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Prescribing patterns of antimicrobials according to the WHO AWaRe classification at a tertiary referral hospital in the southern highlands of Tanzania

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SUMMARY

Background: Antimicrobial consumption continues to rise globally and contributes to the emergence and spread of antimicrobial resistance. This study aimed to evaluate antimicrobial prescribing patterns in a selected tertiary hospital in Tanzania.

Methods: This cross-sectional study was conducted for one year (September 2021—September 2022) at Mbeya Zonal Referral Hospital, a public hospital in the southern highlands zone of Tanzania. Data on clinical diagnosis, laboratory tests, prescribed antimicrobials, and prescribers' designations were collected through a custom eMedical system, aligning antimicrobials with the WHO's 2021 AWaRe classification. Descriptive analysis was performed to assess the pattern of antimicrobial prescriptions.

Results: Of 2,293 antimicrobial prescriptions, 62.41% were ACCESS, 37.42% were WATCH, and 0.17% fell in the RESERVE categories. Metronidazole, accounting for 23.8%, was the most commonly prescribed antimicrobial. More than 50% of the ACCESS and WATCH prescriptions were justified by laboratory diagnosis and were predominantly prescribed by clinicians. A very small proportion of prescriptions (<1%) were informed by culture and sensitivity (C/S) testing. The Paediatric department had the majority of WATCH prescriptions (72.2%).

Conclusion: The prescribing patterns at the study hospital generally align with WHO AWaRe guidelines, potentially mitigating antimicrobial resistance. Nevertheless, the scarcity of culture and sensitivity testing is a concern that warrants targeted improvement.

Introduction

The World Health Organization's (WHO's) Global Report on Antimicrobial Consumption 2016—2018 presents an analysis of national-level surveillance data from 56 countries, highlighting

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that antimicrobial consumption continues to rise globally and reveals significant variations in antimicrobial consumption patterns between different countries and regions, which could contribute to the emergence and spread of antimicrobial resistance (AMR) [1,2]. Antimicrobial over-prescription and inappropriate use have led to the global crisis of antimicrobial resistance [3—5]. To address this issue, among other approaches, the WHO developed the ACCESS, WATCH, and RESERVE (AWaRe) Classification of antimicrobials, which recommends the appropriate use of antimicrobials and aims to reduce the development and spread of AMR [6].

The AWaRe classification provides a valuable framework for categorizing antimicrobials based on their spectrum of activity, the potential for resistance, and intended use. The three categories are ACCESS, WATCH and RESERVE [7,8]. The ACCESS group contains antimicrobials considered first-choice treatment options and are typically narrow-spectrum, with a lower potential for resistance, such as Aamoxicillin, metronidazole, doxycycline and nitrofurantoin. The WATCH group includes broader-spectrum antimicrobials such as azithromycin, cefepime cefixime, ceftriaxone, meropenem, piperacillin/tazobactam and vancomycin. These antimicrobials have a higher potential for resistance and should be used judiciously for specific infectious syndromes. The RESERVE group contains antimicrobials considered a last-resort treatment option, such as aztreonam, colistin and tigecycline and should only be used in limited circumstances when other treatment options have failed [6].

One of the goals of the WHO AWaRe classification is to limit at least 60% of global antimicrobial consumption to the ACCESS group. The goal is to promote the appropriate use of antimicrobials, reduce the spread of antimicrobial resistance, ensure that antimicrobials are used judiciously, to preserve their effectiveness for future generations. A cross-sectional study conducted in Kenya found that, while there was a general awareness of the problem of AMR and the need for appropriate antimicrobial use, there were significant barriers to implementing the AWaRe system in practice due to lack of training and education on appropriate antimicrobial use and a lack of institutional support for antimicrobial stewardship programs [9]. In Tanzania, the AWaRe classification system was established in 2019. However, three years later, its implementation has not been fully evaluated. A recent study in Tanzania highlights low level existence of (AMR) surveillance and antimicrobial stewardship (AMS) implementation with absence or minimal standard prescription and auditing [10]. It has further been identified that among the challenges facing antimicrobial use (AMU) surveillance in Tanzania and Uganda are poor quality data and low digitalization of tools [11].

While some studies have explored the success and challenges of promoting appropriate antimicrobial use in Tanzania, studies are needed in all aspects that may have an impact oncurbing AMR, including abidance to WHO AWaRe recommendations. A recent cross-sectional study done in six referral hospitals in Tanzania found that 62.3% of antimicrobial prescriptions belonged to the ACCESS group. It also found significant variation in antimicrobial prescribing practices across primary healthcare facilities and recommended the need for routine monitoring of antimicrobial use [12]. Similarly, a qualitative study in Uganda identified a range of social, cultural, and systemic factors that pose challenges to promoting appropriate antimicrobial use, including limited access to certain types of antimicrobials, patients' expectations for antimicrobial prescriptions, and a lack of political will to address the issue [13].

