclusion criteria must be included in the survey provided there are 500 or fewer bed spaces in a particular hospital.[52] As a result, sample size calculation did not apply, because we had prior information on the number of bed spaces per hospital before conducting the PPS. All patients who were admitted after 08:00 a.m. on the day of the PPS were excluded from the study. Additionally, we also excluded any documentation and pertinent patients prescribed topical antibiotics, antivirals, anti-tuberculosis, antifungals, or anti-parasitic antimicrobials to concentrate on parenterally and orally administered antibiotics. All antibiotic therapy that were started after 08:00 a.m. or stopped before 08:00 a.m. on survey day were excluded. Hence, such patients were not counted in the numerator as being on antibiotic therapy.

## Data Collection

Data was collected using Research Electronic Data Capture (REDCap) software version 9.1.15.[85,86] The WHO PPS methodology questionnaire was utilized to collect data on antibiotic use and prescribing patterns among in-patients in the study hospitals.[52] This included information about (i) the hospital, (ii) ward, (iii) patient (iv) indication and (v) antibiotic use and microbiology data. Microbiology data for culture and sensitivity included blood, urine, would, stool, sputum/

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respiratory samples, sterile fluids including cerebrospinal fluid, peritoneal fluid, and synovial fluid. Data collection was executed by six data collectors who were specifically trained for this purpose and the team visited each hospital for a period of two days translating into a 10-day data collection period. The trainers were part of the Antimicrobial Resistance Coordinating Committee (AMRCC) who are experts in conducting PPS in Zambia. The training was done for a period of three days to ensure that the data collectors understood the need to collect complete and good quality data. REDCap accounts were opened for all the data collectors and testing of data entry was done on day two and three of training. After conducting the PPS, a meeting was held with the hospital management and staff where the findings were disseminated and recommendations were provided.

## Data Analysis

The collected data were extracted from REDCap and exported to Microsoft Excel 2013. Data analysis was performed using IBM SPSS version 23.0. Descriptive statistics were performed for hospital and ward demographic characteristics, patient data, indication, and antibiotic prescribing patterns and the results were presented in tables and charts as frequencies and percentages. To determine the prevalence of antibiotic use, the denominator was the number of patients who met the inclusion criteria and were included in the survey. The numerator was the number of recruited patients who were currently on antibiotic treatment on the day of the survey. Prescribing compliance was assessed using the Zambia Standard Treatment Guidelines (STGs).[87] Antibiotics were also classified by WHO AWaRe classification.[27,28,88]

## Ethical Approval

Ethical approval was obtained from the University of Zambia Health Sciences Research Ethics Committee (UNZAHSREC) with approval number 20231270137. Further approval was obtained from the Zambia National Health Authority (NHRA) with approval number NHRA5949/13/08/2024. Official permission to collect data from the selected hospitals was obtained from the district authority at the Lusaka District Office (DHO). There was no need for informed patient consent as this was a review of the patient's medical records, with all data anonymized, which is similar to other PPS studies.[89–91] The study was conducted according to the guidelines of the Declaration of Helsinki.

# Results

In this study, a total of 580 patients were enrolled with 112 being from Chawama, 134 from Chilenje, 104 from Chipata, 108 from Kanyama, and 122 from Matero Level 1 hospitals. The overall prevalence of antibiotic use among hospitalized patients was 59% (342/580), p=0.190. The highest prescribing of antibiotics was noted for Kanyama (69%), Chilenje (59%), and Matero (59%) Level 1 hospitals (Table 1). Additionally, the prevalence of antibiotic use of highest among

