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Research Article

Cross-Sectional Study to Track Antibiotic Consumption and its Appropriateness in an Intensive Care Setting of a Tertiary Care Hospital using Aware Tool of World Health Organization (WHO)

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ABSTRACT

Background & Objectives: Incorporating AWaRe classification metrics provide a structured approach to evaluating antibiotic consumption and guiding future interventions for better antibiotic stewardship in healthcare facilities. The study aimed to quantify antibiotic consumption and assess its appropriateness in an intensive care unit of a tertiary care hospital in South India using the WHO's AWaRe tool.

Methods: This study was conducted in a South Indian ICU over 2 months, including prescriptions with at least one antibiotic for patients admitted within 2 weeks. Around 100 prescriptions were included based on ICU admission statistics. An AWaRe tool by WHO was used to analyze antibiotic consumption and appropriateness.

Results: 201 antibiotics were prescribed, with an average of 2 antimicrobials per patient. 78.6% administered parenterally, 21.4% orally. 29% cases had clinical samples sent for Culture & Sensitivity testing. Only 29% cases showed escalation or de-escalation of antimicrobials based on clinical response.

Interpretations & Conclusions: The study highlighted the empirical nature of antibiotic prescriptions, limited microbiological guidance, and inadequate adjustments based on clinical responses. These findings emphasize the need for improved guidelines and practices to optimize antibiotic use in intensive care settings, ensuring appropriateness and effectiveness in patient care.

Keywords: Antibiotics, Antibiotic Consumption, Aware Tool, Antibiotic Stewardship Program, ATC Classification.

INTRODUCTION

Antimicrobial Resistance (AMR) refers to ability of the microorganisms to withstand the effects of an antibiotic over time and irrational inappropriate antibiotic use is the major contributing factor for AMR. Increased AMR may lead to prolonged hospitalization, increased costs, and mortality. The World Health Organization (WHO) has identified AMR as a "global security threat" impacting global health and economic growth of a country.[1] Without prompt action, the number of deaths caused by antimicrobial resistance (AMR) could escalate to an alarming 10 million by 2050, with an estimated 700,000 deaths occurring each year presently.

The World Health Organization (WHO) has recently released a comprehensive global action plan on antimicrobial resistance (AMR) to improve the utilization of antibiotics. As a subsequent development, the WHO Expert Committee on Selection and Use of Essential Medicines introduced the AWaRe (Access, Watch, Reserve) classification in 2017. This classification system serves as a valuable tool for monitoring antibiotic consumption, establishing goals, and evaluating the impact of stewardship policies that strive to optimize antibiotic usage and mitigate the emergence of AMR.[2,3]

The first and second choice antibiotics for the treatment of common or severe infectious diseases should be easily accessible at every level of care, in the right quantity, dose, duration, formulation, and price. According to the World Health Organization, at least 60% of antibiotics in the Access category should meet these criteria. The Watch group includes antibiotics with higher concerns for toxicity or potential resistance, while the Reserve group consists of last-resort options for specific patients when first-line drugs fail. The AWaRe tool can be utilized to determine the proportion of narrow-spectrum and broad-spectrum antibiotics being used.[4]

Moreover, an undergraduate level of medical training to use AWaRe tool is ideal to acquire knowledge and generate beliefs and attitudes regarding antibiotics use and resistance, unlike the postgraduate level where extrinsic factors have hardly any influence on the generation of knowledge and attitudes.[5]

With the use of aWaRe tool of WHO to implement its Global Action Plan on Antimicrobial Resistance, this study has been planned with an objective to track antibiotic consumption and appropriateness in the intensive care setting of a tertiary care hospital.

MATERIALS AND METHODS

This study is a cross-sectional, observational study conducted over a 2-month period in the Intensive Care Unit (ICU) of a tertiary care hospital in South India. Prescriptions or drug charts containing at least one antibiotic, prescribed to patients of all ages and gender until 2 weeks or earlier since admission were included in the study. The sample size for the study was estimated to be approximately 100 participants based on quarterly statistics of ICU admissions in the hospital. Universal sampling method was used to include all eligible participants. The study was approved by the Institute Ethics Committee (PIMS/IEC:RC/2022/118), and informed consent waiver was obtained as the data were collected from the medical records of the patients. Data was collected by scrutinizing the drug charts or prescriptions and using a standardized case report form to collect relevant information from the medical records, including details about the antibiotics prescribed, their clinical indications, microbiological culture reports, antibiotic de-escalation, and follow-up treatment. The study data was analyzed using the AWaRe tool provided by the World Health Organization (WHO) website https://aware.essentialmeds.org/list to quantify antibiotic consumption and assess appropriateness of antibiotic use. All the data were entered in Microsoft Excel sheet (Microsoft office 365) and descriptive statistics was used to analyze the data. Data was anonymized and kept confidential to protect participant's privacy.

