Palestinian Medical and Pharmaceutical Journal

Drug Utilization Evaluation of Antibiotics in General Surgery Department: Categorization Using World Health Organization Access, Watch, Reserve (Aware) Classification

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(Type: Full Article). Received: 7th May. 2024, Accepted: 12nd Aug. 2024, Published: 1st June 2025
DOI: https://doi.org/10.59049/2790-0231.10.2.2280

Abstract: Background: Antibiotic prophylaxis is critical in general surgery to prevent surgical site infections (SSIs). While essential for many surgical procedures, the judicious use of antibiotics prevents antimicrobial resistance and maintains patient care. Aim: The current study aims to evaluate the drug usage patterns of antibiotics in the general surgery department by using benchmarks and WHO AWaRe framework for antibiotics. Method: We conducted a drug utilization evaluation study on 384 patients visiting the department of general surgery. We evaluated the antibiotic prescribing using the World Health Organization- Access, Watch, and Reserve (AWaRe) classification system. Result: Ceftriaxone is the commonly prescribed antibiotic in our study (17.70%). Ceftriaxone is a Watch category antibiotic. The most common surgical procedure in our study was hernioplasty (16.40). The average number of antibiotics per prescription was 2.16 and had a compliance rate of 90.89% with the National List of Essential Medicines (NLEM). Conclusion: Cefazolin is recommended over ceftriaxone because it is an access class of antibiotic. Judicious use of second- and third- generation antibiotics and Watch class antibiotics such as ceftriaxone are necessary to prevent antimicrobial resistance.

Keywords: Drug Utilization Evaluation, Antibiotic, Ceftriaxone, Access, Watch, Reserve.

Introduction

Drug Utilization Evaluation (DUE) is essential for ensuring appropriate medication use and prescribing patterns in healthcare, especially to promote rational and effective medication use. DUE, a systematic process supported by the American Society of Health-System Pharmacists (ASHP), focuses on the ongoing review of drug usage and prescribing patterns to improve patient outcomes [1, 2]. Antibiotics, central to hospital care for treating infectious diseases, have become a focal point due to the rise in drug-resistant strains, a substantial public health threat [3-5]. Addressing this, DUE policies are instrumental, involving criteria-based assessments to ensure drugs are used safely and effectively [6].

Antibiotic prophylaxis is critical in general surgery to prevent surgical site infections (SSIs), which are prevalent nosocomial infections causing significant morbidity, mortality, and healthcare costs [7]. While essential for many surgical procedures, the judicious use of antibiotics prevents antimicrobial resistance and maintains patient care [8]. In response to these challenges, the World Health Organization (WHO) introduced the Access, Watch, and Reserve (AWaRe) system, a framework categorizing antibiotics to guide their optimal use and reduce resistance [9].

The implementation of the WHO AWaRe classification in general surgery has demonstrated significant insights into antibiotic stewardship and prescribing practices. Studies have shown a high proportion of antibiotics categorized under the 'Watch' group being prescribed, highlighting a potential area for improving antibiotic use [10]. Moreover, the adherence to the AWaRe classification can significantly influence the reduction of antimicrobial resistance by ensuring that 'Access' antibiotics are prioritized, and 'Reserve' antibiotics are preserved for the most critical cases [11]. Such an approach not only aligns with global health objectives but also promotes sustainable antibiotic use in surgical settings, ultimately improving patient outcomes and healthcare efficiency [12]. Therefore, the current study aims to evaluate the drug utilization patterns of antibiotics in general surgery department using WHO AWaRe framework for antibiotics.

Methods

Study design, setting, and duration

We employed a hospital based cross-sectional study on drug utilization evaluation of antibiotics in the general surgery department for a duration of six months (November 2022 to April 2023). This is a tertiary care public hospital with a bed occupancy of 800.

Study participants

We included both male and female patients who underwent surgery and prescribed with at least one antibiotic during pre-operative and post-operative phase. We exclude day care patients and patients with any active infection.

Sampling technique and sample size estimation

We employed convenience and judgemental sampling for selecting patients. The estimated sample size is 384 with a population size of 20000, 5% margin of error, and 95% confidence interval.

