ORIGINAL RESEARCH

Amoxicillin Utilization Pattern at Governmental Hospitals in Eastern Ethiopia

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Introduction: Penicillin is among the highly used antibiotics in most parts of the world, with amoxicillin being the most frequently utilized drug in the category. However, amoxicillin use has been found to deviate from standard treatment guidelines (STGs).

Objective: This study aimed to evaluate amoxicillin utilization patterns based on Ethiopian STGs criteria at four governmental hospitals in Harar town: Hiwot Fana Specialized University Hospital, Jugel Hospital, South East Command III Hospital, and Federal Harar Police Hospital in Eastern Ethiopia in 2016.

Methods: A hospital-based retrospective cross-sectional study was employed using medication records of patients who received amoxicillin in 2016 at four governmental hospitals from May 15 to June 30, 2018. A total of 502 medication records were proportionally allocated based on the ratio of consumption data of each hospital. Simple random sampling was employed to collect the required sample from the sampling frame. The collected data were entered into SPSS version 21 and analyzed using descriptive analysis.

Results: Amoxicillin was used in all age groups, including pregnant and lactating women. The majority (96.2%) of patients were from the outpatient departments. Complete blood count was the most laboratory investigation carried out in 24.9% whereas microbiological culture was not recorded at all. Top three indications include nonspecific upper respiratory tract infections (15.1%), pneumonia (13.5%) and dental problems (10.6%). Non-steroidal anti-inflammatory drugs (56.2%) were frequently co-administered agents. An appropriate utilization was made considering indication, dose, frequency and therapy duration in 23.9% as per the Ethiopian STG. The wrong indication (65.4%) was the prime reason for inappropriateness, followed by dose (14.6%) and duration of therapy (12.2%).

Conclusion: Amoxicillin utilization was appropriate in less than a quarter of patients. The wrong indication was the main reason for inappropriateness, predisposing to resistance development. Further studies identifying factors related to misuse and sensitivity tests should be the next steps.

Keywords: amoxicillin, utilization, antibiotics, resistance, appropriateness

Introduction

Antibiotics are the most commonly prescribed drugs worldwide,[1–4] and the misuse and overuse of antimicrobials is also a common problem worldwide.[5–7] The inappropriate use of medicines on a wide-scale can have a significant impact on health care costs and the quality of drug therapy and medical care, as well as being a primary contributor to the spread of antimicrobial resistance (AMR) and increased likelihood of adverse drug reactions and encouraging patients' inappropriate reliance on medicines.[8–12]

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The emergence and spread of AMR is a complex problem driven by numerous interconnected factors,[5] among which prior antimicrobial drug exposure is a vital risk factor for colonization and infection due to a drug-resistant pathogen.[13] Thus, pharmaco-epidemiological studies that evaluate individual exposure to antimicrobial agents are critical.[14,15] Drug use evaluation (DUE) is a system of ongoing, systematic, criteria-based evaluation of drug uses to ensure that medicines are used appropriately at the individual patient level. It might be drug/disease-specific and can be structured to assess the actual process of prescribing, dispensing, or administering a medication. The selection of agents for drug utilization research should be based on whether a drug is high-use, high-cost, or high risk.[16]

Penicillin, specifically amoxicillin, is one of the most frequently used categories of antibiotics worldwide.[17] Amoxicillin is an aminopenicillin that is active against *S. pyogenes* and many strains of *S. pneumoniae* and *H. influenzae*, which are among the common upper respiratory pathogens. The drug is effective in urinary tract infections, sinusitis, otitis media, acute exacerbations of chronic bronchitis, and epiglottitis. It is the most active of the oral β lactam antibiotics, effective against both penicillin-sensitive and penicillin-resistant *S. pneumoniae*. The addition of a β-lactamase inhibitor (clavulanate or sulbactam) extends the spectrum to β lactamase-producing *H. influenzae* and Enterobacteriaceae. The drug is remarkably nontoxic and most of the serious adverse effects are due to hypersensitivity.[18]

