


Appropriateness of Antibiotics Use and Associated Factors in Hospitalized Patients at University of Gondar Specialized Hospital, Amhara, Ethiopia: Prospective Follow-up Study

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Abstract

Background: Appropriate antibiotic use means that the patient receives the appropriate drug at adequate doses and duration for a susceptible pathogen. This improves the effectiveness of antibiotic therapy and prevents the emergence of resistant pathogens. Thus, this study aimed to assess the appropriateness of antibiotics use and associated factors among hospitalized patients.

Methods: A hospital-based prospective follow-up study was conducted in internal medicine. Data were collected by chart review and interview of prescribers and patients using a pre-tested questionnaire derived from RAND modified Delphi method. Appropriate antibiotic use means that the patient receives the drug based on culture result at the right time in adequate doses and duration. Frequencies and percentage distribution of dependent variables were analyzed. Moreover, bivariate and multivariate analyses were used to assess the factors influencing factors.

Result: Of the 303 study participants, the mean age was 44.36 ± 1.07 years and the majority 173 (57.1%) of the participants were females. The appropriateness of antibiotics use among hospitalized patients was 26 (8.6%). Males have used antibiotics more appropriately than females [5.99 (Adjusted odd ration (AOR) 95% CI 2.00-7.98)], while employed study participants were used antibiotics more appropriately than nonemployees [7.29 (AOR 95% CI 1.34-9.58)]. Moreover, patients who received antibiotics after blood culture [2.74 (AOR 95% CI 1.09-8.37)] and cerebrospinal fluid culture [5.82 (AOR 95% CI 1.84-5.63)] were used antibiotics more appropriately than patients who received antibiotics without culture. In addition, patients who believe that the prescribed antibiotics prevent complication of the disease [4.21 (AOR 95% CI 1.33-7.35)] were used antibiotics more appropriately than those who didn't understand the use of antibiotics.

Conclusion: The appropriateness of antibiotics use was very low in the study area. Patient gender, ethnicity, source of income, patient's belief in antibiotics, and specimen cultures were significantly associated with the appropriateness of antibiotics use.

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Keywords

appropriateness of antibiotics, infectious disease, factors, internal medicine, university of Gondar, Ethiopia

What Do We Already Know About This Topic?

- Over the past few years, even though there was a growing proportion of resistant microbes and a reduction in the discovery of new antibiotics, most antibiotics (90%) were used empirically. Despite this inappropriate antibiotic use in various parts of the world, there is limited data on the appropriateness of antibiotics use, especially in developing countries where inadequate diagnosis tests and limited antibiotics are available.

How Does Your Research Contribute to the Field?

- This finding improves the knowledge of prescribers and dispensers for appropriate diagnosis, prescribing, and counseling on infectious disease and antibiotics initiation, modification, and termination. This study also improves the principles of antibiotic therapy considering the restriction of prescription, empirical and definitive therapy initiation, and criteria and isolation of common pathogens.

What are Your Research's Implications Toward Theory, Practice, or Policy?

- The findings of the study will strengthen the appropriateness of antibiotics use, which improves antibiotic drug resistance and failure of therapy. Different stakeholders such as drug therapeutic committee, antimicrobial stewardship, and infection prevention committee, and other stakeholders should be participated in reviewing antibiotic utilization in different sites.

Introduction

Antibiotics are a class of antimicrobials that are used to treat or prevent infections caused by bacteria either by inhibiting the growth or killing and have saved millions of lives since the introduction of penicillin in the 1940s.¹ Appropriate antibiotic use means that the patients receive the appropriate drug at the right time in adequate doses and duration for a susceptible pathogen to meet the individual requirements.^{2,3} Appropriateness is evaluated by measuring the content and quality of prescribing decisions. It enhances effectiveness, safety, and patient outcomes. Studies conducted on the pattern of antimicrobials use in medical wards of some teaching hospitals showed that from 54% of the patient received antimicrobial therapy, more than 90% of antimicrobials were prescribed empirically.³⁻⁶ Studies validated the advantage of the utilization of both microbiological data and clinical assessment in the selection of initial broad-spectrum therapy and further therapeutic decisions. Before starting empirical antibiotic therapy, appropriate specimen collection for culture to identify the likely pathogens or imaging for further modification of the empiric antibiotics therapy to definitive therapy is mandatory.⁷⁻⁹