World Health Organization- Access, Watch, and Reserve (AWaRe) classification of antibiotics [9]

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Access group of antibiotics are first and second choices for empirical treatment of 21 common or severe clinical syndromes. These access antibiotics are a core set of antibiotics and should always be made available in every place at an appropriate dose, quality, duration, price, and formulation. The Watch group includes antibiotics with higher toxicity concerns or resistance potential compared with the Access group. The Watch group antibiotics assist the development of tools for stewardship at the global, national, and local levels. The Reserve group antibiotics are last-resort options and are used for specific patients and clinical settings in case of failure of other alternatives. Prioritizing this group as key targets of high-intensity international and national stewardship programs saves their effectiveness.

Data Collection and Data analysis

We collected data on age of the patient, gender, diagnosis, type of surgery, name of surgery, pre-operative antibiotics, post-operative antibiotics, AWaRe category, spectrum of activity of antibiotic, dosing, route of administration, allergic reactions from patients' case sheets and accessibility, and patients' acceptability from patient interaction. We represented qualitative data in the form of frequencies and percentages and quantitative data in the form of mean ± standard deviation or median and interquartile range, which ever is appropriate. Jeffrey's Amazing Statistical Programme (JASP version 0.18.3) was used for statistical analysis.

Ethical Approval

The institutional ethical committee approved our study (VIPT/IEC/221/2022). We obtained a written informed consent from patients who are willing to participate in our study. We ensured confidentiality of data by removing the personal identifiers to protect participant identities and limited the access of the final data to authorized personnel (MVK).

Results

Table1 presents a comprehensive overview of the sociodemographic and clinical characteristics of the patients. The mean age of the patients is 41.65 years with a standard deviation of 15.50 years. Males constitute a larger proportion of the sample at 55.3%. The most common diagnoses include Lipoma & Cysts (14.9%), Hernias (14.7%), and Infections and Abscesses (14.2%). The most frequently performed surgical procedure is Debridement and Excision, accounting for 28.4% of cases. Patient accessibility to healthcare facilities is reported to be low, at 24.6%, whereas patient acceptability of treatments is high, at 80.1%. The majority of patients (93.6%) did not experience any allergic reactions.

Table (1): Sociodemographic and clinical characteristics of patients (n=423).

Characteristic	Statistic
Age (in years)	41.65 ± 15.50
Males, n (%)	234 (55.3)
Diagnosis, n (%)	
Lipoma & Cysts	63 (14.9)
Hernias	62 (14.7)
Infections and Abscesses	60 (14.2)
Ulcers and Fissures	47 (11.1)
Appendicitis	28 (6.6)
Hemorrhoids	24 (5.7)
Diabetic Foot Infections	06 (1.4)
Miscellaneous	133 (31.4)
Surgery, n (%)	
Debridement and excision	120 (28.4)
Hemorrhoid related surgeries	49 (11.6)
Hernia repairs	46 (10.9)
Abscess and cyst surgeries	43 (10.2)
Appendectomies	37 (8.7)
Thyroid surgeries	11 (2.6)
Miscellaneous	117 (27.7)
Accessibility, n (%)	
Yes	104 (24.6)
No	319 (75.4)
Patient's acceptability, n (%)	
Yes	339 (80.1)
No	84 (19.9)
Allergic Reactions, n (%)	
No reactions	396 (93.6)
Itching	11 (2.6)
Rashes	10 (2.4)
Vomitings	3 (0.7)
Desquamation	3 (0.7)

Table (2): Prescribing pattern of pre-operative antibiotics in the patients.

Name of the Antibiotic	Class of Antibiotic	Frequency (%)	AWaRe Category
Ceftriaxone	3rd gen Cephalosporin	263 (63.2)	Watch
Cefoperazone + Sulbactam	3rd gen Cephalosporin + Beta lactamase inhibitor	58 (13.94)	Watch+ Access
Amoxicillin+ Clavulanic acid	Penicillin + Beta lactamase inhibitor	49 (11.70)	Access
Cefuroxime	2nd gen Cephalosporin	7 (1.68)	Watch
Piperacillin + Tazobactam	Penicillin + Beta lactamase inhibitor	6 (1.44)	Watch
Cefixime	3rd gen Cephalosporin	4 (0.96)	Watch
Metronidazole	Anthelmintic	3 (0.72)	Access
Ofloxacin	Fluoroquinolone	1 (0.24)	Watch

Table (3): Prescribing patterns of post-operative antibiotics in the patients.