While different studies provide important insights into the challenges of promoting appropriate antimicrobial use in different settings, more research is needed to fully understand the factors influencing prescribing practices and specifically identify areas that require targeted interventions to promote appropriate antimicrobial use. It is vital to assess the prescribing patterns in different healthcare settings to understand the implementation status of the laid down measures for curbing AMR and determine the basis for making necessary interventions [14]. This study aimed at assessing the prescribing pattern of antimicrobials in the context of the WHO AWaRe recommendations in order to understand the status and areas that need further improvement. The findings from this study provide valuable insights into the prescribing patterns of antimicrobials in the southern highlands zone of Tanzania.

Methods

Study site and population

The study was done in a public Tertiary Hospital (Mbeya Zonal Referral Hospital) that serves about 10.3 million people in the Southern Highland zone of Tanzania [15].

Study design

This was a cross-sectional study conducted from 24th September 2021 to 23rd September 2022. Different information regarding antimicrobial prescriptions and other parameters of interest were automatically captured from the Hospital electronic system (eMedical) that is currently used at Mbeya Zonal Referral Hospital (MZRH). Among the parameters captured for this study included diagnosis, laboratory investigations, antimicrobials prescribed, departments and qualifications of the prescribers.

Study population

All patients who were prescribed antimicrobials between September 2021 and September 2022, irrespective of the dosage or age, being in or outpatient, were eligible for this study. We excluded patients whose antimicrobial prescriptions were done outside Mbeya Zonal referral Hospital.

Data analysis

Microsoft Excel was used to analyse the data. We determined the overall percentage of prescribed antimicrobials in each WHO AWaRe category based on the total number of antimicrobial prescriptions, use of laboratory tests in guiding the choice of antimicrobials and identifying designation of prescribers for each category. The results were then stratified by department and antimicrobials according to the 2021 WHO AWaRe classification. We finally determined laboratory utilization in all prescriptions. The results were presented in charts and frequency tables.

Results

Prescription pattern according to WHO AWaRe classification

A total of 2,293 antimicrobial prescriptions were identified between September 2021 and September 2022. Of these prescriptions, 1,431 (62.41%) belonged to the ACCESS category, 858 (37.42%) belonged to the WATCH category, and 4 (0.17%) belonged to the RESERVE category (Figure 1).

The most prescribed antimicrobials were Metronidazole (23.8%) followed by Co-amoxiclav (16.5%) (Table I).

Table I
Top ten prescribed antimicrobials

Antimicrobial name	Class	Frequency	%
Metronidazole	Access	545	23.77
Co-amoxiclav	Access	378	16.48
Azithromycin	Watch	207	9.03
Ampicillin + Cloxacillin	Access	183	7.98
Cefixime	Watch	183	7.98
Ceftriaxone	Watch	180	7.85
Ciprofloxacin	Watch	125	5.45
Flucloxacillin + Amoxicillin	Access	117	5.10
Nitrofurantoin	Access	109	4.75
Gentamicin	Watch	50	2.18

Utilization of laboratory tests

Among the patients who received ACCESS Antimicrobials, 328 (22.9%) underwent supportive investigations for their presumed diagnosis. Among them, only 4 patients (0.01%) underwent culture and sensitivity testing to support their prescriptions. On the other hand, 227 (26.5%) of those who received antimicrobials from the WATCH group underwent some investigations, of which only 3 (0.01%) prescriptions were supported by culture and sensitivity testing (Table II).

Prescribers by category of antimicrobials

Analysis of known prescribers revealed that most ACCESS antimicrobials were prescribed by Medical Officers 415 (47.2%), followed by intern Doctors 244 (27.8%), then medical specialists 220 (25.0%). In the WATCH category, Medical Specialists prescribed the majority 238 (43.8%), followed by the Registrars 205 (37.8) and Intern Doctors were the least with 100 (18.4%) prescriptions. One antimicrobial from a RESERVE group was prescribed by an intern Doctor and the other one by a Registrar (Table II).

Departmental antimicrobial prescription by AWaRe categories

The Department of Obstetrics and Gynecology issued the highest number of antimicrobial prescriptions, amounting to 589 prescriptions of which 499 (84.72%) fell into the ACCESS group, while the remaining 90 (15.28%) belonged to the WATCH group. The Department of Internal Medicine issued 448 prescriptions with 265 (59.15%) belonging to the ACCESS group and 183 (40.85%) belonging to the WATCH group. The WATCH category had the highest proportion of prescriptions in the Paediatric Department, amounting to 197 (72.2%) while ACESS group were only 74 (27.1%) Generally RESERVE group prescriptions were less than 0.1% (Table III).