In a study, about 64% of hospitalized patients used antibiotics inappropriately due to either failure of isolation of pathogens or narrowing of the spectrum of antibiotics, of which 50–80% of them were preventable.^{10,11} A study stated

that from 51.9% and 60.86% patients who received empirical antibiotics, 37% and 95.65% were received definitive therapy after culture/imaging results obtained, respectively.^{6,11}

The major factors influencing appropriate antibiotic use include (culture 60%, income 45.7%, drug availability 97.1%, adherence 50%, and experience 54.3%).¹² Even though there was a growing proportion of resistant microbes and a reduction in the discovery of new antibiotics, about 90% of antibiotics used empirically.¹³ If these trends continue similarly, in developing countries including Ethiopia, infectious diseases become major killers. So, one obvious strategy is the assessment and management of antibiotic use problem which is a cornerstone to reduce resistance and optimize treatment outcome. Therefore, this study will generate valuable data for researchers, policymakers, and prescribers on the appropriateness of antibiotic use and factors at University of Gondar Comprehensive Specialized Hospital (UoGCSH), Amhara region, Ethiopia.

Methods

Study Area

The study was conducted in internal medicine ward (IMW), UGSH, Gondar, Amhara regional state, Northwest, Ethiopia. This is one of the largest hospitals in Ethiopia which provides all types of care, majorly focused on curative and rehabilitative service for more than 5 million people in Amhara

regional state. It is also a teaching and research center for different professionals and students. Currently, the hospital has more than 500 beds providing inpatient services at different wards. Internal medicine ward is the largest in-patient service with 120 beds.

Study Design and Period

A hospital-based prospective follow-up study was employed in IMWs from March 01 to June 30, 2020.

Population

Source of Population

All adult (18 years old and above) patients admitted to IMW at UGSH.

Study Population

All adults (18 years and above) used systemic antibiotics and admitted to internal medicine of UGSH from March 01 to June 30, 2020.

Inclusion Criteria

Adult patients (>18 years old) admitted in IMW with a minimum of 1 antibiotic for 24–48 hours were included.

Exclusion Criteria

Adult patients who were on Anti-TB drugs, unconscious, or on antibiotics for more than 48 hours before admission in IMW were not included.

Study Variables

Dependent Variable

Appropriateness of antibiotics use (Drug initiation, Dose adjustment, Route of administration, Duration, and De-escalation) among hospitalized patients.

Independent Variables

Patient and prescriber related factors. Age, gender, occupation, education, religion, ethnicity, marital status, residence, culture values, site of infection, professional experience, and use of national guideline (NG).

Sample Size Determination

The sample size was calculated based on a single population proportion formula with the assumption of 50% as a proportion (p) of patients with appropriate antibiotics use, at 95% confidence level and Margin of error (d) = 5%.

The source population (N) = 964, then
So, estimated sample (n) = $\frac{(Z\alpha/2)^2 \times P(1-P)}{d^2}$, n = 384.

Then, corrected estimated sample size = $\frac{N \times n}{N+n} = \frac{964 \times 384}{964+384} = 275$.

Finally, by adding 10% contingency, a total of 303 samples were included in the study.

Sampling Technique

Patients that were admitted to IMW and had one or more antibiotics were assigned to have a code Number based on admission time order. The first sample that fulfills the inclusion criteria were selected based on a lottery method from a code Number 1 or 2 (since 'k' = 2). The first sample selected was code Number 2, and then every second patient was taken as a sample using the systematic sampling method. A sample (303) patients were selected within 4 months of the study period from a total of 778 patients taking antibiotics.

