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Research Article

Evaluation of Vancomycin Utilization in the Medical and Gynecology Wards of Felege Hiwot Comprehensive Specialized Hospital, Northwest Ethiopia

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Background. Drug use evaluation is an approach that focuses on evaluating and optimizing drug use practices to achieve the best possible patient outcomes. The purpose of this study was to assess the appropriateness of vancomycin usage patterns and their practical application in hospitalized patients. *Methods*. An institutional-based descriptive retrospective cross-sectional study design was carried out among 265 hospitalized patients from May 1, 2022, to July 30, 2022. The study participants were selected using a simple random sampling method. *Result*. Among the 265 study participants, 60.4% were male respondents, while 86.8% of vancomycin was administered for treatment; however, 13.2% was administered for prophylaxis. In addition, 41.9% and 27.5% of vancomycin were ordered for treatment of meningitis and pneumonia, respectively. The culture was performed for only 17.4% of patients, and 82.6% of vancomycin was used for empiric therapy. Most (66.8%) of vancomycin was given in the dose range of 800–1000 mg. The finding indicates that 57.36% and 39.25% were due to incorrect doses and durations, respectively. Only 17.4% of patients had sensitivity tests. *Conclusions*. Vancomycin inappropriateness was common with the indication, dose, frequency, and duration of therapy according to the guidelines. Vancomycin was mostly indicated as empiric therapy, even though the sensitive test was performed in a small amount. Given the widespread use of vancomycin as an empiric drug, its utilization should be monitored closely. Therefore, the usual sensitive test is recommended to identify those intermediate and resistant results and to predict the outcomes of the treatment.

1. Introduction

Antibiotic use has significantly improved public health by reducing disease progression and death [1]. The long-term health and longevity of populations improved as a result of significant advances made in the combat of infectious diseases during the 19th and 20th centuries, which is remarkable. However, this was not without challenges [2].

Antimicrobial resistance (AMR) is one of the dangerous challenges affecting public health that results from the inappropriate and excessive use of antibiotics [3]. Because infections caused by viruses, bacteria, and protozoa are no longer treatable with readily accessible antibiotics, many patients experience suffering as a result of AMR [4].

An increase in the expense of diagnosis and treatment (consultations, infrastructure, screening, cost of equipment, and pharmaceuticals) and a reduction in productivity (loss of money, decreased worker productivity, and time spent with family) are potential outcomes according to a WHO report. It also obviously imposes a significant additional human burden in terms of pain, decreased daily activities, and psychosocial costs [5].

Focusing on quality assurance is crucial, and it starts with licensing and certifying healthcare professionals in all settings. This is essential to guarantee the efficient use of antibiotics, which are in great demand in nations such as Ethiopia, where the burden of infectious diseases is high and the practice is reportedly substandard, resulting in serious AMR infections [3, 6].

WHO suggested an alternate strategy for carefully assessing medicine use in healthcare facilities to identify inappropriate uses and promote rational medicine use through drug and therapeutic committees [7]. A drug use evaluation (DUE) or drug use review (DUR) is an approach that will help guarantee adequate medication use through an ongoing, systematic, and criteria-based program of medicine use review to ensure appropriate medicine use [7, 8].

The Hospital Infection Control Practices Advisory Committee (HICPAC) and the Centers for Disease Control (CDC) developed guidelines for use that were based on the presence of vancomycin-resistant enterococci (VRE) [9–11]. Following modified HICPAC criteria, indications for the use of vancomycin were evaluated as either appropriate or inappropriate. Based on the guidelines, vancomycin inappropriate use is subdivided into five: empiric therapy without risk factors, continued empiric use without additional culture evidence of Gram-positive infections, treatment of methicillin-susceptible *Staphylococcus aureus* (MSSA) infections without a history of beta-lactam antimicrobial allergies, treatment in response to a single positive blood culture, while other blood cultures taken at the same time frame are negative, and use as systemic or local prophylaxis for infections [12].

In most hospitals and health facilities, the use of vancomycin is considered inappropriate. To avoid the occurrence of VRE, it is now vital to reduce overall exposure to vancomycin due to recent introduction of *S. aureus* strains with decreased susceptibility to the antibiotic [13].

According to the National Nosocomial Infections Surveillance System of the Centers for Disease Control and Prevention (CDC), VRE caused 40% of infections in US hospitals in 2012. Studies show that VRE is responsible for 10–30% of all nosocomial infections in the US [14].