**Table 1** Prevalence of Antibiotic Use by Hospital and Ward Among Hospitalized Patients

| Hospital Name | Overall Antibiotic Use % (n/N) | Antibiotic Use By Ward | | | | | |
|---|---|---|---|---|---|---|---|
| | | CW % (n/N) | OBGYW % (n/N) | FMW % (n/N) | MMW % (n/N) | MSW % (n/N) | FSW % (n/N) |
| Chawama | 54 (61/112) | 9/13 | 12/48 | 13/17 | 12/15 | 9/13 | 6/6 |
| Chilenje | 59 (79/134) | 10/14 | 23/43 | 14/25 | 18/27 | 11/19 | 3/6 |
| Chipata | 54 (56/104) | 8/11 | 17/52 | 8/14 | 11/15 | 1/1 | 11/11 |
| Kanyama | 69 (74/108) | 14/18 | 15/37 | 10/16 | 7/7 | 14/15 | 14/15 |
| Matero | 59 (72/122) | 29/37 | 6/29 | 7/13 | 10/12 | 10/13 | 10/18 |
| Average | 59 (342/580) | 75 (70/93) | 35 (73/209) | 61 (52/85) | 76 (58/76) | 74 (45/61) | 79 (44/56) |

**Abbreviations**: CW, Children's ward; OBGYW, Obstetrics and Gynaecology; FMW, Female Medical Ward; MMW, Male Medical Ward; FSW, Female Surgical Ward; MSW, Male Surgical Ward; n, numerator of number of patients on antibiotics; N, Number of patients included in the study per hospital and per ward.

patients admitted to the female surgical ward (79%), followed by the male medical ward (76%), and children's ward (75%), p=0.001. The lowest use of antibiotics was reported in the Obstetrics and Gynaecology wards (35%) (Table 1).

Most antibiotics were prescribed for children aged below the age of two years (87.5%) followed by those aged between two and five years (68.2%). Additionally, 66.3% of antibiotics were prescribed for adults above the age of 35 years old. A lower prescribing rate of antibiotics (47.1%) was recorded for children aged between six and 12 years (Table 2). Our study also found that antibiotics were prescribed mostly for male patients (76.1%) (Table 2).

A total of 631 antibiotics were prescribed for the in-patients across the five level 1 hospitals in Lusaka, Zambia. Most of the in-patients received ceftriaxone (36.6%) of which Chilenje, Chawama, and Kanyama Level 1 hospitals had the highest rates of prescribing of ceftriaxone (Table 3). Of the 34 antibiotics prescribed, 18 (53.0%) were from the "Access" group, 13 (38.2%) were from the "Watch" group, and 3 (8.8%) were from the "Reserve" group (Table 3).

The commonly prescribed antibiotic classes were cephalosporins, penicillins, and quinolones (Figure 1). On the other hand, the least prescribed classes of antibiotics were tetracyclines, imidazoles, sulfonamide-trimethoprim-combinations, amphenicols, and carbapenems (Figure 1).

Most patients received antibiotics for empirical treatment, pneumonia, OBGY infections, cellulitis, wounds, soft skin infections, and gastrointestinal tract infections (Figure 2). Of the 61 patients who underwent surgery, 61 (100%) received antibiotics. Of the 81 patients who were at high risk of developing an infection, 80 (99%) received antibiotics for medical prophylaxis. Of the 150 patients with community-acquired infections, 148 (97%) received antibiotics. Further, of the 19 patients with HAIs, 18 (95%) received antibiotics. Therefore, most antibiotics were used for surgical and medical prophylaxis and to treat community-acquired infections.

Compliance with the Zambia STGs was 36.0% with Matero level 1 hospital being the most compliant at 47% while Chilenje (29%) and Kanyama (32%) level 1 hospitals, respectively, were the least compliant (Table 4). Of the 342 in-patients who received antibiotics, only 3 (0.9%) received directed antibiotic treatment (Table 4).

## Discussion

We believe this is the first study in Zambia to investigate antibiotic use among in-patients in level 1 hospitals, building on previous limited studies. Our study found that antibiotics were prescribed in 59.0% of the in-patients seen across all the surveyed facilities. Further, ceftriaxone, an antibiotic from the "Watch" group was widely used in the surveyed hospitals, potentially exacerbated by the highly empirical use of antibiotics in the surveyed hospitals with low use of culture and sensitivity results and low adherence to the national treatment guidelines.