Data Collection Procedure and Intervention

The data collection tool was derived from RAND modified Delphi method and pieces of literature. RAND modified Delphi method procedure was developed a quality indicators on patient level, which contains 9 quality indicators. From these, five quality indicators in RAND modified delphi method were selected for this research. (1) take culture from suspected sites of infection, (2) prescribe empirical antibiotics therapy according to NG, (3) change empirical to pathogen-directed therapy, (4) adapt antibiotics dosage to renal function, and (5) switch from intravenous (IV) to oral therapy.¹⁴⁻¹⁸

The questionnaire was pre-tested in Bahir Dar Felege Hiwot specialized hospital for its applicability on 5% (20) patients. The data collectors were trained on the protocol, patient and prescriber interview, and chart review systems. Amendment of any inconsistency was made by the principal investigator.

Patient interview on consent, patient demographic data, and adherence; and prescriber interview for demographic data, professional experience, and diagnosis methods. Another method was medical chart review, which enables us to get data on diagnosis methods, types of disease, and prescribed antibiotics.

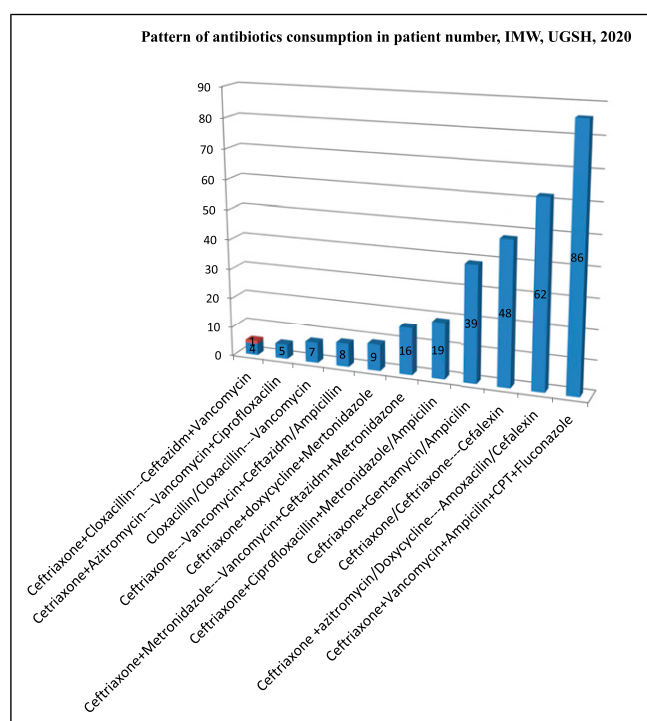
The collected data was checked, assessed, and classified based on Ethiopian NG 2014, and Infectious disease society of America (IDSA) guidelines. Follow-up focused on 5D (Drug choice, Dose, Delivery, Duration, and De-escalation) and hospital outcomes were evaluated daily.

Statistical Analysis

Descriptive Statistics and inferential tests such as multivariate logistic regression was used to characterize and investigate the association between the appropriateness of antibiotics use and independent variables. To avoid spurious associations, variables that showed significant association in bivariate

Table 1. The Pattern of Disease.

Indication of the Antibiotics	Inappropriate N (%)	Appropriate N (%)	Total N (%)
Pyrogenic meningitis	27 (9.7)	8 (30.8)	35 (11.6)
Urinary tract infection	23 (8.3)	4 (15.4)	27 (8.9)
Bone and joint infection	8 (2.9)	3 (11.6)	11 (3.6)
Abscess	11 (4)	2 (7.7)	13 (4.3)
Spontaneous bacterial peritonitis	17 (6.1)	2 (7.7)	19 (6.3)
Aspiration pneumonia	21 (7.6)	2 (7.7)	23 (7.6)
Community-acquired pneumonia	78 (28.2)	2 (7.7)	80 (27.56)
Surgical site infection	1 (.4)	1 (3.8)	2 (.7)
Ineffective endocarditis	2 (.7)	1 (3.8)	3 (1)
Parapneumonic effusion/emphysema	3 (1.1)	0	3 (1)
Hospital-acquired pneumonia	67 (24.2)	0	67 (22.1%)
Neutropenia	7 (2.5)	0	7 (2.3)
Unknown infection	12 (4.3%)	1 (3.8%)	13 (4.3)
Total cases	277 (100%)	26 (100%)	303 (100%)

