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ORIGINAL RESEARCH

Inappropriate Antibiotic Use Among Inpatients Attending Madda Walabu University Goba Referral Hospital, Southeast Ethiopia: Implication for Future Use

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Background: Ethiopia is one of the countries where the healthcare system is not yet developed to the required level; hence, it is not uncommon that drugs, particularly antimicrobials, are inappropriately used for infections by any causative agents, with or without prescription, in combination or not, and, of more concern, without sensitivity tests. So, it was considered important to assess the magnitude of inappropriate antimicrobial use among inpatients attending Madda Walabu University Goba Referral Hospital, southeast Ethiopia.

Methods: A health institution-based cross-sectional study was conducted from September 2018 to April 2019. Patient folders from collaborating wards were reviewed for antibiotic use. Inappropriateness of a drug or its dosage, or both, was considered in reference to the Ethiopian national treatment guideline. The information obtained was analyzed using SPSS version 20. Patterns of prescription of antimicrobials for the hospitalized patients were analyzed using simple descriptive statistics.

Results: A total of 801 antibiotics were written as prescriptions to 471 clients, 228 (47.6%) of whom had received two or more antibiotics at the time of the study. Of the total prescribed antibiotics, 142 (30.1%) had an inappropriate prescription. Genitourinary tract infections accounted for 42 (30.4%) of the inappropriate prescriptions due to the wrong dose and drugs. Cephalosporins were the most extensively prescribed class of antibiotics, 24.4% of which were inappropriately prescribed. Intravenous formulations made up the largest proportion of prescriptions, at 335 (41.8%). The most commonly prescribed antimicrobials were cephalosporins, 178 (38%); nitroimidazoles, 115 (24.5%); and macrolides, 53 (11.3%), while ceftriaxone was prescribed in 249 (53%) and metronidazole in 123 (26.2%) cases.

Conclusion: Low dose, inadequate duration and empiric use of antibiotics were major causes of inappropriate use in the study area. Therefore, local antimicrobial sensitivity tests, antibiotic stewardship and following the national treatment guideline are recommended to overcome inappropriate antimicrobial use.

Keywords: antibiotic use, appropriateness, Goba Referral Hospital

Introduction

Antibiotics are substances existing in nature or fully or partially synthesized in a factory, which are used to kill or check the growth of microorganisms that cause infectious diseases.[1,2] Their development has been the most important advance in the prevention, control and cure of serious infections.[3,4] Nevertheless, the widespread and haphazard use of these drugs,[5,6] on top of poor practices related to disease prevention and control,

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has led to the development of resistance by many strains of microorganisms in many countries.[7] This can cause infections that are not easy to treat, which require costly drugs and longer hospital stays, and cause increased rates of illness and death.[8–10]

According to the latest reports, it is estimated that as many as 10 million excess deaths will result from antimicrobial resistance in the next 30 years, and worldwide economic productivity could be negatively impacted by as much as 100 trillion USD if applicable efforts are not put in place to contain this menace.[11–13] The rate at which resistant strains are developing today is far greater than the rate at which new drugs are being discovered to combat the challenge,[14] and this is the ultimate universal health issue of our time.[15]

Continuous evaluation of antimicrobial use is a useful strategy, as recommended by the WHO, for improving antibiotic use among patients to ensure the ongoing efficacy of antimicrobials and to control resistance and limit any detrimental effects on patients.[2,5] In Ethiopia, as in many other developing countries where health-care systems are not yet adequately formed to address health problems, antibiotics are used more frequently than any other drugs for both bacterial and non-bacterial infections and are often bought without prescription,[16] which is further compounded by empirical prescription without sensitivity testing.[17,18] Therefore, precise evidence on the pattern of antimicrobial use is vital to respond to the problem of antimicrobial overuse and potential resistance. Hence, the intention of this research is to define the magnitude of inappropriate use of antibiotics among inpatients attending Madda Walabu University Goba Referral Hospital (MWUGRH).

Materials and Methods

Study Design, Area and Period

A facility-based cross-sectional study was conducted at MWUGRH, which is situated 445 km from Addis Ababa, the capital city of Ethiopia, in the southeast part of the country, from September 2018 to April 2019. The hospital is a teaching hospital located in Goba town and is the only referral hospital for the southeast part of the country.

