

Surveillance of Antibiotic Use and Adherence to the WHO/INRUD Core Prescribing Indicators at a Primary Healthcare Hospital in Southern Zambia: Opportunities for Antimicrobial Stewardship Programs

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Abstract

Background: The irrational use of medicines remains a key health problem in many developing countries. The overuse of antibiotics is a key driver of antimicrobial resistance (AMR). This study surveyed antibiotic use and adherence to the World Health Organization (WHO) prescribing indicators at the Request Muntanga Hospital in the Kalomo District of Southern Province, Zambia. **Materials and Methods:** This cross-sectional study was conducted from July 2023 to September 2023 at Request Muntanga Hospital in Zambia and reviewed 600 medical record prescriptions which were issued from July 1,

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2022 to June 30, 2023 using the WHO prescribing indicators. The collected data were analyzed using Statistical Package for Social Sciences version 23.0. **Results:** From the 600 prescriptions sampled, 1246 medicines were prescribed, with antibiotics making up 86.7% of the encounters. Additionally, the average number of drugs prescribed per encounter was 2.1 and the prevalence of polypharmacy was 61.3%. Further, 17.8% of medicines were prescribed as injectables. Furthermore, 76.7% of the drugs were prescribed from the Zambia Essential Medicines List and 38.9% by generic names. **Conclusions:** This study found a high use of antibiotics and deviations from the WHO/International Network of Rational Use of Drugs (INRUD) core prescribing indicators at the Request Muntanga Hospital indicating non-adherence to the prescribing indicators. There is a need to promote adherence to the WHO/INRUD core prescribing indicators to promote the rational use of antibiotics and prevent the emergence and spread of AMR.

Keywords

WHO Prescribing Indicators, Antimicrobial Resistance, Antibiotic Use, Polypharmacy, Surveillance, Zambia

1. Introduction

The use of medicines in healthcare facilities is essential for treating various diseases [1] [2]. However, evidence has shown that medicines have been used irrationally in managing diseases [3] [4]. Irrational use of medicines occurs with polypharmacy, with the use of wrong or ineffective medicines, or with underuse or incorrect use of effective drugs [5]. These actions can adversely impact the quality of medical therapy and cost, and they may also cause adverse drug reactions or negative psychosocial impacts [6]. Alongside this, irrational use of medicines can give rise to many problems, including increased mortality, morbidity, poor treatment outcomes and wastage of healthcare resources [3].

The impact of irrational use of medicines is a global public health problem that may influence the resistance of pathogens to antimicrobials, the risk of hospitalization, increased costs, adverse effects, and waste of resources [7]-[10]. The World Health Organization (WHO) reported that approximately 50% of all medicines are prescribed irrationally [11] [12]. Hence, to promote the rational use of medicines in healthcare facilities, the WHO in collaboration with the International Network of Rational Use of Drugs (INRUD) developed core drug prescribing and use indicators [13]-[15]. The WHO and stakeholders concluded that to promote rational use of medicines, patients should receive medications appropriate to their clinical needs, in doses that meet their requirements, for an adequate period, and at the lowest cost to them and their community [16].

The WHO's core drug use indicators include prescribing indicators, patient care indicators and health facility indicators [13] [17]. Drug use indicators are a

set of standardized indices used to measure drug use in hospitals [18]. Medicine use indicators provide a measure of the optimal use of medicines and can help in correcting deviations based on the expected standards [19]. The WHO defines rational use of medicines as giving the right medicine, for the right patient, at the right dose, for the right duration and at the right (lowest) cost to them and their community [20]. Different studies have shown that most medicines are inappropriately prescribed or dispensed [12] [20]-[22]. Moreover, the association between increased misuse of antibiotics and the emergence and spread of resistant microorganisms has been confirmed by many studies [23]-[25].

Prescribing indicators measure the performance of healthcare providers in several key dimensions related to the appropriate use of medicines [14] [26]-[28]. The indicators are based on the practices observed in a sample of clinical encounters taking place in hospitals for the treatment of acute and chronic illness [29]. These include the average number of drugs per encounter which measures the degree of polypharmacy; the percentage of drugs prescribed by generic name which measures the tendency to prescribe by generic name; the percentage of encounters with an antibiotic prescribed and an injection prescribed which measures the overall use of two important but commonly overused and costly forms of drug therapy; and the percentage of drugs prescribed from the Essential Medicines List (EML) [30] [31].