**Table 2** Antibiotic Prescribing Patterns by Age and Sex of Hospitalized Patients

| Variable | Characteristic | Prevalence of Antibiotic Use % (n/N) | p-Value |
|---|---|---|---|
| Age | 0–23 months | 87.5 (49/56) | 0.001 |
| | 2–5 years | 68.2 (15/22) | |
| | 6–12 years | 47.1 (8/17) | |
| | 13–17 years | 53.6 (15/28) | |
| | 18–35 years | 49.3 (139/282) | |
| | > 35 years | 66.3 (116/175) | |
| Sex | Female | 52.3 (218/417) | 0.001 |
| | Male | 76.1 (124/163) | |

**Table 3** Antibiotic Prescribing Patterns by WHO AWaRe Classification of Antibiotics

| Antibiotic name | Overall, % (n) | Chawama, n | Chilenje, n | Chipata, n | Kanyama, n | Matero, n | AWaRe Classification |
|---|---|---|---|---|---|---|---|
| *Ceftriaxone* | 36.6 (231) | 28 | 59 | 34 | 52 | 34 | Watch |
| *Metronidazole* | 21.4 (135) | 34 | 41 | 19 | 43 | 28 | Access |
| *Benzylpenicillin* | 7.8 (49) | 10 | 7 | 4 | 11 | 16 | Access |
| *Sulfamethoxazole/ trimethoprim* | 7.0 (44) | 11 | 16 | 6 | 8 | 6 | Access |
| *Gentamicin* | 7.0 (44) | 9 | 5 | 4 | 13 | 9 | Access |
| *Amoxicillin* | 3.5 (22) | 4 | 9 | 9 | 0 | 4 | Access |
| *Azithromycin* | 3.3 (21) | 1 | 15 | 1 | 2 | 1 | Watch |
| *Cloxacillin* | 1.9 (12) | 2 | 1 | 3 | 3 | 2 | Access |
| *Ciprofloxacin* | 1.6 (10) | 4 | 2 | 2 | 0 | 5 | Watch |
| *Cefotaxime* | 1.4 (9) | 0 | 0 | 1 | 2 | 4 | Watch |
| *Benzathine benzylpenicillin* | 1.3 (8) | 3 | 1 | 0 | 3 | 1 | Access |
| *Cefalexin* | 1.1 (7) | 7 | 0 | 0 | 3 | 1 | Access |
| *Cefuroxime* | 1.0 (6) | 0 | 1 | 0 | 0 | 5 | Watch |
| *Erythromycin* | 1.0 (6) | 3 | 0 | 1 | 2 | 1 | Watch |
| *Azidocillin* | 0.6 (4) | 0 | 2 | 0 | 1 | 0 | Access |
| *Tigecycline* | 0.5 (3) | 0 | 1 | 0 | 1 | 0 | Reserve |
| *Doxycycline* | 0.5 (3) | 1 | 2 | 1 | 0 | 0 | Access |
| *Sulfamethizole* | 0.3 (2) | 1 | 0 | 1 | 0 | 1 | Access |
| *Other* | 3.2 (16) | 3 | 6 | 2 | 3 | 2 | |
| *Total* | 100 (631) | 121 | 168 | 88 | 147 | 120 | |

**Notes**: Other means an antibiotic only available in one hospital: Chawama (Ampicillin, Sulfamethoxypyrazine, and Netilmicin); Chilenje (Ceftezole, Talampicillin, Pipemidic acid, Sulfadimethoxine, Levofloxacin, and Biapenem); Chipata (Thiamphenicol and Tedizolid); Kanyama (Cefaclor, Ceftolozane/Tazobactam, and Amikacin); Matero (Clarithromycin and Gemifloxacin); n = number of prescribed antibiotics.