Sample Size Determination and Sampling Technique

A formula was used to determine the sample size required for estimating the relevant proportion of a single population. Taking 70% inappropriate antibiotic use (P=0.7), 95% confidence interval (z=1.96) and 4% marginal error, the sample size was

$$n = \frac{(z_{\alpha/2})^2 * P(1-P)}{d^2} = \frac{(1.96)^2 * 0.7 * 0.3}{(0.04)^2} \approx 504$$

After excluding 33 patients who had cards with incomplete information, the final sample size was 471. Patient cards were carefully chosen using a simple random sampling method within each ward and the cards were allocated proportionally to each ward (medical, surgical and gynecology/obstetric). All inpatient cards with an antibiotic prescription during the specified period were included, while incomplete patient cards, and cards for drugs other than antibiotics (antituberculosis, antifungal and antiviral agents) were excluded.

Data Abstraction Format

The format for data collection was based on WHO criteria[19,20] and American Society of Health System Pharmacists guidelines.[21] The tool for antibiotic use, in terms of the name of the antimicrobial prescribed and dosage regimen (dosage form, dose, route, frequency and duration of administration), was validated using the Ethiopian standard treatment guideline of 2010 for general hospitals; and the use of antibiotic combinations was noted. Sociodemographic characteristics and drug-related information, as mentioned above, were extracted from the records and entered on the data collection forms.

Appropriateness of Antibiotics

Antibiotic choice, dosage form, dose, frequency and duration were compared against the Ethiopian national treatment guideline to check antibiotic appropriateness. There is no ingrained formal guideline on antibiotic use in the hospital and use of the national guideline is not evident either. Furthermore, there is no established committee, such as a drugs and therapeutic committee or antibiotic stewardship committee, to safeguard antibiotic use in the hospital. This is further complicated by the absence of antibiotic susceptibility testing to check local resistance patterns.

Data Quality

One week before data collection, 5% of patient cards were examined as a pretest. The data collection format was translated into the local language (Afan Oromo) and back-translated to English to make sure that the consistency of the questionnaire was maintained. The entire data

collection tool was checked for possible errors and corrections were made as required. A suitable person (an experienced pharmacist) was engaged for patient card review.

Data Analysis

Descriptive statistics were used to fix the means and extents for the prevalence study. In addition, data entry and analysis were accomplished using SPSS version 20, and then the entered data were edited, cleaned and analyzed.

Results

Sociodemographic Characteristics

A total of 471 inpatient folders were reviewed, of which the medical ward accounted for 177 (37.6%, 95% CI 33.-1–41.6, followed by the surgical ward with 154 (32.7%, 95% CI 28.9–36.9) and the gynecology ward with 140 (29.7%, 95% CI 25.9–33.8). Among the included patients, the majority were female, accounting for 288 (61.1%, 95% CI 56.7–65.6). The age ranged from 15 to 90 years, with a median age of 27 years.

Prevalence of Antibiotic Use

Overall, 801 antibiotics were prescribed for 471 inpatients, of whom 228 (48.4%) received at least two during the study period. Most were intravenous antiobiotics, at 356 (76.4%, 95% CI 72.4–80), while only two patients received intramuscular antibiotics. One-hundred and ninety-four patients (41.2%, 95% CI 36.7–45.7) were on one antibiotic while the majority were on combination therapy, 277 (58.8%). The median number of antibiotics for each patient was two.

Indications for Antibiotic Use

Overall, 335 (71.1%, 95% CI 66.9–75.2) of 471 prescriptions were administered for therapy while 136 (28.9%, 95% CI 24.8–33.1) were for prophylaxis. As indicated in Table 1, cephalosporins were the most prescribed class of antibiotics (35.7%), with ceftriaxone accounting for all of this class (100%), followed by nitroimidazoles (22.3%), penicillins (11.04%) and glycopeptides (10.6%). When individual antibiotics were analyzed, ceftriaxone (47.6%) was the most prescribed, followed by metronidazole (28%) and vancomycin (10.6%). According to this study, genitourinary infection was the most commonly prescribed type of disease, accounting for 138 (29.3%), followed by skin and soft tissue infection, 87 (18.5%), and preoperative prophylaxis, 81 (17.2%) (Table 2).