**Figure 1.** Pattern of antibiotics consumption in patient number, IMW, UGSH, 2020.

analysis were taken and interred to multivariate analysis. Crude odd ration (COR) and Adjusted odd ration (AOR) were calculated to check the statistical association.

Result

The Pattern of Disease

The most common possible infectious disease was pneumonia in terms of community-acquired pneumonia 80 (27.56%), and

hospital-acquired pneumonia 67 (22.1%). The third most common 35 (11.6%) and the first most appropriately treated possible infectious disease was pyrogenic meningitis 8 (30.8%) while the least appropriate was hospital-acquired pneumonia and Parapneumonic effusion/emphysema (Table 1).

The Pattern of Antibiotics Use

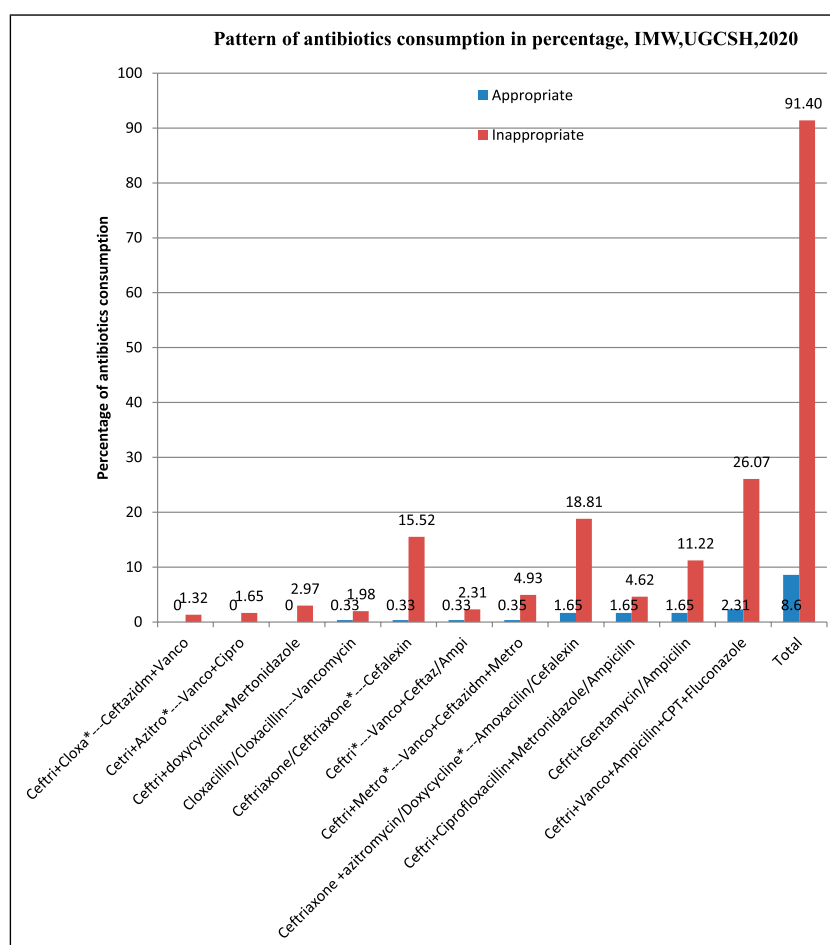
A total of 664 antibiotics were prescribed and 77.60% were given to the patients intravenously. About 87.6% of patients were on combination antibiotics. The average number of antibiotics prescribed per patient was $2.2 \pm .89$ with a median duration of 15 days. Of all patients, 53 (17.5%) and 250 (82.5%) were received empirical antibiotics without culture result simply by clinical evaluation and laboratory investigation respectively. The most common antibiotics prescribed were ceftriaxone+ Vancomycin +ampicillin + cotrimoxazole (CPT) + fluconazole 86 (28.38%), ceftriaxone + azithromycin/doxycycline—Amoxicillin/Cefalexin 62 (20.46%), and ceftriaxone/ceftriaxone—Cefalexin 48 (15.84%), respectively (Figure1).