According to a nationwide survey to map antibiotic resistance in Ethiopia, VRE made up roughly 8.7% of all confirmed enterococci species [15]. There are several causes for concern about VRE, including the potential for nosocomial transmission, the lack of antibiotics to treat infections caused by this organism, and the potential for vancomycin-resistant genes found in VRE to spread to other Gram-positive microorganisms such as *Staphylococcus aureus* [14, 15].

Assessing individual drug use variability and promoting adjustments will lead to improved patient outcomes [7, 16, 17]. Ethiopia needs more attention due to its inadequate culture and sensitivity testing practices, the potential for the transmission of resistant infections from person to person, and the fact that the majority of healthcare facilities do not have their own guidelines or rigorously follow the national guidelines. A large number of hospital-acquired infections are being treated with vancomycin, with an emphasis on its effectiveness against MRSA. To provide maximum benefit with minimal risk, we evaluated the vancomycin usage profile in Felege Hiwot Comprehensive Specialized Hospital, northwest Ethiopia.

2. Methods

2.1. Study Area. The study was conducted at Felege Hiwot Comprehensive Specialized Hospital, which is located in Bahir Dar, Amhara Region. It is located 563 Km from Addis Ababa. It officially commenced its function in 1963 and currently provides comprehensive care to patients in need of pediatrics, medical, ophthalmological, surgical, gynecological, orthopedic, intensive care units, and a wide range of other settings.

2.2. Study Design and Period. An institutional-based descriptive retrospective cross-sectional study design was used, and the research was conducted from May 1, 2022, to July 3, 2022.

2.3. Population

2.3.1. Source Population. All patients were admitted to the medical and gynecology wards during the study period.

2.3.2. Study Population. All patients who would be hospitalized in the internal and gynecology wards and receive any dose or course of vancomycin throughout the study period were incorporated into the study population.

2.4. Inclusion and Exclusion Criteria

2.4.1. Inclusion Criteria. The inclusion criteria were as follows: all individuals who were admitted to the hospital between September 2020 and September 2021, who received vancomycin treatment for various medical conditions, medication records (charts) for patients who were hospitalized in the internal and gynecological wards of Felege Hiwot Compressive Specialized Hospital between September 2020 and September 2021, medication histories (charts) for patients who took vancomycin within the previous 12 months, regardless of the dosage or course of treatment, and medication records with sufficient information on sociodemographic factors (age, sex, hospital stay, and result), drug-related factors (dose, frequency, duration), and diagnoses included in the study.

2.4.2. Exclusion Criteria. The exclusion criteria were as follows: outpatient department (OPD) patients, medication records (charts) lacking complete information on any of the following variables: age, sex, dose, frequency, and duration of vancomycin therapy, findings for which the drug was prescribed, and patients who were admitted before and after the study period.

2.5. Sample Size Calculation and Sampling Technique. A single population proportion technique was used to calculate the sample size. It is suspected that the 95% confidence interval is desired to estimate the proportion within 5%. We obtained a 95% confidence level of 1.96, a margin of error of 0.05, and a p value of 0.195 [18]:

$$n = \frac{(z\alpha/2)^2 p(1-p)}{d^2} = \frac{(1.96).\,0.195 * 0.805}{(0.05)^2} = 241. \quad (1)$$

The final sample size was 265 when considering a 10% nonresponse rate. Study participants were selected using a simple random sampling technique after evaluation and review of their medical records.

2.6. Data Collection Tools and Procedures. The Standard Treatment Guidelines (STG) of Ethiopia [19], the Infectious Diseases Society of America (IDSA) [20], the American Society of Health-System Pharmacists (ASHP) [8], and the patient characteristics of the study setting were all considered when constructing the data abstraction format. For most of the conditions, STG was used to evaluate vancomycin use compliance in terms of indication, dose, frequency, and duration. For new indications and diseases not included in STG, ASHP, and IDSA recommendations, they were implemented. The appropriate DUE methods and criteria were also identified using the guidelines for the Drug and Therapeutics Committee training from the World Health Organization and Management Sciences for Health [21]. Using a checklist from a medical record, the data were collected, which considered sociodemographic data including age, sex, diagnosis, BUN, SCR, weight/BMI, dose frequency duration, dosage form, and indication.

The data were collected by three pharmacists. They were given guidelines on how to use the data abstraction format and for what purposes. They were trained on the ethical standards of confidentiality and data management before taking part in the data collection process.

2.7. Data Quality Control. Data quality control issues were ensured by performing the pretest on prescription papers and inpatient medication records gathered from Felege Hiwot Compressive Hospital. Although the data collectors received training at the start, ongoing supervision and support were provided throughout the data collection period to guarantee consistency and accuracy. During data collection, the information was checked regularly for consistency and completeness.