At each hospital surveyed, a high prevalence of antibiotic use was evident with 54% at Chawama, 59% at Chilenje, 54% at Chipata, 69% at Kanyama, and 59% at Matero level 1 hospital, respectively. A similar average prevalence of antibiotic use among hospitalized patients was reported in an earlier PPS that was conducted in Zambia.[62] The high use of antibiotics in Zambia has been reported to be due to a high burden of disease, a lack of diagnostic capacity, non-adherence to treatment guidelines, lack of awareness and knowledge regarding antibiotic use and AMR among prescribers.[92,93] Our findings agree with the relatively high antibiotic use patterns among hospitalized patients in the sub-Saharan African region.[62,94,95] The high prevalence of antibiotic use in hospitals has been reported in other PPS ranging from 62.3% up to 94.6% globally.[49,60,68,96–100] The prevalence of antibiotic use in our study is higher than reported in other PPS globally.[101–110] The differences in the prevalence of antibiotic use could be attributed to different disease burdens, diagnostic capabilities, and availability of a full range of antibiotics in various hospitals and countries.

In this study, ceftriaxone, a Watch group antibiotic was widely prescribed and used across the five hospitals. The high use of ceftriaxone indicates low adherence to the treatment guidelines and a deviation from the WHO AWaRe classification of antibiotics. Ceftriaxone, like most cephalosporins, is frequently prescribed and used inappropriately.[111–116] Arguably,