Quality Indicators for the Appropriateness of Antibiotics Use

Based on RAND Modified Delphi method, which was used to measure the appropriateness of antibiotics use in hospitalized patients. According to RAND Modified Delphi method, 172 (56.8%) of patients received empirical antibiotics within 24 hours of evaluation, 130 (42.9%) of patients received empirical antibiotics according to NG, 46 (15.2%) of patients had performed culture from the suspected site of infection, 27 (8.9%) of patients received pathogen-directed therapy based on culture results, 167 (55.1%) of patients received antibiotics with adjusted dose and dosing interval

Table 2. Quality Indicators for the Appropriateness of Antibiotics Use.

Appropriateness of Antibiotics Use	N (%)	
	Yes	No
1. Patients received empirical antibiotics within 24 h of evaluation	172 (56.8)	131 (43.2)
2. Patients received empirical antibiotics according to NG	130 (42.9)	173 (57.1)
3. Culture performed/imaging from the suspected site of infection	46 (15.2)	157 (84.8)
4. Patients received pathogen-directed therapy based on confirmation	27 (8.9)	276 (91.1)
5. Adapt antibiotics dose and dosing interval based on renal function	167 (55.1)	136 (44.9)
6. Definitive antibiotics therapy switch from intravenous to oral therapy	82 (27.1)	221 (72.9)
Total	26 (8.6)	277 (94.1)

**Figure 2.** The appropriateness of antibiotics use in IMW, UGSH, 2020. *— = empirical antibiotics change to definitive antibiotics.

based on renal function, and 82 (27.1%) of patients antibiotics switched from IV to oral therapy. The present finding revealed that only 26 (8.6%) of the patients were receiving appropriate antibiotics (Table 2). The current finding showed that ceftriaxone + vancomycin + ampicillin + CPT + fluconazole 2.31%, and ceftriaxone + gentamycin/ampicillin 1.65% were relatively the most frequent appropriately used antibiotics (Figure 2).

Socio-demographic characteristics and associated factors on appropriate of antibiotics use. In this study, from all hospitalized patients received antibiotics, 303 (38.95%) of them were selected as study participant in the IMW at UoGCSH, Ethiopia. Half of the patients were female and similarly half of them had primary educational level. The mean age of the study participants was 44.36 ± 1.07 years (18–95 years). The majority of patients (38.28%) were in the age range of

Table 3. Demographic Characteristics and Associated Factors for Appropriate Antibiotics Use.