The European Center for Disease Control and Prevention (ECDC) reported that penicillin is the primary antibacterial agents used in wider regions of the European continent.[19] Report from studies conducted at primary healthcare facilities in Turkey,[20] Malaysia,[21] and Ethiopia[22] showed penicillin accounted for 29.2%, 30.7%, and 51.9% of the antibiotics prescribed, respectively. Results from primary healthcare facilities in Nigeria[23] and China[24] also showed amoxicillin was the most frequently prescribed penicillin, which accounted for 25.4% and 21.3% of the prescribed antibiotics. Research from Ethiopia at health centers of Somali Regional State (33.3%),[25] hospital of Southern part (16.4%),[26] Public Primary Healthcare Facilities in Addis Ababa (44.8%),[22] and Communities of Bahir Dar City Administration (64.4%)[27] reported amoxicillin utilization prescription was high. Moreover, studies from Uganda,[28] Indonesia,[29] Guatemala,[30] Greece,[31,32] and Mongolia,[33] further

augment the wider preference of using this drug internationally.[34] This high prescribing practice might increase the reliability of the community using this drug in self-medication practices.[26,35,36]

Inappropriate antimicrobial use has been quantified in various settings using numerous definitions; however, no established reference standard exists.[37] Yet, different working groups for chemotherapy have proposed key points for the appropriate use of antibiotics in hospital settings, among which prescribing drugs at their optimal dosing and appropriate duration, adapted to each clinical situation and patient characteristics.[38,39] There is also a wide consensus that the main factor driving AMR development is the overprescribing of antibiotics[40] leading to the highest consumption rate of antibiotics.[41,42] The more the antibiotics are used, particularly when misused, the greater the selective pressure placed on bacteria to acquire resistance genes; hence, the need to limit the use of these medicines to what is necessary and proper is critical.[43] Moreover, although there are national good prescribing practices and antimicrobial stewardship guidelines, these guidelines have not yet been implemented in practice. There are neither strict local rules, regulations, or antimicrobial use policies in such resource-limited settings,[44] overlocking antibiotics cost which account for 20–50% of drug expenditures.[45] Besides, as there are no studies showing amoxicillin utilization in the selected settings, the current study aimed at evaluating its utilization pattern based on Ethiopian standard treatment guideline (STG) criteria in governmental hospitals at Harar, Eastern Ethiopia.

Materials and Methods
Study Setting, Design, and Population
Harar is located 526 km East of Addis Ababa, the capital city of Ethiopia.[46] The study was conducted in four governmental hospitals: Hiwot Fana Specialized University Hospital (HFSUH), Jugel Hospital (JH), Federal Harar Police Hospital (FHPH) and South-East command III Hospital (SECIIIH). HFSUH is a tertiary care teaching hospital of Haramaya University and hosts the majority of patient attendees per day from the Harar town and nearby areas. JH is a regional hospital in Harari regional state. Whereas FHPH and SECIIIH are special government hospitals in which service is primarily delivered to police and military clients and their relatives. A hospital-based retrospective cross-sectional study was employed to

evaluate amoxicillin utilization patterns using medication records of patients who received the drug in 2016 from May 15 to June 30, 2018.

Sample Size and Sampling Techniques

Considering all hospitals as a single entity, the sample size was determined by using the single proportion formula n=$\frac{Z_\alpha^2 P(1-P)}{W^2}$

Where: n=sample size, Z=confidence level, P=point estimate of population W=maximum width tolerable error, q =1-p (failure rate) to determine the sample size, the Z statistics value =95% (1.96) with two-sided tolerable error (α) (W=5% or 0.05) and P=50% (0.5). P-value is taken as 50% for determining adequate sample size since there was no research on the topic selected.

Hence, n=$\frac{(1.96)^2*0.5(0.5)}{(0.05)^2}$

n=384

To increase the representativeness and address few methodological issues the sample size was adjusted to 502 medical cards.

Sampling Techniques

The aforementioned sample size was proportionally allocated by multiplying a correction factor obtained from the ratio of each hospital's amoxicillin consumption data to that of the total consumption of four hospitals.[44] Accordingly, medical records containing amoxicillin of 100, 200, 130, and 72 were allotted for HFSUH, JH, SCIIIH, and FHPH, respectively. Simple random sampling was employed to collect the required sample size from the sampling frame prepared from card numbers of prescriptions containing amoxicillin.

Study Variables

- Drug use evaluation
- Sociodemographic status of the patient
- Indication, dose, frequency, and duration of amoxicillin
- Co-administered medications
- Duration of inpatient hospital stay

Inclusion and Exclusion Criteria

Medication records of patients who were prescribed amoxicillin were included. Records with missing information from more than one criterion stated for analyzing appropriateness as well as those with incomplete sociodemographic status were excluded.