RESULTS

In the study conducted to track antibiotic consumption and appropriateness in an intensive care setting of a tertiary care hospital utilizing the AWaRe tool by the World Health Organization (WHO), we collected data using the case report form from 100 patients' prescription charts admitted in the ICU over a period of two months. The prescription charts reviewed belonged to elderly patients admitted in ICU with mean age of 55.03±14.92 years representing both genders equally as shown in figure 1. Analysis of study characteristics revealed that out of 100 drug charts reviewed, a total of 201 antibiotics were prescribed with an average of 2 antimicrobials per patient, with 78.6% (158) of antimicrobials being administered parenterally and 21.4%(43) of antimicrobials administered orally (table 1). Notably, all antimicrobials were empirically prescribed, with only 29% of cases having clinical samples sent for Culture & Sensitivity testing, indicating a lack of microbiological guidance in prescribing decisions. A concerning finding was the low proportion of cases (29%) where escalation or de-escalation of antimicrobials occurred, suggesting a potential gap in treatment optimization based on clinical response (table 2).

The list of indications for which antimicrobials were prescribed across the reviewed drug charts are presented in table 3 where antimicrobials were most prescribed for blood stream infections, accounting for 41% of the prescriptions. Respiratory tract infections were the second most common indication, comprising 25% of prescriptions. Prophylaxis was indicated in 19% of the cases and urinary tract infections accounted for 10% of the antimicrobial prescriptions. Skin infections and CNS infections were relatively less common, making up only 2% of the prescriptions each.

Gastrointestinal infections were least common indications, with only 1% of prescriptions.

Table 4 categorizes various antimicrobials according to the WHO AWaRe classification, along with the number of prescriptions and their percentage of the total. It was observed that most prescribed antimicrobials fell under the Watch category (62%), while Access antibiotics accounted for 25% of the prescriptions, and Reserve antibiotics comprised 13% of the total antimicrobial usage (figure 2). In the Watch category, PIPERACILLIN TAZOBACTUM was leading at 49 prescriptions (24.4%), followed by CEFTRIAXONE with 33 (16.4%), and MEROPENEM with 29 (14.4%). In the Access category, DOXYCYCLINE had 16 prescriptions (8%), and other drugs such as AMOXICILLIN CLAVULANIC ACID and GENTAMICIN had fewer, each at around 1-2%. In the Reserve category MINOCYCLINE and POLYMYXIN B were prescribed 3 (1.5%) and 2 (1%) times respectively.

Table 5 provides detailed information on the list of antimicrobials included in the Essential Medicines List (India), along with WHO ATC category and product type. Out of the 24 antimicrobials listed, all but four drugs, namely MINOCYCLINE, POLYMYXIN B, IMIPENEM, and FAROPENEM, are included on the Essential Medicines List, marking 83.3% of the total. Every listed antimicrobial has a designated ATC classification code, facilitating standardized classification and international comparison. The product type for all listed antimicrobials is predominantly single formulation (SF), with only one being a Fixed Dose Combination (FDC), specifically AMOXICILLIN CLAVULANIC ACID.

These data together provide a comprehensive oversight into how antimicrobials are being utilized in the study site, highlighting the need for improved antimicrobial stewardship practices in the intensive care setting to ensure the judicious use of antibiotics and enhance patient care outcomes.

DISCUSSION

In our study on antibiotic consumption and appropriateness in an intensive care setting of a tertiary care hospital, we used the AWaRe tool developed by the World Health Organization. We collected data from 100 patients in the ICU over a two-month period. The patients in our study were sourced from various healthcare institutions, including stand-alone clinics, private nursing homes, primary and secondary public sector health centers, and hospitals. Therefore, we believe that our study sample accurately reflects the emergency settings in tertiary care facilities within our country.