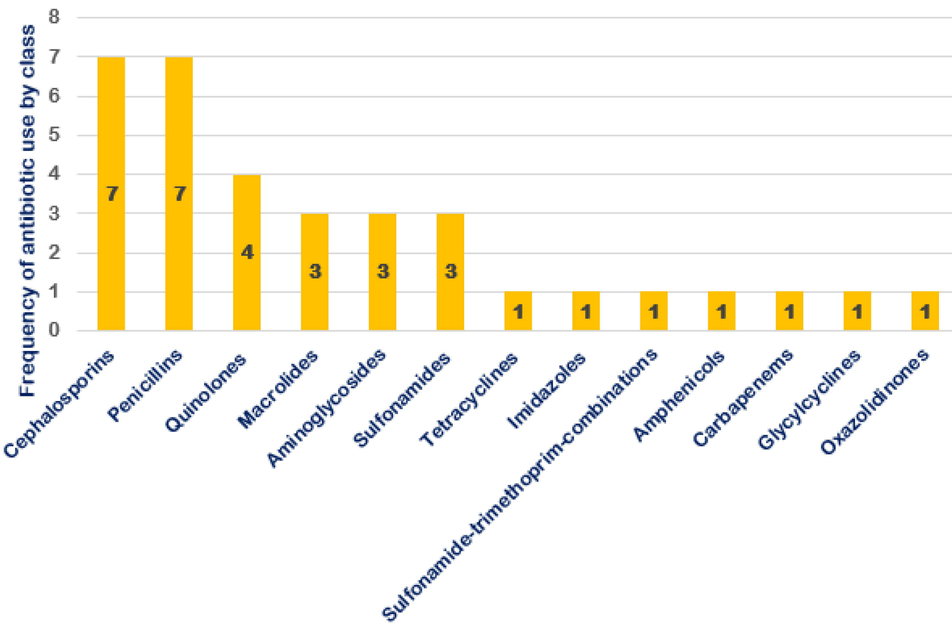


**Figure 1** Antibiotic prescribing patterns by class of antibiotics in level 1 hospitals in Lusaka, Zambia.

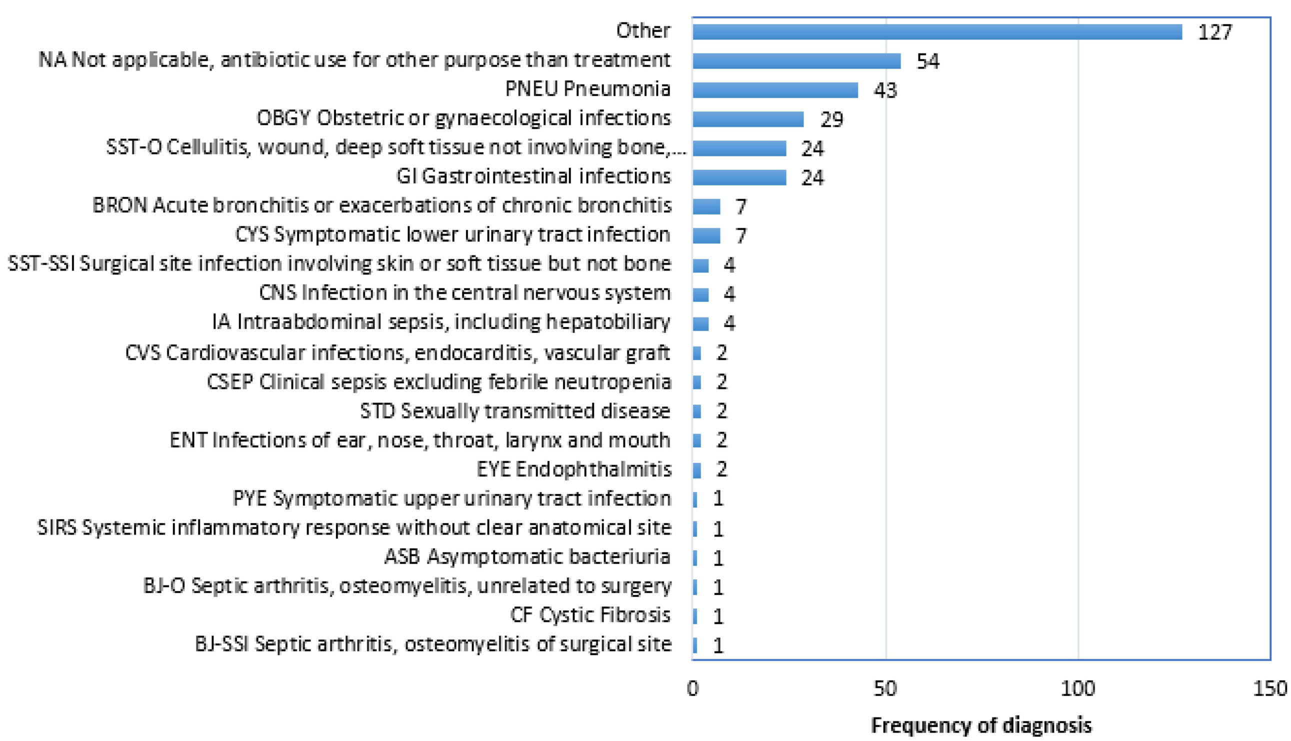


**Figure 2** Distribution of diagnoses found in the surveyed level 1 hospitals in Lusaka District, Zambia.

Ceftriaxone is overused due to its high clinical usage across many diseases covering a variety of bacteria and its ease of administration.[59,111,117–119] Further evidence has shown that the overuse of ceftriaxone could be due to its availability in the supply chain compared to other antibiotics.[120] The prescriber preference to prescribe broad-spectrum antibiotics such as ceftriaxone over other antibiotics could also be a leading cause of overuse of this antibiotic in hospitals. A Zambian survey revealed that 36.1% of hospitalised patients were inappropriately prescribed ceftriaxone, lacking culture and sensitivity


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**Table 4** Adherence Rates to Current National Treatment Guidelines and Treatment Type in Level 1 hospitals in Lusaka District, Zambia

| Hospital Name | Adherence to Treatment Guidelines % (n/N) | Directed Treatment % (n/N) |
|---|---|---|
| Chawama Level 1 | 39 (24/61) | 1.6 (1/61) |
| Chilenje Level 1 | 29 (22/79) | 1.3 (1/79) |
| Chipata Level 1 | 36 (20/56) | 0.0 (0/56) |
| Kanyama Level 1 | 32 (24/74) | 1.4 (1/74) |
| Matero Level 1 | 47 (34/72) | 0.0 (0/72) |
| Average | 36 (124/342) | 0.9 (3/342) |

**Notes**: n, Number of patients treated in line with the Zambia STGs; n, number of patients treated based on culture and sensitivity tests (direct treatment); N, Number of Patients on Antibiotics.