Table 1 List of Antibiotics Prescribed to Hospitalized Patients Attending Madda Walabu University Goba Referral Hospital, Bale-Goba, from September 2018 to April 2019

Antibiotics	Frequency	Percent
Penicillins	**52**	**11.04**
Cloxacillin	35	67.3
Augmentin	17	32.7
Cephalosporins	**168**	**35.7**
Ceftriaxone	168	100
Nitroimidazoles	**105**	**22.3**
Metronidazole	105	100
Glycopeptides	**50**	**10.6**
Vancomycin	50	10.6
Fluoroquinolones	**18**	**3.8**
Ciprofloxacin	18	100
Cephal, nitroimidazoles	**16**	**3.4**
Ceftriaxone and metronidazole	16	100
Cephal, glycopeptides	**15**	**3.2**
Ceftriaxone and vancomycin	15	100
Cephal, macrolides	**14**	**3.0**
Ceftriaxone and azithromycin	14	100
Tetracyclines	**12**	**2.5**
Doxycycline	12	100
Cephal, nitro, macrolides	**11**	**2.3**
Ceftriaxone, metronidazole and azithromycin	11	100
Penicillins, macrolides	**10**	**2.0**
Ampicillin and erythromycin	10	100
Total	471	100.0

Note: Bold face indicates class of antibiotics.

Relevance of Antibiotic Use

With respect to the relevance of the antibiotic use, dosage and type of drug were checked, revealing that 329 patients (70%) had been prescribed an appropriate drug and dosage (dose, frequency and duration), while 142 (30.0%) were inappropriate because of the wrong drug, 56 (12%), or dosage form, 86 (18%), or both drug and dosage form. Cephalosporins and nitroimidazoles accounted for the highest level of inappropriate prescription (51.1%). Twenty-six patients (39.4%) with respiratory tract infections received inappropriate antibiotics, while patients

Table 2 Indications for Antibiotic Use Among Patients Attending Madda Walabu University Goba Referral Hospital, Bale-Goba, from September 2018 to April 2019

Antibiotics	Type of Infection/Prophylaxis							Total
	Skin and Soft Tissue	Genitourinary	Gastrointestinal	Bloodstream	Preoperative	Respiratory Tract	CNS	
Ceftriaxone	33	63	7	10	46	5	4	168
Metronidazole	32	22	10	8	26	7	0	105
Vancomycin	0	4	5	4	0	37	0	50
Cloxacillin	1	24	4	1	0	3	2	35
Ciprofloxacin	1	1	0	2	1	1	12	18
Augmentin	6	9	1	1	0	0	0	17
Ceftriaxone and metronidazole	3	0	2	0	2	9	0	16
Ceftriaxone and vancomycin	4	9	1	0	0	0	1	15
Ceftriaxone and azithromycin	1	5	3	3	0	2	0	14
Doxycycline	5	1	0	0	6	0	0	12
Ceftriaxone, metronidazole, azithromycin	0	0	1	4	0	0	6	11
Ampicillin and erythromycin	1	0	1	3	0	2	3	10
Total	87	138	35	36	81	66	28	471

Table 3 Appropriateness of Antibiotic Use Among Patients Attending Madda Walabu University Goba Referral Hospital, Bale-Goba, from September 2018 to April 2019

Antibiotics	Appropriate, N (%)	Incorrect Drug, N (%)	Inappropriate Dosage, N (%)	Total, N (%)
Ceftriaxone	127 (75.6)	13 (7.7)	28 (16.7)	168 (35.7)
Metronidazole	77 (73.3)	6	22 (21)	105 (22.3)
Vancomycin	36 (72)	9	5	50 (10.6)
Cloxacillin	21 (60)	7	7	35 (7.4)
Ciprofloxacin	12 (66.7)	1	5	18 (3.8)
Augmentin	9	4	4	17 (3.6)
Ceftriaxone and metronidazole	7	7	2	16 (3.4)
Ceftriaxone and vancomycin	9	3	3	15 (3.2)
Ceftriaxone and azithromycin	10	2	2	14 (3)
Doxycycline	8	1	3	12 (2.5)
Ceftriaxone, metronidazole, azithromycin	9	1	1	11 (2.3)
Ampicillin and erythromycin	4	2	4	10 (2)
Total	329 (70)	56 (12)	86 (18)	471 (100)

with preoperative prophylaxis had the lowest level of inappropriate prescription (17.3%) (Tables 3 and 4).