Discussion

Evaluating antimicrobial prescribing practice is crucial for addressing AMR, as it informs future efforts to improve antimicrobial use and prevent the spread of AMR [16]. Our research findings show that a significant proportion (>60%) of prescribed antimicrobials fell within the ACCESS category. This is consistent with the WHO AWaRe classification's recommendation to prioritize the use of narrow-spectrum, readily available, and affordable antimicrobials [6]. The fact that very few antimicrobials were prescribed in the RESERVE category is encouraging, as this category is reserved for antimicrobials that should only be used as the last resort to treat severe and resistant infections.

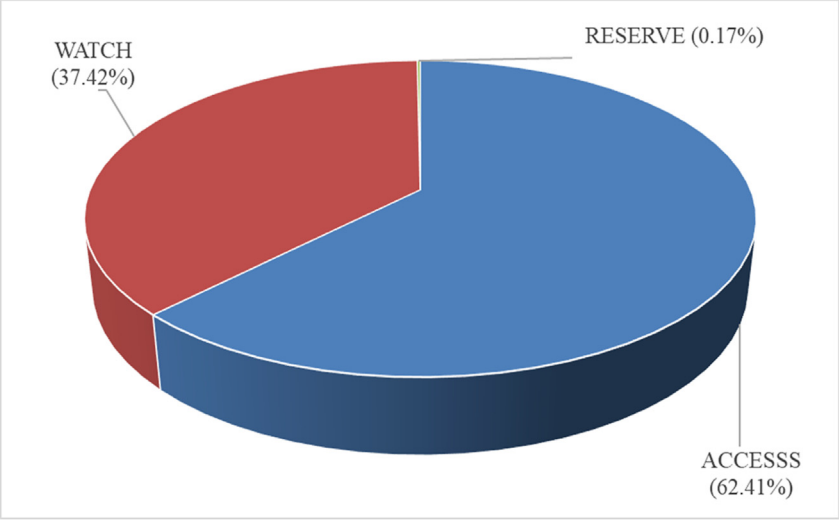

Figure 1. Prescribed antimicrobials according to WHO AWaRe classification.

Table II
Antibiotic prescriptions by laboratory test and prescribers

Antibiotic group	ACCESS (*N*=1431)		WATCH (*N*=858)		RESERVE (*N*=4)	
	N	%	*N*	%	*N*	%
Laboratory						
Other investigations	324	22.64	224	26.11	0	0.00
Culture & sensitivity	4	0.28	3	0.35	0	0.00
Diagnosis	723	50.52	443	51.63	0	0.00
Empirical	380	26.55	188	21.91	4	100.00
Prescriber (All)						
Unknown Prescribers[a]	552	38.57	315	36.71	2	0.23
Intern Doctor	244	17.05	100	11.66	1	0.12
Medical Officer	415	29.00	205	23.89	1	0.12
Medical Specialist	220	15.37	238	27.74	0	0.00
Known prescriber						
Intern Doctor	244	27.76	100	18.42	1	25.00
Medical Officer	415	47.21	205	37.75	1	25.00
Medical Specialist	220	25.03	238	43.83	0	0.00

[a] Prescriptions which were captured in a hardcopy and entered in the system by either a pharmacist or a nurse.

Although the findings were generally consistent with WHO AWaRe recommendations, stratified data by department revealed a huge range from 27.1% in the Paediatric and Child Health department to 84.72% in Obstetrics and Gynecology for ACCESS category. This finding underscores the need to stratify data by units to identify specific and focused intervention needs by hospital AMS committees. More exploration is needed to assess the reason for high prescription of WATCH category in the Pediatric department.

Our findings further show that a significant proportion of prescriptions in all categories were not supported by culture and antimicrobial susceptibility testing (AST). Being a tertiary hospital with all the facilities to support such tests, it was least expected that prescribers were not utilising the laboratory as per recommendations. The role of the laboratory in the fight against AMR can never be over-emphasized [17]. In our previous study, which evaluated antimicrobial prescription habits from data collected in 2018, we observed similar challenges [18]. However, 17% of antimicrobial prescriptions were guided by culture and AST, while this study revealed only 0.1%; far less than what was seen in 2018. The difference is most likely due to fewer number of evaluated prescriptions in 2018 (only 100) as compared to 2,293 in this study, but also the duration of the previous study which was only a few months, compared to one year for this study. Timing is crucial when conducting this type of study in low- and middle-income countries (LMICs) bearing in mind the usual challenge of inconsistency in supplies of reagents and consumables for laboratory investigations, but also seasonal variability of infections [19,20]. The time during which data was collected for this study, the laboratory was being supported for urine and blood culture tests by the Fleming fund. However, logistical issues during this time were still a challenge that led to intermittent laboratory supplies. Inconsistent availability of culture and AST is ongoing and due to several reasons, including higher running costs, which are not recoverable by charges paid by the National Health Insurance Fund (NHIF) (which covers the healthcare cost incurred by most of our patients) [21]. This may have slowly, over time, built clinicians' habit not to request specimens for culture and AST until all empirical treatments have failed. Moreover, this finding calls for training on evidence-based antimicrobial prescriptions through conducting appropriate diagnostic and AST investigations before prescribing antimicrobials [6]. Knowledge and practice on evidence based antimicrobial prescribing, will