testing.[62] Studies conducted globally have revealed an overuse of ceftriaxone in hospitals including 54% reported in Malawi,[121] 78.6% in Ethiopia,[122] 53.3% in Uganda,[112] 62.4% in Sanandaj, 20.5% in Southeast Asia, and 4.5% in Europe,[98] 51.1% in Tanzania,[123] 21.6% in Eswatini,[124] and 12.1% in Ghana,[20] respectively. The overuse and misuse of broad-spectrum antibiotics such as ceftriaxone are contributing factors to the observed resistance against cephalosporins.[55,112,125,126]

Our study found that 53% of antibiotics prescribed in level 1 hospitals belonged to the Access group while 38.2% and 8.8% belonged to the Watch and Reserve groups, respectively. The WHO recommends that 60% of antibiotics prescribed for in-patients must belong to the Access group.[36,127] The present study found that the prescribing practices in investigated hospitals did not meet the WHO recommendations, indicating more concerted efforts to address this. Even though this is the case, our findings are in keeping with the recent Mapping Antimicrobial Resistance and Antimicrobial Use (MAAP) report released by the African Society of Laboratory Medicine (ASLM) in 2022.[93] The report indicated a high use of Access antibiotics compared to the Watch and Reserve categories. Even though our study indicated that the use of Access category drugs was only at 53%, which is lower as compared to the findings in 14 countries as reported in MAAP. This may be attributed to the small number of patients evaluated during a PPS.[43] This requires monitoring and improvement. Our study findings are in line with those reported in other countries where the prescribing of Access group antibiotics was less than the recommended 60%. A PPS in Bangladesh found that 64% of Watch group antibiotics were prescribed for in-patients.[128] The overuse of Watch group antibiotics has also been reported in other studies[62,121,129,130] This practice requires monitoring and probably strengthening of AMS programs to improve prescribing patterns of antibiotics.

In this study, most of the in the inpatients were diagnosed with community-acquired infections (CAIs). The present study found a high use of antibiotics for surgical and medical prophylaxis and for the treatment of CAIs. Additionally, the most diagnoses for antibiotic use were pneumonia, OBGY infections, gastrointestinal tract infections, and respiratory and urinary tract infections. A systematic review reported that community-acquired infections tend to be the major reason for initiating antibiotics among inpatients.[94] Our findings are in line with existing evidence that has demonstrated high overuse of antibiotics for the treatment of community-acquired infections, surgical prophylaxis, urinary tract infections and obstetric-associated infections.[131,132] For both adults and paediatrics, respiratory illnesses constitute the most common community-acquired infections. The overuse of antibiotics for the treatment of respiratory tract infections including pneumonia was also reported in China.[133] Due to the diagnostic challenges to separate viral and bacterial infections, empirical use of antibiotics grossly remains high leading to overuse and misuse of antibiotics.[134] The use of antibiotics in surgical care as prophylaxis is routine in most countries.[135,136] It is part of the WHO and CDC recommendations for the infection prevention care package.[137–139] Furthermore, in obstetrics, most obstetric complications such as puerperal sepsis demand the use of antibiotics. Due to diagnostic challenges, these antibiotics are usually prescribed empirically leading to irrational use and antimicrobial resistance.[140]

Our results showed that most of the antibiotic use was empirical with a low use of culture and sensitivity results. Additionally, only 0.9% of in-patients received directed treatment in which culture and sensitivity tests were performed indicating a high empirical prescribing of antibiotics in level 1 hospitals of Lusaka, Zambia. In Zambia, the high prescribing of antibiotics empirically could be due to the low diagnostic capacity of laboratories to conduct microbiological to guide treatment as reported previously.[67,141] A study in Tanzania also found that less than 1% of prescriptions were informed by culture and sensitivity test results also demonstrating high empirical prescribing of antibiotics.[127] Our study findings corroborate with those reported in Central India where most antibiotics were prescribed and used empirically.[99] Similarly, the high prevalence of antibiotic prescribing empirically was reported in Iran and was highly due to low diagnostic laboratory capacity.[98] A PPS across 10 hospitals in Peru found that 74% of antibiotics were prescribed empirically, with only 4.4% as a targeted treatment.[109]