Patient and Prescriber-Related factors		Appropriateness		Crude Odds Ratio 95%CI	Adjusted Odd Ratio 95%CI
		Appropriate N (%)	Inappropriate N (%)		
Patient gender	Male	18 (13.8)	112 (86.2)	3.32 (1.39-7.89)	8.74 (2.00-7.98)
	Female	8 (4.6)	165 (95.4)	1	
Patient age category	18–34 years	8 (6.9)	108 (93.1)	.78 (.28-2.16)	
	35–50 years	10 (10.5)	85 (89.5)	1.24 (.47-3.28)	
	Above 50 years	8 (8.7)	84 (91.3)	1	
Residency	Rural	14 (7.3)	178 (92.7)	.65 (.29-1.46)	
	Urban	12 (10.8)	99 (89.2)	1	
Ethnicity	Amhara	17 (6)	266 (94)	.08 (.03-.21)	.05(.01-.23)
	Others	9 (45)	11 (9)	1	
Marital status	Single	6 (9.7)	56 (90.3)	1.14 (.33-3.94)	
	Married	15 (8.2)	168 (91.8)	.95 (.33-2.73)	
	Others	5 (8.6)	53 (91.4)	1	
Educational level	Not read or write	5 (4.7)	101 (95.3)	.22 (.07-.67)	4.36 (.60-32.23)
	Elementary school	10 (7.3)	127 (92.7)	.35 (.14-.88)	.69 (.16-3.02)
	High school and above	11 (18.3)	49 (81.7)	1	
Source of income	Farming	5 (3.4)	140 (96.6)	.48 (.15-1.56)	.32 (.05-2.06)
	Merchant	14 (24.6)	43 (75.4)	4.37 (1.65-11.60)	7.29 (1.34-9.58)
	Monthly salary	7 (6.9)	94 (93.1)	1	
Health assurance-	Free services	18 (14.1)	110 (88.7)	3.42 (1.44-8.13)	1.70 (.42-6.98)
	Direct payment	8 (4.6)	167 (95.4)	1	
Patient belief on antibiotics	Prevent seriousness	11 (12.2)	79 (87.8)	8.63 (1.09-8.69)	4.21(1.33-7.35)
	Provide relief	14 (9.3)	136 (90.7)	6.38 (.82-49.62)	5.96 (.29-23.43)
	Not understand	1 (1.6)	62 (98.4)	1	
Type of specimen	Blood	6 (30.0)	14 (70)	9.54 (5.31-11.98)	2.74(1.09-8.37)
	CSF	9 (40.9)	13 (59.1)	11.57 (9.25-17.77)	5.82(1.84-5.63)
	Other body fluids	6 (21.4)	22 (78.6)	12.44 (3.51-14.06)	1.33(1.92-6.86)
	No specimen	5 (2.1)	228 (97.9)	1	
Prescriber gender	Male	18 (8)	208 (92)	1.34 (.56-3.22)	
	Female	8 (10.4)	69 (89.6)	1	
Prescriber age	20–34 years	22 (8.5)	238 (91.5)	1.11 (.36-3.40)	
	35–44 years	4 (9.3)	39 (90.7)	1	
Prescriber experience	Practitioner (<1 y)	8 (4.5)	171 (95.5)	3.63 (1.53-8.64)	2.06 (.54-7.80)
	Professional (≥1 y)	18 (14.5)	106 (85.5)	1	
Prescriber visit in 48hrs	Visited	19 (10.3)	165 (89.7)	1.84 (.75-4.53)	
	Not visited	7 (5.9)	112 (94.1)	1	
Prescriber belief on drug	Needs training	5 (6.4)	73 (93.6)	.67 (.24-1.83)	
	Feels confidence	21 (9.3)	204 (90.7)	1	

(18–34) years. Sixty percent of patients were from rural areas. Factors that were significantly associated with the appropriateness of antibiotics use were patient-related factors such as the source of income, ethnicity, gender, patient belief on antibiotics, and type of specimen for culture/gram stain (Table 3).

Discussion

A checklist derived from RAND Modified Delphi method was available at the patient's bedside as a reminder of the criteria for evaluating the appropriateness of antibiotics use and associated factors.^{19,20} Forty percent of hospitalized patients were receiving antibiotics, from this 77.60% were

given intravenously. The average number of antibiotics prescribed per patient was $2.2 \pm .89$. A similar study conducted in 11 African countries showed that 46.8% of patients were received antibiotics, from this 25% of patients were received injections, and the average number of drugs per patient was 3.1.²¹

The current finding, about 26 (8.6%) of patients were received appropriate antibiotics in IMW. This result was lower than similar studies conducted in Switzerland 63%,²² in Lesotho 32.2%,¹⁷ and Kenya 53.6%.²³ This may be due to differences in the hospital setting, presence of local guidelines, the experience of the prescriber, characteristics of the patients such as income, previous exposure or belief on antibiotics, residency, and educational level.