Name of the Antibiotic	Class of the Antibiotic	Frequency (%)	AWaRe Category
Ceftriaxone	3rd gen Cephalosporin	181 (43.50)	Watch
Amoxicillin+ Clavulanic acid	Penicillin + Beta Lactamase inhibitor	122 (29.32)	Access
Cefuroxime	2nd gen Cephalosporin	49 (11.77)	Watch
Metronidazole	Anthelmintic	45 (10.81)	Access
Cefoperazone+ Sulbactam	3rd gen Cephalosporin + Beta lactamase inhibitor	24 (5.76)	Watch+ Access
Piperacillin+ Tazobactam	Penicillin + Beta lactamase inhibitor	14 (3.36)	Watch
Ciprofloxacin	Fluoroquinolone	12 (2.88)	Watch
Cefixime	3rd gen Cephalosporin	11 (2.64)	Watch
Amikacin	Aminoglycoside	5 (1.20)	Access
Azithromycin	Macrolide	1 (0.24)	Watch
Linezolid	Oxazolidinone	1 (0.24)	Reserve
Meropenem	Carbapenem	1 (0.24)	Watch

Ceftriaxone, a third-generation cephalosporin, was the most frequently prescribed antibiotic for both pre-operative (63.2%) and post-operative (43.5%) surgical procedures (Table 2 and Table 3). According to the AWaRe framework of antibiotics, antibiotics in the "Watch" category were the most commonly prescribed in both pre-operative and post-operative settings. The average number of antibiotics per prescription were 2.16 and had a compliance rate of 90.89% with the National List of Essential Medicines (NLEM).

Discussion

Accessibility to surgical care remains a critical issue, with only 24.6% of patients reporting easy access in the current study. This sheer contrast highlights ongoing challenges in healthcare accessibility. A study on geographical health accessibility and socioeconomic deprivation found that these factors significantly impact surgical outcomes, underscoring the need for improved healthcare access [13]. Patient acceptability of the surgical procedures was high, with 80.1% expressing satisfaction. This aligns with the findings of other studies that reported high levels of patient satisfaction in surgical settings. For instance, a study on patient satisfaction in pediatric general surgery settings highlighted the importance of the patient-physician relationship in driving overall satisfaction [14]. High acceptability rates suggest that despite the accessibility issues, the quality of care provided is perceived positively by patients.

Allergic reactions to antibiotics were relatively low, with itching (2.6%), rashes (2.4%), vomiting (0.7%), and desquamation (0.7%) being the most common. These rates are consistent with the findings of studies that reported similar adverse reaction rates in surgical patients. For example, a prospective evaluation of adverse reactions to single-dose intravenous antibiotic prophylaxis during outpatient hand surgery found that the rate of adverse reactions was minimal [15]. In contrast, another study highlighted that antibiotics are the most frequent cause of life-threatening anaphylaxis in the operating theatre, further emphasizing the need for careful monitoring of antibiotic use [16].

Similar to our study, few studies reported ceftriaxone as the most commonly prescribed antibiotic in the surgery wards [17-19]. Ceftriaxone is a third-generation cephalosporin antibiotic with a broad spectrum of activity against a wide range of Gram-positive and Gram-negative bacteria [17]. This broad-spectrum coverage makes it an attractive choice for empiric antibiotic therapy in surgical settings where there will be uncertainty about the source of infection and lack of microbiological evidence [20]. This broad coverage is essential in surgical environments where infections often involve multiple types of bacteria [21]. Additionally, ceftriaxone has a long half-life, allowing for convenient once-daily dosing, which can improve patient compliance and ease of administration in hospital settings [22].