2.8. Operational Definitions. Empirical treatment: before or after detection of the type of bacteria with vancomycin susceptibility, vancomycin was administered.

Definitive therapy (specific therapy): Following the identification of a bacterial pathogen that was vancomycin-sensitive, vancomycin treatment was initiated.

Adherence (compliance with vancomycin use) implies when the guidelines under consideration are identical to the observed vancomycin prescribing practice. Another term for this is "proper use."

Medication records: patient records with complete personal, medical, and medication histories are referred to as charts, patient medication records, or cards.

2.9. Statistical Analysis. Descriptive statistics were performed, and the data were analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Data are presented as the mean ± SD. A p value of ≤0.05 is considered statistically significant.

3. Results

3.1. Sociodemographic Characteristics. Among the 265 study participants, 160 (60.4%) were male respondents. Nearly, half of the participants were between 35 and 55 years old. In addition, more than half of the participants had a weight range of 51–70 kg. Furthermore, 228 (86%) of the participants were admitted to the medical ward, while the remaining 14% were admitted to the gynecology ward (Table 1).

3.2. Medical-Related Characteristics of the Respondents. Regarding its medical characteristics, 230 (86.8%) doses of vancomycin were administered for treatment, while 13.2% were administered as prophylaxis. In addition, 177 (66.8%) doses of vancomycin were given in the dose range of 800–1000 mg. Furthermore, 207 (78.1%) doses of vancomycin were given on a BID basis. Nearly, half of the participants were taking the drug for a duration of 6–10 days. Moreover, 255 (96.2%) of participants took concurrent antimicrobials (Table 2).

3.3. Reason for Inappropriate Use of Vancomycin. In 57 (21.5%) of the patients, the frequency of vancomycin administration was inappropriate; 77 (29.5%), 152 (57.36%), and 104 (39.5%) had an incorrect indication, dose, and duration, respectively, according to the guideline (Table 3).

3.4. Diagnosis and Treatment. Among the study participants, 109 (41.1%) doses of vancomycin were ordered for treating meningitis and 9 (3.4%) for acute febrile illness (Table 4).

Vancomycin was mostly, 45 (16.98%), taken concomitantly with ceftriaxone; however, 15 (0.7%) were taken with cotrimoxazole. These drugs are coprescribed for the treatment of meningitis, hospital-acquired pneumonia, and septic shock, respectively (Figure 1).

3.5. Drug Sensitivity Result. The culture was performed for only 46 (17.4%) patients. Among them, 37 (80.43%) had sensitive results, whereas 9 (19.57%) had an intermediate result. No resistance was found (Table 5).

Table 1: Sociodemographic characteristics of respondents in the medical and gynecology wards of Felege Hiwot Comprehensive Specialized Hospital, northwest Ethiopia, 2022 ($n = 265$).

Variables	Category	Frequency (n)	Percentage
Age	14–34	82	30.9
	35–55	128	48.3
	55–80	55	20.8
Sex	Male	160	60.4
	Female	105	39.6
The weight of respondents	30–50	67	25.3
	51–70	173	65.3
	71–90	25	9.4
Ward admitted	Medical	228	86
	Gynecology	37	14

Table 2: Clinical characteristics of study participants in the medical and gynecology wards of Felege Hiwot Comprehensive Specialized Hospital, northwest Ethiopia, 2022 ($n = 265$).

Variables	Category	Frequency (n)	Percentage
Mode of indication	Prophylaxis	35	13.2
	Treatment	230	86.8
Creatinine monitoring	Not done at all	2	0.8
	Three weeklies	263	99.2
The dose of vancomycin	500–800 mg	88	33.2
	800–1000 mg	177	66.8
Frequency of administration	BID	207	78.1
	TID	24	9.1
	Per day (QD)	34	12.8
The duration of treatment	1–5 days	108	40.8
	6–10	125	47.2
	10–14	32	12.1
The duration of infusion	One hour	261	98.5
	Half hour	4	1.5
Concurrent antimicrobial	Yes	255	96.2
	No	10	3.8
Types of therapy	Empiric	219	82.6
	Specific	46	17.4
Vancomycin appropriateness	Appropriate frequency	208	78.5
	Appropriate duration	161	60.8
	Appropriate indication	188	70.9
	Appropriate dose	113	42.6

Table 3: Reasons for the inappropriate use of vancomycin in the medical and gynecology wards of Felege Hiwot Comprehensive Specialized Hospital, northwest Ethiopia, 2022 ($n = 265$).