The results showed that most prescribed antimicrobials fell into the Watch category (62%), followed by Access antibiotics (25%), and Reserve antibiotics (13%). The World Health Organization has recommended the prioritization of narrow-spectrum ACCESS antibiotics over broad-spectrum WATCH and RESERVE antibiotics to reduce the risks of resistance. However, our research findings indicate that the utilization of ACCESS antibiotics falls short of the recommended 60%, with WATCH antibiotics being consumed more frequently (62%) compared to ACCESS antibiotics (25%). This inconsistency highlights the need for alternative antimicrobial stewardship strategies such as de-escalation, antibiotic restriction, and healthcare worker training to address the discrepancy and promote appropriate antibiotic use.[6] For instance, Watch antibiotics were among top four medicines used across during the study period with Piperacillin tazobactam use in 49 (24.4%) of prescriptions. Piperacillin tazobactam is a combination of a β-lactam antibiotic and a β-lactamase inhibitor, known for its extensive antibacterial activity against a wide range of gram positive and gram negative aerobic and anaerobic bacteria. This includes various pathogenic bacteria that possess β-lactamases, enzymes that can render traditional β-lactam antibiotics ineffective.[7] The reason for its use in most of the patients was based on the antibiotic policy of the study hospital. The antibiotic policy of our hospital was formulated by leveraging a hospital-specific antibiogram that was generated through the analysis of patient samples. This policy emphasizes the importance of considering the potential clinical syndrome, primary site of infection, and probable pathogens when initiating treatment for infections. Additionally, it incorporates indicators such as host characteristics and disease severity to assess the risk of drug-resistant pathogens. The data collected from medication charts were deemed suitable for guiding antibiotic policy adherence, thus promoting effective antimicrobial stewardship within the hospital.

The mean number of medications per prescription in our study was 2.1, which is consistent with the WHO standard value of 2. This finding is lower than the results reported in studies conducted by Atif et al[8] (2.8 drugs per prescription), Mashalla et al.[9] in Botsawna (2.8 drugs per prescription), and Mamo and Alemu et al.[10] (2.5 drugs per prescription). In a positive light, the Essential Drug List (EDL) was consistently accessible in this study hospital, with 83% of the prescribed medications being derived from the list. The next point to be noted is that every patient was prescribed antimicrobials, with 78.6% of them administered through injections for systemic infection indications. It is appropriate since all the medication charts reviewed are from intensive care unit comprising of mostly sick patients.

It is important to mention that most prescriptions (>65%) consisted of broad-spectrum antimicrobials like piperacillin tazobactam, ceftriaxone, and meropenem, which were administered as empirical therapy. However, it is concerning that only 29% of cases involved sending clinical samples for Culture & Sensitivity testing, indicating a lack of microbiological guidance in prescribing decisions. Furthermore, only 29% of cases saw adjustments in antimicrobial treatment based on clinical response, suggesting potential room for improvement in optimizing treatment. These findings highlight the need to enhance antimicrobial stewardship practices in the intensive care setting to ensure appropriate antibiotic use and improve patient care outcomes. This finding indicates a potential area for educational intervention as part of a future antibiotic stewardship program.

Systemic antibiotics, as per our study, were defined as drugs categorized under the J01 group in the WHO Anatomical Therapeutic Chemical (ATC) classification system. This group consists of antibacterial drugs intended for systemic use. It would have provided a more comprehensive understanding of antimicrobial consumption if we had access to data on the volume of antimicrobials utilized to calculate metrics such as defined daily doses (DDD), defined daily doses per 1,000 inhabitants per day (DID), or days of therapy (DOT). These metrics provide valuable insights into the extent of antimicrobial usage.

The findings of this study suggest several implications for practice. Firstly, there is a pressing need for enhanced antimicrobial stewardship programs to promote the judicious use of antibiotics, especially considering the high proportion of antimicrobials falling under the Watch category. Secondly, optimizing the utilization of microbiological testing, as indicated by the low rate of samples sent for Culture & Sensitivity testing, is essential to guide more targeted antibiotic prescribing. Thirdly, improving treatment protocols based on clinical response, demonstrated by the limited instances of antimicrobial escalation or de-escalation, could enhance individualized therapy and patient outcomes. Lastly, ongoing education and awareness initiatives focusing on appropriate antibiotic use, understanding antibiotic categories, and the significance of microbiological testing are imperative to cultivate a culture of responsible antibiotic prescribing in intensive care settings. Implementing these implications into practice can lead to better patient care, optimized antibiotic therapy, and the mitigation of antimicrobial resistance.