Data Collection

A preliminary study was conducted on a small number of medical records at Haramaya Hospital, and minor revisions were made on the structured data abstraction format. Next, data were collected retrospectively using the format from patient medication records.

Data Processing and Analysis

The collected data were entered into SPSS version 21 (SPSS Inc., Chicago, IL, USA) and checked for cleanness. Descriptive analysis was used to summarize the sociodemographic, clinical, and drug-related factors. The amoxicillin utilization was evaluated using the STG of Ethiopia for General Hospital Criteria (indication for use, dose, frequency, and duration).[47] Tabular and graphical presentations were used to summarize the findings.

Operational Definition
Appropriate

Appropriateness was defined based on the four parameters, ie, indication, dose, frequency, and duration of therapy of a specific disease. Therefore, proper utilization was correct if all four parameters were found to be appropriate.

Inappropriate

Incorrect prescribing in one of the four parameters, ie, indication, dose, frequency, and duration of therapy of a specific disease.

Indeterminate

When there was missed/unrecorded information in one of the four parameters, ie, indication, dose, frequency, and duration of therapy of a specific disease.

Results
Sociodemographic Characteristics of Patients

The study showed that most participants were female (58.4%) and in the age group of 25–49 years (50.6%). Information regarding body mass index (BMI), weight, and height were negligibly recorded in all study areas. Though it seems inconsistent, the drug was also used during pregnancy and lactating mothers (Table 1).

Among patients treated with amoxicillin, nearly half (n=259, 51.7%) of the patients were served in the Medical OPD followed by Pediatric OPD (n=89, 17.8%), Emergency OPD (n=77, 15.4%), and Gynecology and Obstetrics OPD (n=58, 11.6%) (Table 2). Complete blood count (CBC) was

Table 1 Sociodemographic Characteristics of Patients Who Were on Amoxicillin Therapy in Selected Governmental Hospitals of Eastern Ethiopia in 2016 (n=502)

Sociodemographic Variables		JH	FHPH	HFSUH	SECIIIH	Overall Freq (%)
Age (y)	1–9	34	17	37	12	100 (19.9)
	10–19	30	5	8	5	48 (9.6)
	20–24	24	13	18	13	68 (13.5)
	25–49	102	25	31	95	253 (50.6)
	≥50	10	12	6	5	33 (6.4)
	Total	200	72	100	130	502
Sex	Female	132	34	62	65	293 (58.4)
	Male	68	38	38	65	209 (41.6)
Pregnancy status	Yes	29	0	0	0	29
	No	103	32	54	0	189
Lactating status	Yes	2	0	2	0	4
	No	129	32	52	0	213

Abbreviations: HFSUH, Hiwot Fana Specialized University Hospital; FHPH, Federal Harar Police Hospital; JH, Jugel Hospital; SECIIIH, Southeast Command III Hospital.

Table 2 Wards and OPDs Where Patients Treated with Amoxicillin in Selected Governmental Hospitals of Eastern Ethiopia in 2016 (n=502)

Departments	JH	FHPH	HFSUH	SECIIIH	Overall Freq (%)
Medical OPD	69	29	43	118	259 (51.7)
Pediatric OPD	32	14	31	12	89 (17.8)
Emergency OPD	39	29	9	0	77 (15.4)
Gyn/obs OPD	56	0	2	0	58 (11.6)
Medical Ward	1	0	7	0	8 (1.6)
Pediatric Ward	0	0	5	0	5 (1.0)
Surgery	2	0	1	0	3 (0.6)
TB Clinic	–	–	–	2	2 (0.4)
ART Clinic	1	–	–	–	1 (0.2)
Total	200	72	100	130	502

Abbreviations: HFSUH, Hiwot Fana Specialized University Hospital; FHPH, Federal Harar Police Hospital; JH, Jugel Hospital; SECIIIH, Southeast Command III Hospital; OPD, outpatient department; Gyn/obs, gynecology and obstetrics; TB, tuberculosis; ART, antiretroviral therapy.

the most frequent laboratory investigation performed during treatment (Table 3). There was no discharge summary in the vast majority of patients treated with amoxicillin. Duration of hospital stay was less than one day in most cases. The treatment outcome was not documented in the majority of medical records (Table 4).