Rational medicine use (RMU) is essential to optimize the quality of healthcare delivery and resource utilization [32]-[34]. Consequently, studies have shown that prescribing indicators for the African region deviate significantly from the WHO recommendations [13] [21] [22] [35]-[39]. Notably, the deviations from the WHO recommended indicators in low- and middle-income countries (LMICs) could be because of an increased burden of infectious diseases, shortages of medicines, and understaffing of competent healthcare professionals [5] [13] [39]-[42]. Consequently, a shortage of medicines in healthcare facilities causes prescribers to usually prescribe irrationally [43] [44].

The overuse and misuse of antibiotics contribute to the emergence of antimicrobial resistance (AMR) which tends to be a global public health threat [45]-[47]. The high prescribing of antibiotics has been reported in other studies [3] [48]-[50]. This is of great concern because most prescribed antibiotics tend to be inappropriate, especially in LMICs [21] [22] [51] [52]. Therefore, there is a strong need for strategies to be instigated to address this problem and reduce the emergence and spread of AMR [53] [54]. The development and implementation of antimicrobial stewardship (AMS) programs in hospitals are very essential to address the problem of AMR. Furthermore, to curb AMR, countries must develop and implement their National Action Plans (NAPs), as guided by the Global Action Plan (GAP) on AMR [55]-[58]. Alongside this, hospitals must adhere to the set prescribing guidelines and antibiotic use following the WHO Access, Watch, and Reserve (AWaRe) classification of antibiotics [59]-[64]. The AWaRe framework promotes the rational use of antibiotics in healthcare facilities to prevent the

emergence and spread of AMR [60] [63]-[65].

In Zambia, despite the Zambian National Drug Policy's emphasis on promoting good practices, there exists a notable gap in information regarding Rational Medicine Use (RMU). Additionally, this is evidenced by several studies that highlighted instances of inappropriate prescribing practices [21] [22] [25] [35] [36] [44] [66] [67]. Consequently, there is still a paucity of information on the prescribing of medicines using the WHO/INRUD prescribing indicators in hospitals in Zambia. Therefore, this study evaluated the prevalence of antibiotic use and adherence to the WHO prescribing indicators at the Request Muntanga Hospital in the Kalomo district of Southern Province, Zambia.

2. Materials and Methods

2.1. Study Design, Period, Site, and Population

This was a cross-sectional study that was conducted in July 2023 by reviewing medical prescriptions for the period from July 1, 2022, to June 30, 2023. The study was carried out at the Request Muntanga Hospital in Kalomo District, Southern Province, Zambia. Kalomo District had a total human population of approximately 274,640 of which 134,317 were males and 140,323 were females [68]. Request Muntanga First Level Hospital is the largest and only first-level hospital in Kalomo district providing medical services to the people of this area. With no reports of studies conducted in Kalomo district on the adherence to WHO/INRUD core prescribing indicators at a hospital, we chose to enroll this hospital in our study and utilize the findings to instigate strategies to promote rational prescribing and the use of medicines.

2.2. Sampling Technique and Sample Size Determination

This study reviewed a total of 600 prescriptions following the WHO recommendation [14]. This recommendation was also adopted and utilised in previous studies [69] [70]. Overall, 30,000 prescriptions were obtained for the period 1st July 2022 to 30th June 2023 at Request Muntanga Hospital. To obtain the required interval of sampling, the total number of prescriptions obtained (30,000) was divided by the recommended sample size of 600 which gave an interval of 50. Therefore, we used systematic random sampling at an interval of 50 to select the required prescriptions that met the inclusion criteria.

2.3. Data Collection Tool

A validated WHO prescribing indicator form was used to review medical prescriptions [14] [15]. Data collection was carried out in July 2023 at the Request Muntanga Hospital with prescribing encounter records from 1st July 2022 to 30th June 2023. Further, we used the Zambia Standard Treatment Guidelines to check whether the medicines were prescribed using their generic names [71]. Furthermore, we used the Zambian Essential Medicines List (ZEML) to check whether the prescribed medicines were from the EML [72].