Variable	Category	Frequency (n)	Percentage
Reason for inappropriate use	Incorrect indication	77	29.05
	Incorrect duration	104	39.25
	Incorrect dose	152	57.36
	Inappropriate frequency	57	21.5
	Combination*	34	12.83

*Either an incorrect indication, dose, and frequency or an incorrect duration.

4. Discussion

To prevent the emergence of multidrug-resistant microorganisms, reduce total healthcare expenditures, and improve patient outcomes, antibiotics must be used wisely and appropriately. Drug use evaluation is the best criterion for assessing the clinical appropriateness, cost-effectiveness, and efficacy of medication therapy. Antimicrobial agents are the drugs most usually recommended for DUE projects because of widespread misuse, the development of antimicrobial resistance, and the growing need for unnecessary expenditures [5].

Table 4: The most common diagnosis for vancomycin indication in the medical and gynecology wards of Felege Hiwot Comprehensive Specialized Hospital, northwest Ethiopia, 2022 ($n = 265$).

Diagnosis	Frequency	Percentage
Pneumonia	67	25.3
Meningitis	109	41.2
Sepsis	47	17.7
Postoperative prophylaxis	12	4.5
Acute febrile illness	9	3.4
Other*	21	7.9

*Respiratory tract infection, skin and soft tissue infection, bone infection, cardiovascular infection, urinary tract infection, and gastrointestinal infection.

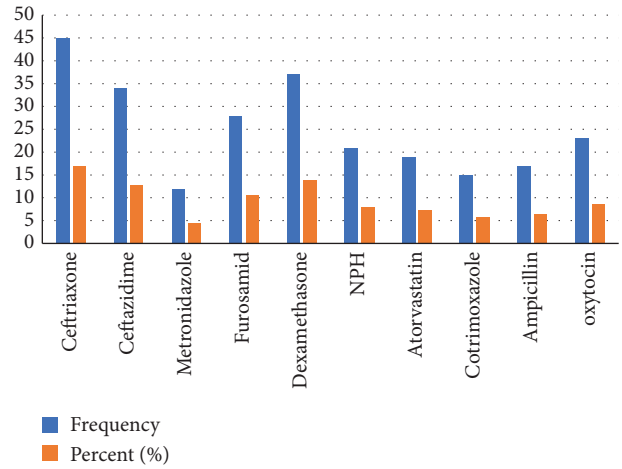

Figure 1: Top 10 concomitantly administered drugs with vancomycin in the medical and gynecology wards of the study area, 2022.

Table 5: Sensitivity result of vancomycin use in the medical and gynecology wards of Felege Hiwot Comprehensive Specialized Hospital, northwest Ethiopia, 2022 ($n = 265$).

Variables	Category	Frequency (n)	Percentage
Drug sensitivity is done	Yes	46	17.4
	No	219	82.6
Sensitivity result	Sensitive	37	80.43
	Intermediate	9	19.57

The criteria for antibiotic treatment are often inadequate in developing nations, which increases the irrational use of these drugs. Antibiotics are frequently provided inappropriately for most types of diseases, including bacterial and viral infections, which increases their misuse.

Based on the findings of this study, 41.9% of vancomycin was prescribed for meningitis and 25.3% for pneumonia. However, study findings of Tikur Anbessa Hospital showed that the main clinical use of vancomycin was for pneumonia (54%). This discrepancy may be due to the absence of a blood culture and sensitivity test. According to previous studies, the two main reasons for prescribing vancomycin were 87.9% for febrile neutropenia and 74.5% for primary sepsis for all vancomycin prescriptions [22, 23]. However, vancomycin was used for pneumonia at the third level in a study conducted in Tehran, Iran [24]. A study conducted at the Shiraz University of Medical Sciences in Shiraz, Iran, showed that the most common indications for prescribing vancomycin were sepsis (22.1%), ventilator-associated hospital-acquired pneumonia (22.6%), and CNS infection (12.6%), respectively [24]. whereas in a study conducted at Yekatit 12 Hospital, vancomycin was prescribed for HAP in 23.1% of cases, followed by meningitis (12.4%), PCP (12.4%), and then 12.4% of cases [18].

According to this finding, vancomycin was prescribed for empirical treatment in 82.6% of the cases. This is somewhat lower than that of the study conducted at the Shiraz University of Medical Sciences (81%). This differs from the study conducted in Iran, in which vancomycin was prescribed for empirical treatment in 98.2% of the cases [23]. This is due to cultural sensitivity testing performed in our study setting, which was around 17.4%. Accurate identification at the genus or species level is required for the decision-making process when culture findings are available because the susceptibility pattern of many organisms is commonly predictable. But it was higher than that of the study conducted at Yekatit 12 Hospital. Vancomycin was mostly indicated as empiric therapy (80.5%). This is because antibacterial treatment guidelines are limited, as is information about the susceptibility patterns of common pathogens and a good drug use management approach.