In contrast, few studies emphasized the use of cefazolin, a first-generation cephalosporin, for surgical prophylaxis due to its efficacy against Staphylococcus species and gram-negative bacilli, superior pharmacokinetic properties, ease of administration, and cost effectiveness [23, 24]. According to American Society of Health-System Pharmacists (ASHP) clinical practice guidelines for antimicrobial prophylaxis in surgery, cefazolin is recommended for hernioplasty and uncomplicated appendicitis. For patients with beta-lactam allergy, the alternative agents are clindamycin and vancomycin are the drugs of choice for hernioplasty [25]. Furthermore, cefazolin is an “Access” group antibiotic, whereas ceftriaxone is an “Watch” category antibiotic. Therefore, indiscriminate use of watch group antibiotics such as ceftriaxone over access antibiotics such as cefazolin can contribute to the emergence and spread of resistant pathogens [26, 27]. Additionally, cefazolin is as effective as ceftriaxone in preventing surgical site infections and is inexpensive and safer than ceftriaxone [28].

We observed a high compliance rate (90.89%) with the National List of Essential Medicines (NLEM) compared to a study (81.57%) by Kumar et al. [29]. Despite a more standardized approach to antibiotic prescription, we observed a prevalent prescription of the cefoperazone + sulbactam combination, which is not included in NLEM 2022. While adherence to the NLEM is an essential step in promoting judicious antibiotic use, the inclusion of certain antibiotics not listed in the NLEM raises questions about the appropriateness of their usage and the need for regular updates to reflect emerging healthcare trends.

The study has a few limitations. The study was conducted in a single center and the antibiotic prescribing practices may differ from other healthcare settings. We excluded day care patients and patients with active infections and this limits the generalizability of our findings.

Conclusion

The study highlights significant challenges in surgical care accessibility, with only 24.6% of patients reporting easy access. Despite high patient satisfaction and low adverse reactions to antibiotics, the prevalent use of cefoperazone + sulbactam, not included in NLEM, raises concerns. The preference for ceftriaxone over cefazolin warrants reconsideration due to resistance risks. Future research should explore strategies to improve access and adherence to standardized guidelines, ensuring judicious antibiotic use.

Disclosure Statement

- **Data Availability Statement:** The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.
- **Conflicts of Interest:** The authors declare no conflicts of interest.
- **Funding:** This study was not funded.

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References

1] Ashokan A, Charly KA, Anand MB, Hussain S, George C. Drug Utilization Study on Antibiotics in The Department of Medicine at a Tertiary Care Hospital: A Retrospective Observational Cohort Study. International Journal of Scientific and Research Publications. 2022;12(8):352-360. http://dx.doi.org/10.29322/IJSRP.12.08.2022.p12844

2] Suhas Reddy C, Davoudi RH, Shankar BK, Mariyam AS. Drug Utilization Evaluation of Cephalosporins in the General Medicine and General Surgery Departments in A Tertiary Care Teaching Hospital. Am J Phar Heal Res. 2015;3(6):1-11

3] Thu TA, Rahman M, Coffin S, Harun-Or-Rashid M, Sakamoto J, Hung NV. Antibiotic use in Vietnamese hospitals: a multicenter point-prevalence study. Am J Infect Control. 2012 Sep;40(9):840-4. https://doi.org/10.1016/j.ajic.2011.10.020.

4] van der Meer JW, Gyssens IC. Quality of antimicrobial drug prescription in hospital. Clin Microbiol Infect. 2001;7(Suppl 6):12-15. https://doi.org/10.1046/j.1469-0691.2001.00079.x.

5] Suhas Reddy C, Davoudi RH, Shankar BK, Mariyam AS. Drug Utilization Evaluation of Cephalosporins in the General Medicine and General Surgery Departments in A Tertiary Care Teaching Hospital. Am J Phar Heal Res. 2015;3(6):1-11

6] Ortmann MJ, Johnson EG, Jarrell DH, Bilhimer M, Hayes BD, Mishler A, Pugliese RS, Roberson TA, Slocum G, Smith AP, Yabut K, Zimmerman DE. ASHP Guidelines on Emergency Medicine Pharmacist Services. Am J Health Syst Pharm. 2021;78(3):261-275. https://doi.org/10.1093/ajhp/zxaa378.

7] Raut A, Cherian T, Chauhan S, Pawar A. Antibiotic utilization pattern at the surgery department of a tertiary care hospital. Asian Journal of Pharmaceutical and Clinical Research. 2017;10(6):131. https://doi.org/10.22159/ajpcr.2017.v10i6.1809.