2.4. Data Analysis

The collected data from the medical prescriptions was entered into a Microsoft Excel Spreadsheet and analysed using IBM SPSS version 23.0. We used descriptive statistics to summarize the sociodemographics of patient information and prescribing patterns of medicines. To evaluate the prescribing patterns of medicines, the WHO/INRUD core prescribing indicators were used including the average number of medicines prescribed per encounter (reference range 1.6 - 1.8), the percentage of encounters in which antibiotics were prescribed (reference range 20.0% - 26.8%), the percentage of encounters in which injections were prescribed (reference range 20.0% - 26.8%), the percentage of medicines prescribed in generic names (reference value 100%), and the percentage of medicines prescribed from the ZEML (reference value 100%).

2.5. Ethical Approval

Ethical approval was sought from the University of Zambia Health Sciences Research Ethics Committee (UNZAHSREC), protocol ID: 202301270005. Permission to conduct a research study was obtained from the Senior Medical Superintendent at Request Muntanga Hospital. This study did not involve human subjects. Hence, there was no harm to people as only the essential drug list or institutional formulary and prescriptions were used. Confidentiality was maintained throughout the study. The collected data did not indicate patient names but they were assigned numbers and initials only.

3. Results

3.1. Sociodemographic Characteristics of Sampled Medical Prescriptions at Request Muntanga Hospital, July 1, 2022- June 30, 2023

This study reviewed a total of 600 prescriptions. The majority of patient prescriptions came from females (54%) and most patients were aged between 21 - 35 years (Table 1).

3.2. Number of Drugs per Prescribing Encounters (Degree of Polypharmacy) at Request Muntanga Hospital, July 1, 2022- June 30, 2023

This study found that 38.7% of encounters had one drug. Further, 29% of encounters had two drugs and 19.5% had three drugs. Furthermore, 12.8% of encounters had four or more drugs (Figure 1). Consequently, these findings indicated that 61.3% of the encounters were polypharmacy.

3.3. Total Number of Antibiotics per Prescribing Encounter

This study found that 50.3% of the encounters had one antibiotic while 34% did not have any antibiotic. Further, 10.7% of the encounters had two antibiotics and 5% had three antibiotics (Figure 2). As a result, polypharmacy with antibiotics was found to be 15.7%.

Table 1. Sociodemographic characteristics of participants.

Characteristics	Frequency (N = 600)	Percentage (%)
Gender		
Female	324	54
Male	276	46
Age category		
0 - 1 year	32	5.3
2 - 12 years	77	12.8
13 - 20 years	112	18.7
21 - 35 years	184	30.7
36 - 55 years	129	21.5
Above 55 years	65	10.8

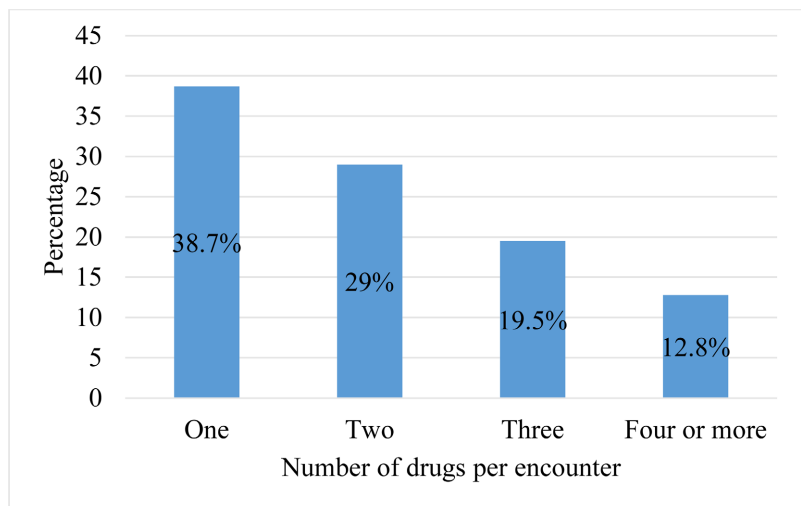


Figure 1. Number of drugs per prescribing encounter (Degree of polypharmacy) in Southern province selected hospital, Request Muntanga Hospital, July 1, 2022-June 30, 2023.