Regarding vancomycin's appropriateness, 70.9%, 42.6%, 78.5%, and 60.8% of doses of vancomycin had the appropriate indication, dose, frequency, and duration, respectively, according to the guideline. However, according to the study from Yekatit 12 Hospital, 75.7%, 73.4%, 79.9%, and 61.6% of doses of vancomycin had the appropriate indication, dose, frequency, and duration, respectively, according to the guideline [18].

Evaluating the vancomycin drug sensitivity results at Felege Hiwot Comprehensive Hospital was one of the key purposes of the study. Accordingly, only 17.4% of the study participants had sensitivity test results. This was higher than the results reported in Pakistan, which showed 15.6% sensitivity to all available concentrations [25]. Accurate identification at the genus or species level is crucial for the decision-making process when culture findings are available because the susceptibility pattern of many organisms is largely predictable. Not all organisms show predictable patterns of resistance; the use of antibiotics in hospitals and the general population has resulted in rising resistance in many significant human infections. In this study, 13.04% of the participants also had an intermediate result. This result is higher than that of research reported in China [26]. However, it was more than that of studies reported in Pakistan, which reported 13% of intermediate results [25], and Asia [27]. In this study, no resistant reports were found. This result is in line with the study reported in Pakistan [25]. The evaluation criteria for antibiotic treatment are often careless in developing nations, which increases the inappropriate use of these drugs. Antibiotics are frequently recommended irrationally for both bacterial and viral diseases, which promotes their indiscriminate use

[25]. The true extent of the problem, however, is unknown, and many cases of sensitivity are probably not identified because of inadequate screening processes and potential weaknesses in automated and nonautomated detection methods. Therefore, it should be a primary focus to perform effective screening targeted at patients who are considered most at risk.

Antibiotic usage, abuse, and overuse cause the development of antimicrobial resistance. Treatment delays, prolonged hospital stays, and increased patient expenditures have all been affected by the increased prevalence of already identified resistant infections and the emergence of recently discovered resistant organisms. Therefore, it is necessary to encourage the wise and reasonable use of antibacterial agents to slow the development of resistance and lengthen the shelf life of currently accessible medications, which can only be achieved if baseline data on antimicrobial therapy are available.

The CDC Hospital Infection Control Practices Advisory Committee (HICPAC) has created guidelines in response to the emergence of VRE [10, 11]. When considering using significant antibiotics such as vancomycin, it is crucial to encourage practical principles for using culture and sensitivity testing.

5. Conclusion and Recommendation

Vancomycin inappropriateness was common with the indication, dose, frequency, and duration of therapy according to the guidelines. Vancomycin was mostly indicated as empiric therapy, even though the sensitive test was performed in a small amount. Given the widespread use of vancomycin as an empiric drug, its utilization should be monitored closely. Therefore, the usual sensitive test is recommended to identify those intermediate and resistant results and to predict the outcomes of the treatment. Therapeutic infection control committees should be established in hospitals, educational materials should be made available to healthcare professionals, standard treatment guidelines for vancomycin based on hospital resistance patterns should be implemented, and antibiotic utilization review studies should be conducted to make the use of vancomycin more reasonable and rational.

Abbreviations

ADR: Adverse drug reaction
CDC: Center of Disease Control
HICPAC: Hospital Infection Control Practices Advisory Committee
DSA: Infectious Disease Society of America
MRSA: Methicillin-resistant*Staphylococcus aureus*
VRE: Vancomycin-resistant enterococci
WHO: World Health Organization.

Data Availability

The study data used to support the findings of this study are available from the corresponding author upon request.

Ethical Approval

Ethical approval was obtained from the Ethical Review Committee of the College of Medicine and Health Science, Bahir Dar University, with a reference number of Phar 03/27/2022, and a formal letter was written and submitted to Felege Hiwot Comprehensive Specialized Hospital.

Consent

The respondents were informed about the purpose of the study, and their consent to participate was obtained. All information obtained was kept confidential.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Authors' Contributions

BYA conceived the study, drafted and revised the study proposal, collected the data, and performed data analysis and interpretation. ZYD, BAM, and ATK prepared data collection instruments and supervised data collection. ATK drafted the manuscript, revised the manuscript, and approved the submission of the manuscript. All the authors read and approved the final manuscript.

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