Out of three hundred three patients, 172 (56.8%) were received empirical antibiotics within 24 hours. This antibiotics utilization rate was higher than a similar study conducted in Switzerland (19.4%).²⁴ From all patients received empirical antibiotics, 130 (42.6%) of patients were received according to NG. This is lower than the previous study conducted in Switzerland (85%).²⁵ Clinical parameters alone have not been helpful for the prediction of bacteremia and thus are not useful guides for the identification of pathogens. Thus, antibiotics based on the likely pathogen, which can be identified by culture or imaging helps to control antibiotics overuse, reduce resistance microbes, and prevent the spread of infection by guiding the definitive antibiotics therapy.²⁶ Before the beginning of empirical antibiotic therapy, it is crucial to obtain appropriate specimens for culture or imaging from the suspected site of infection. Specimens collected after antibiotics initiation, the causative agent and sensitivity result may not proliferate from the laboratory as antibiotics use decreases the yield of cultures.²⁷ In this study, about 46 (15.20%) of patients' samples were received. This is lower than a similar study done in Switzerland (69%). But, nearly equals to a study conducted in Vermont (15.14%),²⁶ and in Nigeria (20.53%).⁶ This may be due to the fact that most of the prescribers prescribe antibiotics with a feeling of confidence based on expert's opinion and NG, which depends on clinical evaluation and prevalence of the local disease. Based on the isolation of likely causative agent from the above culture result or imaging, the empirical antibiotics were modified to pathogen-directed therapy in 27 (8.9%) patients. The current study is lower than a study conducted in India (47.27%),²⁸ and Switzerland (31%).²⁴

Appropriate dosage adjustment for drugs in renal failure can optimize efficacy and help in reducing toxicity and cost.^{29,30} This is because the dose and toxicity of antibiotics are dependent on renal excretion.³¹ In this study, the dose and dosing interval of those antibiotics were adjusted for 167 (55.1%) patients. Usually, IV antibiotics are shifted to the oral route of antibiotics after 3–5 days of therapy when the patient shows improvement in clinical parameters.³² In the current study, definitive IV antibiotics were switched to oral administration in 82 (27.1%) patients. Empirical IV antibiotics therapy in 73% of patients did not change to oral route due to insufficient clinical improvements within 3–5 days of therapy and impossible to change into oral. This finding is lower than similar studies conducted in Jimma University specialized hospital, (67.6%),³³ and in Switzerland (38%).³⁴ The main reasons were the absence of clinical improvement. On the other side, in Netherland, 54% after a median of 6 days.³⁵

The 5 most frequently used antibiotics in the current study were ceftriaxone + vancomycin + ampicillin + cotrimoxazole 86 (28.38%), ceftazidime + Azithromycin 62 (20.46%), ceftriaxone or ceftriaxone changed to Cefalexin 48 (15.84%) and ceftriaxone + gentamycin/ampicillin 39 (12.87%), and ceftriaxone + ciprofloxacin + metronidazole 19 (6.27%). Additionally, the most frequently appropriately prescribed antibiotics in this study were ceftriaxone, which was changed to

Vancomycin plus Ceftazidime or ampicillin while the most inappropriately used drug was Ceftriaxone plus Metronidazole.