Amoxicillin Utilization Pattern

The top amoxicillin clinical indications include non-specific upper respiratory tract infections (URTIs) (n=76, 15.1%) followed by pneumonia (n=68, 13.5%) and dental problems (n=53, 10.6%) (Table 5). Paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs), including diclofenac, tramadol, and ibuprofen accounted for 56.2% (340) of the co-administered medications with amoxicillin therapy followed by antimicrobial agents such as

metronidazole, ceftriaxone, and azithromycin which accounted for 29.9% (181) (Table 6).

Drug Use Evaluation as per Ethiopian STG

According to Ethiopian STG drug use evaluation criteria, amoxicillin therapy was found appropriate in nearly one-fourth of patients treated in these hospitals (n=120, 24%) (Figure 1). Among the components of the evaluation criteria, the wrong indication was identified as a predominant reason for the inappropriate utilization of this drug (n= 219, 65.4%) (Figure 2).

Discussion

In this study, amoxicillin was used in all age groups including pregnant and lactating women. The majority

Table 3 Laboratory Tests Performed During Amoxicillin Therapy in Selected Governmental Hospitals of Eastern Ethiopia in 2016 (n=502)

Laboratory tests	JH	FHPH	HFSUH	SECIIIH	Overall Frequency (%)
CBC	79	5	29	12	125 (24.90)
Urine analysis	2	2	2	8	14 (2.78)
LFT	2	–	–	–	2 (0.4)
Chemistry	1	1	7	–	9 (1.8)
Stool examination	2	2		–	4 (0.8)
Serology	–	2	1	–	3 (0.6)
Blood film	–	–	–	–	–
Total	86	12	39	20	157

Abbreviations: HFSUH, Hiwot Fana Specialized University Hospital; FHPH, Federal Harar Police Hospital; JH, Jugel Hospital; SECIIIH, Southeast Command III Hospital; CBC, complete blood count; LFT, liver function test.

Table 4 Outcome of Amoxicillin Therapy in Selected Governmental Hospitals of Eastern Ethiopia in 2016 (n=502)

		JH	FHPH	HFSUH	SECIIIH	Overall Frequency (%)
Outcome of therapy	Cured	1	–	–	–	1 (0.2)
	Improved	3	–	8	–	11 (2.2)
	Not known	196	72	92	130	490 (97.6)
Total		200	72	100	130	502
Discharge summary statement	Yes	185	3	22	–	210 (41.8)
	No	15	69	78	130	292 (58.2)
Total		200	72	100	130	502
Duration of stay at hospital (day)	≤1	144	–	25	–	169 (33.7)
	2–5	41	–	1	–	42 (8.4)
	>5	6	–	4	–	10 (1.2)
	Not known	9	72	70	130	281 (56)
Total		200	72	100	130	502

Abbreviations: HFSUH, Hiwot Fana Specialized University Hospital; FHPH, Federal Harar Police Hospital; JH, Jugel Hospital; SECIIIH, Southeast Command III Hospital.

(96.2%) of patients were treated in the outpatient departments. Complete blood count was the most frequent laboratory investigation found in 24.9% of patient records whereas microbiological culture was not found in any of the records. Top three indications for prescribing amoxicillin were nonspecific upper respiratory tract infections (15.1%), pneumonia (13.5%), and dental problems (10.6%). Non-steroidal anti-inflammatory drugs (56.2%) were the most frequently co-administered agents. An appropriate utilization was made considering indication, dose, frequency, and duration of therapy in 23.9% as per the Ethiopian STG. The primary reason found for inappropriateness was the wrong indication (65.4%), followed by dose (14.6%), and duration of therapy (12.2%).

The administration of antimicrobials primarily depends on the Vivo bioavailability of the drug, in addition to the susceptibility of the bacteria. Other factors also influence the choice of antimicrobial medication, such as the age (infants, children), pregnancy/lactation, and the general state of the patient.[48] Hence, the common use of amoxicillin in this study might be attributed to its safety and spectrum of activity. It is a pregnancy category B approved drug by the US Food and Drug Administration (FDA) and is considered safe to be taken in any trimester of pregnancy. Clinical evaluations also revealed no association between exposure to the drug and incidence of major birth defects, miscarriage, or adverse maternal or fetal outcomes.[49–53] In addition, data from literature explained the presence of amoxicillin in breast milk is low with approximately 1% of the administered dose reaching the infants. A drug with a relative infant dose less than 10% is considered to be compatible with breastfeeding[54–56] that may further explain why high prescribing patterns of this drug in all populations.[57,58]