In this study, compliance with the Zambia STGs was low at 36% (Chawama 39%, Chilenje 29%, Chipata 36%, Kanyama 32%, and Matero 47%). Non-adherence to treatment guidelines has been found to contribute to the increase in antibiotic-resistant pathogens.[74] Our study findings are in line with those reported in Uganda in which adherence to treatment guidelines was 30%.[59] Our study findings also corroborate those found in Ghana where a 25% adherence to treatment guidelines was reported.[20] A study in Germany found a 33% adherence to treatment guidelines for patients who were being treated for bloodstream and urinary tract infections, indicating a low adherence to the guidelines.[142] Once more, the low adherence to treatment guidelines may be attributed to several factors such as patient preference, availability of alternative antibiotics, weak regulations, and limited diagnostic capacity which usually lead to empirical use of antibiotics. These findings have been reported in various studies done across the globe.[17,143–146] Non-adherence to standard treatment guidelines can lead to the irrational use of antibiotics and eventually the development of drug resistance.

This study revealed that most antibiotics prescribed were for the paediatric age group. The high use of antibiotics in paediatrics has been reported to be a leading cause of adverse effects and AMR.[147] The use of antibiotics in pediatric patients is a common practice due to the pattern of their illnesses. Respiratory tract infections form most of the common illnesses in younger populations and are usually difficult to differentiate between viral and bacterial.[134,148,149] Hence, antibiotics are mostly prescribed empirically. This may have a catastrophic impact on the future of antimicrobial medicines and their efficacy. The high use of antibiotics in hospitals requires careful monitoring and innovative instigation of AMS programs to optimize the prescribing practices by adhering to recommended guidelines, especially in the sub-Saharan African region.[94] Establishing and implementing effective AMS programs while providing on-site orientation and mentorship to multidisciplinary teams of healthcare workers in hospitals is critical in promoting the rational use of antibiotics.[150,151] Implementing AMS programs has been found to improve the prescribing of antibiotics for hospitalized patients in hospitals.[84,152–156]

Our study highlights the prescribing patterns and use of antibiotics in level 1 hospitals in Lusaka which can provide information for conducting internal quality improvements. Our findings can also be used to provide interventions to improve antibiotic use in the surveyed hospitals. Therefore, going forward, we recommend the establishment and implementation of AMS programs in level 1 hospitals, similar to previous recommendations and guidance.[79,150,157,158] This should start with establishing multidisciplinary AMS committees and focal point persons with clear terms of references. AMS programs are critical in optimizing antibiotic use through the education of healthcare workers, patients, communities, and students.[159–161] Additionally, we propose the strengthening of laboratory capacity to conduct microbiological tests to promote diagnostic stewardship.[162–169] This is built on previous studies that we conducted in Zambia that found a low capacity of laboratories to conduct AMR surveillance.[67,93,141]

We are aware that our study had limitations. This study only covered level 1 hospitals in the Lusaka District of Zambia and provided some useful insights into antibiotic prescription and use at that level. Hence, the findings cannot be generalized to hospital hospitals offering other levels of care like secondary and tertiary levels. Thus, future studies are recommended for secondary and tertiary healthcare facilities. Future studies should also consider the inclusion of private and faith-based hospitals. Finally, this study was not designed to investigate any effect that the factor “province” may have on antibiotic prescription and use behaviour; it is arguable that provincial-level latent determinants such as provincial health leadership, staff adherence to relevant clinical protocols, and other health system factors, may be at play.

## Conclusions

The prevalence of antibiotic use in level 1 hospitals in Zambia was higher than recommended by the WHO for hospitalized patients. Additionally, this study found a high use of ceftriaxone, a Watch group antibiotic with low adherence to the treatment guidelines across all level 1 hospitals. Additionally, this study found a high prevalence of antibiotic prescribing for hospitalized patients usually without laboratory culture and sensitivity results. Therefore, these findings demonstrate the need for establishing and implementing antimicrobial stewardship programs to promote the rational use of antibiotics and reduce AMR. The study also indicates a need to promote and strengthen laboratory capacity to conduct clinical microbiological tests to guide antibiotic use and improve patient outcomes.

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## Disclosure

The authors report no conflicts of interest in this work.

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