Antimicrobial stewardship programs (ASP) play a vital role in optimizing antibiotic treatment and mitigating the risk of antimicrobial resistance by minimizing unnecessary antibiotic consumption. It is crucial for healthcare facilities to implement systems that can evaluate the use of antibiotics within the institution and examine the correlation between antibiotic utilization trends and the prevalence of antibiotic resistance. To effectively tackle the emergence and dissemination of antibiotic resistance, it is imperative to implement these strategies.[11]

CONCLUSION

In conclusion, the study findings reinforce the need for effective antibiotic stewardship programs to address antibiotic resistance. By examining antibiotic usage patterns across different categories, the study underscores the importance of monitoring and optimizing antibiotic prescribing practices. Global initiatives promoting the use of the AWaRe classification highlight the significance of data-driven interventions in promoting prudent antibiotic use and safeguarding the efficacy of antimicrobial agents. These insights emphasize the critical role of responsible antibiotic use in combating the growing threat of antibiotic resistance.

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Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of paper.

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Table 1: Study Characteristics:

Parameters	Values
Total Drug Charts Of Patients Reviewed	100
Mean Age (Years)	55.03±14.92
Total Number Of Antimicrobials Prescribed	201
Average Number Of Antimicrobials Per Patient	2
Total Number Of Oral Antimicrobials Prescribed N(%)	43 (21.4)
Total Number Of Parenteral Antimicrobials Prescribed N(%)	158 (78.6)

Table 2: Prescription Indicators

Parameters	Values
Antimicrobials Prescribed Empirically (%)	100%
Clinical Samples Sent For Culture & Sensitivity	
Yes (%)	29%
No (%)	71%

Escalation/De-Escalation Of Antimicrobials (%)	29%
Antibiotic Indications Documented	100%
Treatment Duration Of Antimicrobials Mentioned In Drug Charts	100%

Table 3: List of Indications Where Antimicrobials Were Prescribed In Reviewed Drug Charts.

Indications	Values
Blood Stream Infections	41%
Respiratory Tract Infections	25%
Prophylaxis	19%
Urinary Tract Infections	10%
Skin Infections	2%
CNS Infections	2%
Gastrointestinal Infection	1%

Table 4: List of Antimicrobials and Their Category According To WHO Aware Classification:

S.No	Antimicrobials Prescribed	Category According To Who Aware Classification	Number Of Prescriptions N (%)
1	Piperacillin Tazobactum	Watch	49 (24.4)
2	Ceftriaxone	Watch	33 (16.4)
3	Meropenem	Watch	29 (14.4)
4	Azithromycin	Watch	24 (11.9)
5	Doxycycline	Access	16 (8)
6	Vancomycin	Watch	14 (7)
7	Clindamycin	Access	10 (5)
8	Amoxicillin Clavulanic Acid	Access	3 (1.5)
9	Ceftazidime	Watch	3 (1.5)
10	Minocycline	Reserve	3 (1.5)
11	Polymyxin B	Reserve	2(1)
12	Gentamicin	Access	2 (1)
13	Moxifloxacin	Watch	2 (1)
14	Levofloxacin	Watch	1 (0.5)
15	Imipenem	Watch	1 (0.5)
16	Cefixime	Watch	1 (0.5)
17	Faropenem	Reserve	1 (0.5)
18	Amikacin	Access	1 (0.5)
19	Cefepime	Watch	1 (0.5)
20	Benzyl Penicillin	Access	1 (0.5)
21	Cefoperazone	Watch	1 (0.5)
22	Cefotaxime	Watch	1 (0.5)
23	Ciprofloxacin	Watch	1 (0.5)
24	Norfloxacin	Watch	1 (0.5)

Table 5: List of Antimicrobials Included In Essential Medicines List (India), WHO ATC Category and Product Type:

S.No	Antimicrobials Prescribed	Atc Classification	Essentiality (Eml List, India)	Product Type (Fdc/Sf)*
1	Piperacillin Tazobactum	J01cr05	Listed	Sf
2	Ceftriaxone	J01dd04	Listed	Sf
3	Meropenem	J01dh02	Listed	Sf
4	Azithromycin	J01fa10	Listed	Sf
5	Doxycycline	J01aa02	Listed	Sf
6	Vancomycin	J01xa01	Listed	Sf