Table 5 Top Amoxicillin Indications in Selected Governmental Hospitals of Eastern Ethiopia in 2016 (n=502)

Indications	JH	FHPH	HFSUH	SECIIIH	Overall Frequency (%)
URTIs	13	23	7	33	76 (15.1)
Pneumonia	14	1	42	11	68 (13.5)
Multiple Indications	27	11	7	9	54 (10.8)
Dental problem	33	2	1	17	53 (10.6)
During/Post Delivery	47	0	2	0	49 (9.8)
Tonsillitis	11	4	3	16	34 (6.8)
Injury	22	2	1	4	29 (5.8)
Bronchitis	0	3	4	15	22 (4.4)
UTI	6	4	5	0	15 (3)
Tonsillo pharyngitis	8	0	6	0	14 (2.8)
Common cold	0	0	0	11	11 (2.2)
Conjunctivitis	0	10	0	0	10 (2)
AFI	3	2	3	0	8 (1.6)
Otitis media	4	1	2	0	7 (1.4)
PUD/Dyspepsia	0	1	4	1	6 (1.2)
Asthma	0	0	0	4	4 (0.8)
AGE	0	1	2	0	3 (0.6)
Others	12	7	11	9	39 (7.8)
Total	200	72	100	130	502

Abbreviations: HFSUH, Hiwot Fana Specialized University Hospital; FHPH, Federal Harar Police Hospital; JH, Jugel Hospital; SECIIIH, Southeast Command III Hospital; URTIs, upper respiratory tract infections; UTI, urinary tract infection; AFI, acute febrile illness; PUD, peptic ulcer disease; AGE, acute gastroenteritis.

Table 6 Top Co-Administered Drugs with Amoxicillin in Selected Governmental Hospitals of Eastern Ethiopia in 2016 (n=502)

Drugs	JH	FHPH	HFSUH	SECIIIH	Overall Frequency (%)
Diclofenac	66	22	13	55	156 (25.8)
Paracetamol	38	25	14	26	103 (17.0)
Metronidazole	50	2	16	8	76 (12.6)
Tramadol	54	5	1	–	60 (9.9)
Ceftriaxone	33	2	2	5	42 (6.9)
Omeprazole	7	5	8	9	29 (4.8)
Azithromycin	10	–	12	–	22 (3.6)
Cough syrup	2	1	–	19	22 (3.6)
Ibuprofen	12	4	–	5	21 (3.5)
Almetamine	–	2	–	17	19 (3.1)
Ciprofloxacin	1	13	3	–	17 (2.8)
Chloramphenicol	1	10	–	–	11 (1.8)
Ampicillin	8	1	–	–	9 (1.5)
Pitocin	9	–	–	–	9 (1.5)
Cimetidine	1	2	1	–	5 (0.8)
Doxycycline	2	1	1	–	4 (0.7)
Total					605

Abbreviations: HFSUH, Hiwot Fana Specialized University Hospital; FHPH, Federal Harar Police Hospital; JH, Jugel Hospital; SECIIIH, Southeast Command III Hospital.

Another finding was the majority (n=483, 96.2%) of patients treated with amoxicillin were from the outpatient departments (OPDs), with medical OPD the most frequent. Also, few patients (n=52, 10.4%) had a hospital stay greater than a day. These findings are likely the reasons for the unknown outcome of therapy in most patients, indicating less chance of revisiting the health facilities for follow-up of most ailments.