Discussion

The proper use of antibiotics will have a positive impact on reducing antimicrobial resistance development, morbidity and mortality, and improving the cost of healthcare. This study identified that the majority of participants received antibiotics. The majority of antibiotics were prescribed for infections (71.1%) and surgical prophylaxis (28.9%). In this study, 70% of patients received appropriate antibiotics. This result is is higher than the levels of 59.9% and 53% found in studies carried out in healthcare facilities in Ghana[22,23] and 49.9% in the USA,[24] while it is comparable to findings of 64.6% and 67.4% of proper antibiotic use in studies conducted in Benin and Vietnam.[5,25] It is different from the results of studies in Europe (30.1–35%)[26,27] and lower than a study in Ethiopia (81.5%).[28]

High consumption of antibiotics is directly related to incorrect use of antibiotics, increased drug resistance and

Table 4 Indication and Appropriateness of Antibiotic Use Among Patients Attending Madda Walabu University Goba Referral Hospital, Bale-Goba, from September 2018 to April 2019

Type of Diagnosis	Appropriate, N (%)	Inappropriate, N (%)	Total, N (%)
Genitourinary infection	96 (69.6)	42 (30.4)	138 (29.3)
Skin and soft tissue infection	65 (74.7)	22 (25.3)	87 (18.5)
Preoperative prophylaxis	67 (82.7)	14 (17.3)	81 (17.2)
Respiratory tract infection	40 (60.6)	26 (39.4)	66 (14.0)
Gastrointestinal infection	25 (69.4)	11 (30.6)	36 (7.7)
Bloodstream infection	24 (66.7)	12 (33.3)	36 (7.7)
CNS infection	13 (48.1)	14 (51.9)	27 (5.7)
Total	330 (70)	141 (30)	471 (100)

nosocomial infections.[29,30] Studies conducted in Vietnam and Turkey showed 30.8% and 46.7% of inappropriate prescription,[5,31] which is similar to the results of this study. Antibiotic use in the present study is much lower than in a study conducted in Pakistan, indicating 70% inappropriate use.[32]

In this study, the highest antibiotic use was seen in medical wards (38.6%) and the lowest in gynecology/obstetric wards (29.2%). This may be due to the high use of medical prophylaxis among medical patients. The majority of patients (47.1%) received two antibiotics, which is comparable with the study conducted in Ghana (42.6%).[23] The majority of antibiotics were administered via the intravenous route (74.9%), which increases the risk of unsafe needle use.[33]

Regarding the number of antibiotics used, the study conducted in Ghana showed that metronidazole, ampicillin/amoxicillin, gentamicin and cloxacillin were used commonly,[4,23] while ceftriaxone, metronidazole and azithromycin accounted for more than 50% of prescriptions in this study. These may be due to high usage during surgical prophylaxis and infection management. The use of carbapenems and glycopeptides in the participating wards in the hospital was low. This may reflect the high cost of purchasing these antibiotics. We have to use these antibiotics carefully in order to minimize the development of carbapenem-resistant Enterobacteriaceae and vancomycin-resistant *Enterococcus*, which are associated with poor clinical outcomes.[34]

Of all prescriptions, 40% were for treating infections, of which the majority were treated with ceftriaxone (53%). This is an indication of the number one usage of ceftriaxone as a first line agent for infections and the high prevalence of ceftriaxone-resistant isolates in the current hospital, which was indicated in another study (Mama M, Usman H, Hussen B, Mamo A. Bacterial profile and resistance pattern among patients attending Madda Walabu University Goba Referral Hospital, Southeast Ethiopia; Unpublished; 2020). In this study, ceftriaxone and metronidazole were commonly used for surgical prophylaxis, which is a common practice for patients undergoing caesarean section.[35] The high usage of metronidazole in the current study may aggravate healthcare-associated infections such as vancomycin-resistant *Enterococcus* infections.[36,37]

Limitations of the Study

The findings of this study cannot be generalized because it was conducted in a single hospital setting; in particular, these inpatients do not replicate the outpatient prescribing patterns.

Conclusion

In this study, a high prevalence of antibiotic use was identified, with high consumption by medical patients. Of all antibiotics, ceftriaxone and metronidazole were the most prescribed. There is inappropriate antibiotic use due to the wrong dose (low), duration, frequency and medications, which could be reduced by creating awareness in health professionals, developing and using institutional prescription guidelines, introducing local antibiotic sensitivity tests and establishing antibiotic stewardship committees.

Abbreviations

CI, confidence interval; MWUGRH, Madda Walabu University Goba Referral Hospital; USD, United States dollar; WHO, World Health Organization.

Data Sharing Statement

The datasets used in this study can be obtained from the corresponding author upon sensible application.

Ethics Approval

Ethical clearance was secured from the ethical review board of Madda Walabu University Goba Referral Hospital. A supporting letter was written to the hospital's Medical Director. Since this is a document review, no patient consent was needed. Anonymity was maintained during report writing.

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests.

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