7	Clindamycin	J01ff01	Listed	Sf
8	Amoxicillin Clavulanic Acid	J01cr01	Listed	Fdc
9	Ceftazidime	J01dd02	Listed	Sf
10	Minocycline	J01aa08	Unlisted	Sf
11	Polymyxin B	J01xb02	Unlisted	Sf
12	Gentamicin	J01gb03	Listed	Sf
13	Moxifloxacin	J01ma14	Listed	Sf
14	Levofloxacin	J01ma12	Listed	Sf
15	Imipenem	J01dh51	Unlisted	Sf
16	Cefixime	J01dd08	Listed	Sf
17	Faropenem	J01di03	Unlisted	Sf
18	Amikacin	J01gb06	Listed	Sf
19	Cefepime	J01de01	Unlisted	Sf
20	Benzyl Penicillin	J01ce01	Listed	Sf
21	Cefoperazone	J01dd12	Unlisted	Sf
22	Cefotaxime	J01dd01	Listed	Sf
23	Ciprofloxacin	J01ma02	Listed	Sf
24	Norfloxacin	J01ma06	Unlisted	Sf

*FDC Fixed Dose Combination; SF - Single formulation

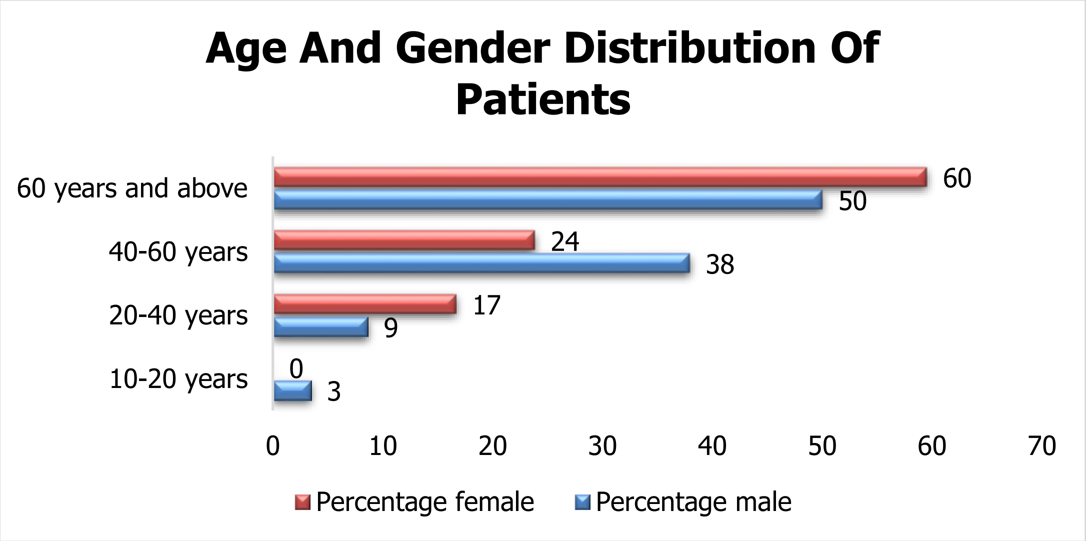

Figure 1: Age and Gender Distribution of Patients' Medication Charts Reviewed:

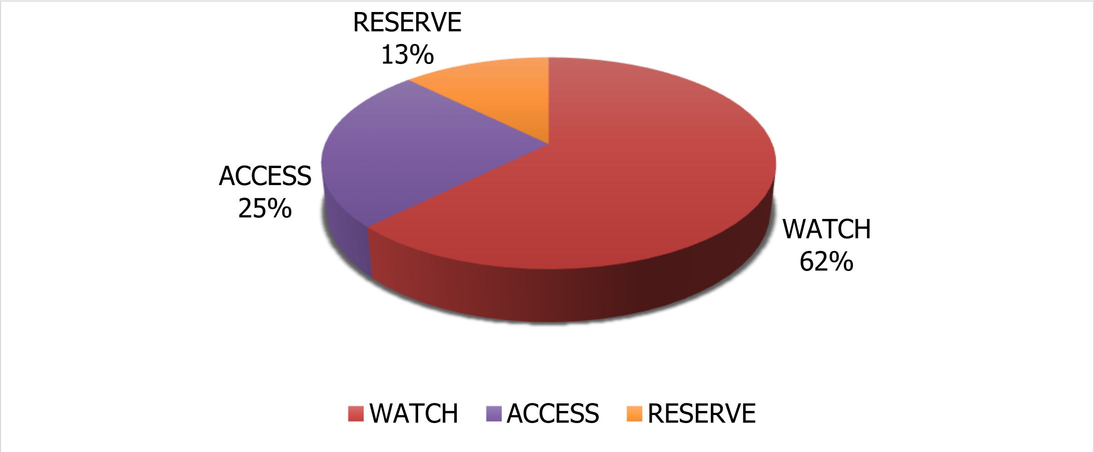

Figure 2: Prescribed Antimicrobials According To WHO Aware Classification