Considering laboratory services, routine but nonspecific investigations (CBC, urine analysis, and blood chemistry) were executed for a portion of patients treated with amoxicillin. However, there was no evidence that microbiological
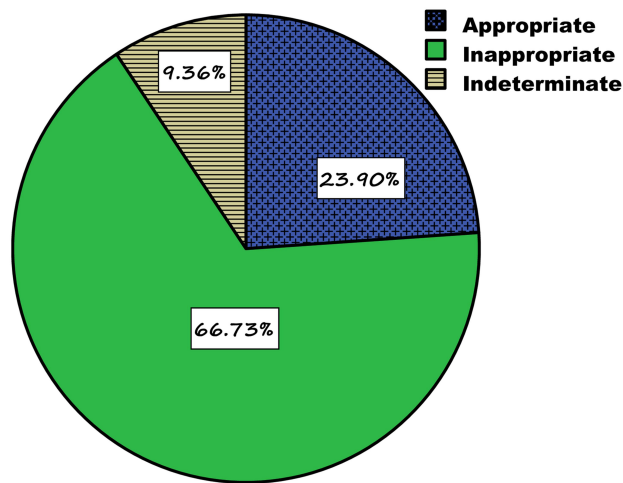
Figure 1 Appropriateness of amoxicillin indication in selected governmental hospitals (JH, HFSUH, FHPH, and SECIIIH) of Eastern Ethiopia in 2016.
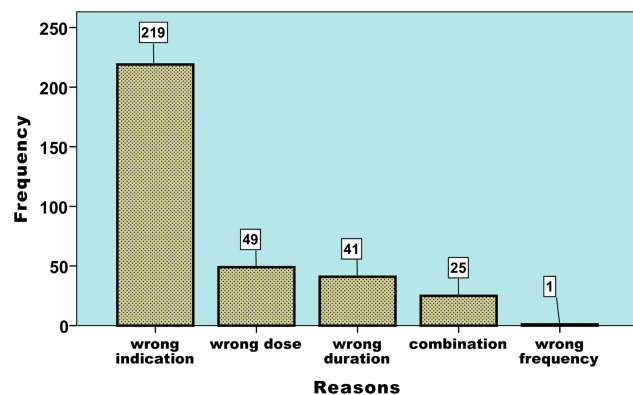

Figure 2 Reasons for inappropriateness in selected governmental hospitals (JH, HFSUH, FHPH, and SECIIIH) of Eastern Ethiopia in 2016.

culture and antibiogram tests were performed prior to the administration of the antimicrobial illustrating that antibiotics are being used empirically. It is clear that empirical therapy erodes the effectiveness of available antimicrobial agents which were previously effective and potentially leading to a post-antibiotic era. World Health Organization (WHO) recommends rapid microbial testing and definitive therapy to slow down the antimicrobial resistance.[59] The analysis of the pharmacokinetic nature of penicillin including amoxicillin shows that it is primarily eliminated unchanged in the urine,[60] yet simple urinalysis and renal function tests were found absent in >80% of cases. Similar practices of empirical therapy were reported in research conducted in public primary healthcare facilities in Addis Ababa, Ethiopia,[22] Bahir Dar city administration, Northwest Ethiopia,[27] and from a systemic review on antibiotic use evaluation in India.[45]

Regarding conditions for which amoxicillin was prescribed, non-specific URTIs (n= 76, 15.1%) was the most frequent indication. A similar primary indication for URTIs was reported in other towns of Ethiopia health facilities such as Addis Ababa,[22] Gondar,[61] Hawassa,[26] Bahir Dar,[35] and Dessie.[36] Moreover, the result from the Euro-Mediterranean region,[62] Malaysia,[21] and Yemen[63] presented an even greater utilization pattern of amoxicillin for nonspecific URTI.

Clinicians speculated most URT infections are of viral origin in nature, though bacteria can cause such infections in some instances.[64] Therefore, prescribing this drug for non-specific diseases without evidence of pathogenic organism further increases the perception by patients that amoxicillin treatment is the appropriate medication for all URT symptoms, increasing inappropriate self-medication practices. As verified by literature, the most common reasons to practice self-medication were the previous experience of clients and/or familiarity with treatments,[65,66] and among the most common group of diseases in which patients self-medicated were respiratory symptoms.[27,67–69] Moreover, among all the antibiotics misused in this practice, penicillin was ranked highest and amoxicillin was most frequently used in this group.[66,70]

Based on the Ethiopian STG, an indication for amoxicillin should specify in terms of dose, frequency, and duration considering previous patient history and severity of the disease. Accordingly, in this research, appropriateness was defined based on the four pertinent parameters, ie, indication, dose, frequency, and duration. An appropriate amoxicillin utilization was found in 120 (23.9%) of patients. While analyzing reasons for inappropriateness, the wrong indication was the leading practice observed in nearly two-thirds of patients treated with amoxicillin (n=219, 65.4%). Indication for non-specific URTI, common cold, asthma, delivery, and accident/injury were some of the wrong indications identified.