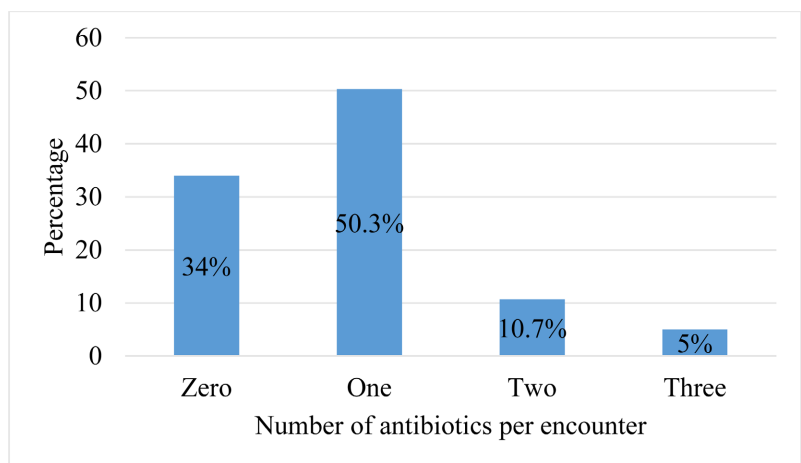


Figure 2. Total number of antibiotics per prescribing encounter.

3.4. Summary of Results at the Request Muntanga Hospital in Southern Province, July 1, 2022-Jun 30, 2023

In Summary, a total of 1246 medicines were prescribed at Request Muntanga Hospital between July 1, 2022 and June 30, 2023. The average number of medicines prescribed per prescription was 2.1. In 520 encounters, 86.7% of the prescriptions included antibiotics. One hundred and seven prescriptions contained injections totaling 17.8%. Additionally, 485 (38.9%) medicines were prescribed by generic name. Finally, 76.7% of medicines prescribed were from the ZEML (**Table 2**).

Table 2. Summary of results obtained at the Request Muntanga Hospital, July 1, 2022-June 30, 2023.

Prescribing indicators assessed	Total drugs/ encounter	Average %	WHO Standard Value
1. Average number of medicines prescribed	1246	2.1	(1.6 - 1.8)
2. Percentage of encounters with antibiotics	520	86.7%	(20% - 26.8%)
3. Percentage of encounters with injections	485	17.8%	(13.4% - 24.1%)
4. Percentage of medicines prescribed by generic names	107	38.9%	100%
5. Percentage of medicines prescribed from the ZEML	956	76.7%	100%

4. Discussion

This study surveyed antibiotic use and the WHO/INRUD prescribing indicators of medicines at the Request Muntanga Hospital in Kalomo District of Southern Province, Zambia. As far as our understanding extends, this study represents the inaugural examination of the WHO/INRUD prescribing indicators for medicines and the frequency of antibiotic utilization within Kalomo District of Southern Province, Zambia.

Our study found that most patients, 61.3% were prescribed more than one medicine, indicating the high practice of polypharmacy. Our findings are similar to those reported in Ethiopia where most patients received more than one medicine [73]. Our findings are also in line with those reported in a study that was conducted in Korea where 46.6% of the participants in a cohort study had experienced polypharmacy [8]. This could be attributed to the burden of disease, non-adherence to treatment guidelines, a lack of prescriber financial incentives, inadequate or no continuous professional development (CPD) training for prescribers, and incompetence among prescribers, especially in LMICs. Consequently, polypharmacy must be practised carefully as it has the potential to cause adverse effects, risk for hospitalization, and may even lead to death [8] [74]-[77].

The current study found that the average number of drugs per encounter was 2.1. This average number deviates from the standard provided by the WHO, according to which, the average number of drugs per encounter should be between

1.6 and 1.8 [14] [15]. Another recent study conducted in Zambia found the average number of medicines prescribed per patient encounter to be 2.5 [35]. Our study findings are consistent with results reported from previous studies where there was a high average number of medicines prescribed per encounter including 3.7 in Tanzania [78], 3.6 in Nigeria [79], 3.48 in India [80], 3.2 in Uganda [27], 2.8 in Pakistan [81], 2.5 in Egypt [32], and 2.3 in Ethiopia [18]. The average number of medicines prescribed in our study and similar studies is higher than the one recommended by the WHO. This shows that most patients were on polypharmacy which has implications including adverse drug effects on the patient. A study in Pakistan reported a low (1.4) average number of medicines prescribed per encounter indicating a low prescribing of medicines in this patient population [24]. Our study findings and many similar studies demonstrated an increased use of medicines in disease management.