Table III
Antibiotic prescriptions by departments

Antibiotic group	Total (*N*)	ACCESS		WATCH		RESERVE	
Department		*N*	%	*N*	%	*N*	%
Internal Medicine	472	287	60.81	185	39.19	0	0.00
Surgery	65	48	73.85	17	26.15	0	0.00
Urology	203	137	67.49	65	32.02	1	0.49
Obstetrics & Gynecology	589	499	84.72	90	15.28	0	0.00
Private	52	32	61.54	20	38.46	0	0.00
ENT, Eye & Dental	291	150	51.55	140	48.11	1	0.34
Emergency	297	162	54.55	135	45.45	0	0.00
Paediatric	273	74	27.11	197	72.16	2	0.73
Orthopaedic	51	42	82.35	9	17.65	0	0.00

not only reduce development of AMR but will also reduce the antimicrobial consumption rate because self-limiting illnesses or conditions do not require antimicrobial treatment [22].

Stratified prescriptions by qualification of prescriber has shown Medical Officers to be the most common prescribers of ACCESS antimicrobials. Medical Officers are ideally the first to attend patients when they come to hospital. It is reassuring that presenting patients are more likely to be treated with the ACCESS group of antimicrobials when they first access this healthcare facility. The variation in prescribing practices across different departments and prescribers, more so in the absence of support by AST, underscores the importance of structured evaluation in order to determine targets for interventions such as education, training or mentorship on appropriate antimicrobial use among healthcare providers.

Metronidazole was the most frequently prescribed antimicrobial in the ACCESS category, followed by Co-amoxiclav. This is consistent with the WHO's global antimicrobial consumption report, which showed that these two antimicrobials were among the most frequently consumed worldwide [23].

Due to hospital procedural practice, some antimicrobials were prescribed on a hardcopy and later entered on the hospital digital system by Pharmacists. This observation can inform the hospital AMS committee; whom need to target and eradicate this practice and promote safe antimicrobial use and improved prescribing governance [24,25].

Our study has some limitations. Firstly, the analysis was based on one tertiary hospital serving the southern highlands zone of Tanzania. Therefore our findings are not generalisable. Future studies should include several hospitals (and those at lower levels) in order to provide a national picture. Secondly, antimicrobials that were unavailable in the hospital pharmacy were not recorded by the system, consequently missed in our analysis. However, with the existing full support of the NHIF through medical store department, we do not expect many missed prescriptions. Nevertheless, this calls for improving the systems to be able to capture all prescriptions.

Conclusion

Our findings suggest that the AWaRe classification provides a useful tool that can easily give insights into the patterns of antimicrobial use and prescribing practices in a health facility, and that the Southern Highlands Zone Referral Hospital in Tanzania generally adheres to the WHO AWaRe recommendations. Nevertheless, the utilization of culture and AST was unacceptably low. This indicates the necessity for promotion and training of prescribers (through continuing professional development) about the importance of diagnostic stewardship and the significance of rational antimicrobial use. It is also important to conduct periodic evaluations that will continuously inform the AMS team on the status and specific areas or groups of healthcare workers that require quality improvement interventions.

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Ethical approval

This study was conducted in accordance with the Declaration of Helsinki and had been reviewed and approved by the Mbeya Medical Research Ethics Committee (MMRec) of Mbeya Zonal Referral Hospital (Ref No. SZEC-2439/RA/V.1/92a). Patient's data were handled with utmost confidentiality and all patient and doctor identifiers were removed.

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Credit authorship contribution statement

Anthony Nsojo: Conceptualization, Data curation, Formal analysis, Methodology, Writing — original draft, Writing — review & editing. **Lutengano George**: Data curation, Formal analysis, Writing — review & editing. **Davance Mwasomola:** Data curation, Formal analysis, Writing — review & editing. **Joseph Tawete**: Data curation, Methodology, Writing — review & editing. **Christopher H. Mbotwa:** Writing — original draft, data analysis, Writing — review & editing, **Clement N. Mweya:** Writing — original draft, Writing — review & editing. **Issakwisa Mwakyula**: Conceptualization, Data curation, Formal analysis, Investigation, Writing — original draft, Writing — review & editing.

Conflict of interest statement

None declared.

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