Finally, the factors that were significantly associated with the appropriateness of antibiotics include patient gender, ethnicity, source of income, patient belief on prescribed antibiotics, and type of specimen for culture. Studies show that experiences on clarifying or communication skills influences the appropriateness of antibiotics use 54.3% (¹³). In this study, males have used antibiotics 5 times more appropriate than female patients [5.00 (AOR 95% CI 2.00–7.98)]. This appropriateness may be due to males may have good communication skills on reporting a chief complaint, aware of health-seeking behavior, and adhered to counseling including antibiotics taking and investigations. Ethnicity is the other factor that influences appropriate antibiotics use in this study. Patients who believe that the prescribed antibiotics prevent seriousness were used antibiotics more appropriately than those who didn't understand the use of antibiotics [4.21 (AOR 95% CI 1.33–7.35)]. This may be due to patients who believe the prescribed antibiotics prevent further exacerbation of the disease will adhere and provide information regarding the treatment outcome when compared to those who didn't understand their antibiotics. Different types of specimens or imaging for diagnosis confirmation were also significantly associated with the appropriateness of antibiotic use. Studies show that culture influences the appropriateness of antibiotics 60% (¹³). Patients who received antibiotics based on blood sample had 2.74 times more appropriate antibiotics use than patients who had no specimen/imaging [2.74 (AOR 95% CI 1.09–8.37)] and patients who received antibiotics based on cerebrospinal fluid analysis had 5.82 times more appropriate antibiotics use than patients without any specimen/imaging [5.82 (AOR 95% CI 1.84–5.63)]. Moreover, taking other body fluids for diagnoses such as urine, pleural fluid, and peritoneal fluids was 1.33 times more appropriate than patients without any specimen/imaging [1.33 (AOR 95% CI 1.92–6.86)]. Studies show that source of income influences 45.7% the appropriateness of antibiotics use (¹³). In this study, income had a significant association with the appropriateness of antibiotics use. Patients who were merchants had 7.29 times more appropriate antibiotic use than patients who were monthly salary [7.29 (AOR 95% CI 1.34–9.58)].

The Strength and Limitation of the Study

The strength of this study was a prospective follow-up study that generates accurate and current data directly from the patient and the prescribers. In addition to this, this is the only research in Ethiopia on the title of the appropriateness of antibiotics use and associated factors, which covers the principles of appropriate antibiotic prescribing and contributing factors in hospitalized patients. The other strength was the sample size which was enough on prospective study, duration, and use of different IDSA guidelines. While the limitations of the research were poor medical documentation

on the patient chart, resident unavailability in the ward, and poor culture-based therapy practice. The other limitation of the research was a single-centered study, which limits this result to generalization. Further research may need to identify resistance pathogens and ineffective drugs. Both quantitative and qualitative studies with detailed and longitudinal appropriate antibiotics use at different sites and times should be encouraged.

Conclusion

Based on modified Delphi methods, this study indicates that the appropriateness of antibiotics use was very low. Achievement of appropriate antibiotics use depends on initiation of competent antibiotic therapy, culture sensitivity testing, dose adjustment, and IV to Po conversion were very necessary to improve appropriate antibiotic use practice. The most frequent and appropriately prescribed antibiotics were Ceftriaxone plus Vancomycin plus ampicillin. The factors that were significantly associated with the appropriateness of antibiotics use include patient gender, ethnicity, source of income, patient belief on prescribed antibiotics, and type of specimen for culture. Most of the patients were treated inappropriately with ceftriaxone plus metronidazole followed by ceftriaxone alone. The types of inappropriate antibiotic use were an inappropriate choice, inappropriate indication, and inappropriate application (route of administration).

Recommendation

To strengthen the appropriateness of antibiotics use, which reduces the emergence of resistance pathogen and failure of therapy, different stakeholders should participate. Hospital management: The hospital management that contain senior health care providers should have prepared local guidelines based on local data. Prescribers: Prescribers should emphasize culture values that will indicate the presence or severity of infection rather than depending on clinical evaluation. Antimicrobial stewardship: The median duration of antibiotics was 15 days, this shows longer hospital stay that recommended by infectious diseases guidelines. So, the antimicrobial stewardship should be strengthened and focuses on appropriateness of antibiotics use.

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Declaration of Conflicting Interests

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Ethics Approval and Consent to Participate

Ethical approval was obtained from the University of Gondar research ethical review committee, School of pharmacy (Ref: SOPs 0441/18) and then University of Gondar specialized hospital, department of internal medicine, was giving consent on the letter. Participants of the study were asked for consent before participating in the study. During the consent process, they were provided with information regarding the purpose of the study, why and how they are selected to be involved in the study, and what is expected from them, and that they can withdraw from the study at any time. Participants were assured about the confidentiality of the information obtained in the course of the study in that: no personal identifiers were used and the data was analyzed in aggregates.

Availability of Materials and Data

The data sets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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