The present study found that the prevalence of antibiotic use per encounter was 86.7%. The antibiotic use per encounter found in our study exceeds the recommended range of 20.0% to 26.8% recommended by the WHO [14] [15] [82]. Our study findings are slightly similar to those reported in other studies, including 79% in Eritrea [83], 81.5% and 82.3% in Pakistan [24] [84], 82.5% in Ethiopia [39], and 88% in Tanzania [78]. Conversely, our findings contrast those reported in Ethiopia where encounter with antibiotics was 69.6% [85], 66.22% in Uganda [27], 66% in India [86], 54.5% in Eritrea [87], 44.7% in Nepal [82], and 41.1% in Tanzania [78]. The overuse and misuse of antibiotics in hospitals is a driver of AMR [88]-[92]. The findings from our study and similar studies indicate the need to instigate and strengthen AMS programs in hospitals to promote the appropriate use of antibiotics [93]-[98].

In the current study, 17.8% of encounters were injectable medicines, which was in line with the WHO recommendations of 13.4% - 24.1% of the prescriptions to contain injectable medicines [14] [15] [17]. A study in Ethiopia found that 6.3% of the encounters were injectable medicines, which was lower than the WHO recommendations [85]. Eritrea also reported a low use of injectable medicines, at 6.6% [87]. However, our findings were lower than those reported in Ethiopia where an encounter with injectable medicines was 38.1%, indicating non-adherence to the WHO prescribing indicators [99]. A study that was conducted in Uganda reported that 25.22% of injectable medicines were prescribed, indicating a higher number of injections than the recommended standard by the WHO [27]. The high use of injectable medicines reported in other studies may have implications including a reduction in the quality of medical care, concerns about patient safety, increased potential to cause adverse effects, and wastage of resources [100].

Our study found that doctors prescribed 38.9% of the medicines under their generic names. This finding deviated from the WHO core prescribing indicators that stated that all medicines (100%) must be prescribed by their generic names [14] [15]. An earlier study conducted in Zambia found that 56.1% of the medicines were prescribed by their generic names [44]. Additionally, a recent study in

Zambia found that 96.5% of medicines were identified by their generic names [35]. The rate of prescribing medicines by generic names in our study was lower than the 97% reported in Eritrea [101], 96% and 97.6% in Ethiopia [85] [102], 62% and 90.48% in Uganda [27] [103].

The current study discovered that 76.7% of drugs came from the ZEML. Our findings fall short of the ideal WHO-recommended value of 100% [14] [15]. The rate of prescribing antibiotics from the National EML found in our study is similar to what has been reported elsewhere [103]. On the other hand, the rate of prescribing medicines from the National EML found in our study was lower than the 98% that was reported in a recent study in Zambia [35], 100% in Eritrea [101], 96.6% and 100% reported in Ethiopia [99] [102], and 96.23% in Uganda [27]. The deviations from the recommended treatment guidelines may promote irrational medicine use and contribute to the emergence and spread of AMR [7] [104] [105].

Our findings showed that the prescribers at Request Muntanga First Level Hospital in the Southern Province of Zambia did not adhere to any of the WHO core prescribing indicators. Consequently, our findings necessitate the instigation and implementation of strategies to promote adherence to prescribing guidelines at the hospital, particularly as reported by other researchers [36] [37] [58] [60] [106]. We believe educational and training interventions through AMS programs in hospitals can improve the prescribing habits of medicines and adherence to treatment guidelines to reduce the emergence and spread of antimicrobial-resistant infections [53] [54] [58] [107]-[112].

We are aware that our study had some limitations. The study was conducted at one hospital in the Southern Province of Zambia, hence, this affects the generalisation of the findings across all hospitals in Southern Province and Zambia at large. However, our findings can be used to instigate interventional strategies to promote rational prescribing and use of antibiotics.

5. Conclusion

This study found that there was low adherence to the WHO core prescribing indicators among prescribers at Request Muntanga First Level Hospital in the Southern Province of Zambia. The high usage of antibiotics is a serious public health issue and requires a multisectoral approach to address. To avoid the negative effects of prescribing antibiotics inappropriately, long-term interventional techniques are required. The amount of the prescribed injectables falls within the normal range. However, due to a large divergence from the WHO-recommended standards, this study indicated that polypharmacy, brand name use, and prescription medications from the Essential Medicines List were significant problems. There is a need to provide educational interventions to prescribers on the need to adhere to the WHO prescribing indicators and other recommended guidelines when prescribing medicines. Therefore, the Antimicrobial Resistance Coordinating Committee (AMRCC) must instigate AMS and surveillance programs to optimize the use of antimicrobials at the surveyed facility and in similar facilities

across the country.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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