Although there was no study reported on the evaluation of amoxicillin utilization to compare, antibacterial with the same mechanism of action, ie, inhibition of cell wall synthesis was considered. Therefore, a research report from the pediatric ward of Jimma University Specialized Hospital indicated the crystalline penicillin utilization adhered to the STGs of Ethiopia and WHO guidelines for the majority of the parameters, while the inappropriateness was primarily exhibited with dose and duration of therapy.[71] Similar inappropriate utilization was reported

with a vancomycin therapy study in Iran[9] and third-generation cephalosporin utilization in India.[72]

It is interesting to note that maximum levels of antibiotics are used in the community and primary care setting, inappropriately for mostly self-limiting infections.[45] Health authorities have strongly encouraged physicians to decrease the prescribing of antibiotics to treat common URTIs since antibiotic usage does not significantly reduce recovery time for these illnesses which are often viral.[73] Some have advocated a delayed antibiotic approach to treating URTIs, which seeks to reduce the consumption of antibiotics while attempting to maintain patient satisfaction.[74]

In addition to non-specific indications, wrong dosage and duration were the causes for inappropriateness which is concerning because dose and duration are critical for penicillin-like amoxicillin since it is a time-dependent bactericidal antibiotic; once the concentration of the drug exceeds the minimum inhibitory concentration (MIC) of the organism, time of exposure (duration) is important for the effectiveness of the drug and since MICs for different bacterial species varies, the dose is dependent on the different bacterial pathogens.[75,76] Therefore, effectiveness is threatened by antimicrobial resistance that can arise from suboptimal dosing and discontinuation of the full course of treatment. Another important finding was the high usage of NSAIDs which could explain infections related to inflammation, pain, and pyrexia which were treated by such agents.[77]

Although different selection criteria and ways of antimicrobial utilization vary in different parts of the world, amoxicillin is still classified as one of the critically important antibiotics.[59,78,79] Hence, excessive and inappropriate use is potentially associated with the development of resistance as it was reported from countries with the highest rate of consumption.[41] Likewise, an increase in the difficulty to treat pathogens has made the selection of appropriate antibiotic therapy a real challenge for present-day clinicians.[80] Hence, it is worthwhile to implement a standard use of available agents to preserve the antimicrobials and contain AMR.

Conclusion and Recommendation

Amoxicillin was used in all age groups and populations including pregnant and nursing mothers. The majority of patients were treated in the medical OPD. Laboratory investigations were performed in less than one-third of patients without any evidence of microbiological culture and antibiogram before administration of amoxicillin. The most common indications were URTIs and pneumonia. Based on the Ethiopian STGs, appropriate utilization was found in nearly a quarter of patients. The wrong indications which were identified included utilization in nonspecific URTIs, common cold, asthma, delivery, and accident/injury. In addition, effectiveness may be compromised by AMR that can arise from suboptimal dosing and premature discontinuation of treatment. Besides, NSAIDs and antimicrobials were the most common co-administered agents. Further studies considering microbiological culture and sensitivity tests, as well as factors that contribute to inappropriate utilization need to be conducted in the study area.

Strength and Limitation

Amoxicillin use evaluation study was the only study conducted by considering patient characteristics in the four government hospitals of Harar town. Hence, it was possible to compare results from various perspectives, and a summary of findings enabled us to display the practice of utilization patterns of the drug in general in the selected town. Poor documentation in the facilities was the main limitation as the study used secondary data. Moreover, since the study is a descriptive cross-sectional, the underlying reasons why this problem exists could not be established at this time.

Data Sharing Statement

The data used to support the findings of this study are included in the article.

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki. Prior to beginning any data collection, ethical approval was obtained from the Institutional Health Research Ethics Review Committee (IHRERC), College of Health and Medical Sciences, Haramaya University with reference number: IHRERC/ 078/2017. Permission letters were also received from Harari regional health office and respective hospital administrators to conduct this study. Voluntary, informed, written, and signed consent was obtained from the administrator of each hospital. Since the study was conducted from secondary data (medication records), informed consent was not required from the patients or healthcare professionals themselves. Nevertheless, the confidentiality of the prescribers and patient's information was maintained in such a way that the data abstraction format was

kept anonymous and data obtained from the hospitals was solely used for the study purpose.

Author Contributions

All authors made a significant contribution to the work reported, starting from its conception, study design, execution, and acquisition of data, analysis, and interpretation. Besides, all took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors have declared that there is no competing interest.

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