8] Ahmed N, Balaha M, Haseeb A, Khan A. Antibiotic Usage in Surgical Prophylaxis: A Retrospective Study in the Surgical Ward of a Governmental Hospital in Riyadh Region. Healthc (Basel). 2022;10(2):387. https://doi.org/10.3390/healthcare10020387.

9] Mugada V, Mahato V, Andhavaram D, Vajhala SM. Evaluation of Prescribing Patterns of Antibiotics Using Selected Indicators for Antimicrobial Use in Hospitals and the Access, Watch, Reserve (AWaRe) Classification by the World Health Organization. Turkish Journal of Pharmaceutical Sciences. 2021;18(3):282-288. https://doi.org/10.4274/tjps.galenos.2020.11456.

10] Mudenda S, Nsofu E, Chisha P, Daka V, Chabalenge B, Mufwambi W, et al. Prescribing Patterns of Antibiotics According to the WHO AWaRe Classification during the COVID-19 Pandemic at a Teaching Hospital in Lusaka, Zambia: Implications for Strengthening of Antimicrobial Stewardship Programmes. Pharmacoepidemiology. 2023;2(1):42–53. https://doi.org/10.3390/pharma2010005

11] Islam MA, Akhtar Z, Hassan MZ, Chowdhury S, Rashid MM, Aleem MA, et al. Pattern of Antibiotic Dispensing at Pharmacies According

to the WHO Access, Watch, Reserve (AWaRe) Classification in Bangladesh. Antibiotics (Basel). 2022;11(2):247. https://doi.org/10.3390/antibiotics11020247.

12] Rashid MM, Akhtar Z, Chowdhury S, Islam MA, Parveen S, Ghosh PK, et al. Pattern of Antibiotic Use among Hospitalized Patients according to WHO Access, Watch, Reserve (AWaRe) Classification: Findings from a Point Prevalence Survey in Bangladesh. Antibiotics (Basel). 2022;11(6):810. https://doi.org/10.3390/antibiotics11060810.

13] Pouchucq C, Menahem B, Le Roux Y, Bouvier V, Gardy J, Meunier H, Thomas F, Launoy G, Dejardin O, Alves A. Are Geographical Health Accessibility and Socioeconomic Deprivation Associated with Outcomes Following Bariatric Surgery? A Retrospective Study in a High-Volume Referral Bariatric Surgical Center. Obes Surg. 2022;32(5):1486-1497. https://doi.org/10.1007/s11695-022-05937-w.

14] Lu KB, Vinocur C, Burrows JF, Rosen P. Key determinants of patient satisfaction in the ambulatory pediatric general surgery setting. 2017;2: 1324.

15] Sandrowski K, Edelman D, Rivlin M, Jones C, Wang M, Gallant G, Beredjiklian PK. A Prospective Evaluation of Adverse Reactions to Single-Dose Intravenous Antibiotic Prophylaxis During Outpatient Hand Surgery. Hand (N Y). 2020;15(1):41-44. https://doi.org/10.1177/1558944718787264.

16] Torjesen I. Antibiotics are the main cause of life-threatening allergic reactions during surgery. BMJ. 2018 ;361: k2124. https://doi.org/10.1136/bmj.k2124.

17] Shinu MJ, Bijoy Kumar P, Banerjee JK, Soman N. A study on prescribing pattern of cephalosporins utilization and its compliance towards the hospital antibiotic policy in surgery ward of a tertiary care teaching hospital in India. International surgery journal. 2019;6(10):3614–4. https://www.ijsurgery.com/index.php/isj/article/view/4795

18] Pinto M, Phillips M, Ramlal H, Teemul K, Prabhakar P. Third generation cephalosporin use in a tertiary hospital in Port of Spain, Trinidad: need for an antibiotic policy. BMC Infectious Diseases. 2004;4(1). https://bmcinfectdis.biomedcentral.com/articles/10.1186/1471-2334-4-59

19] Sileshi A, Tenna A, Feyissa M, Shibeshi W. Evaluation of ceftriaxone utilization in medical and emergency wards of Tikur Anbessa specialized hospital: a prospective cross-sectional study. BMC Pharmacol Toxicol. 2016;17:7. https://doi.org/10.1186/s40360-016-0057-x

20] Vu TLH, Vu QD, Hoang BL, Nguyen TCT, Ta TDN, Nadjm B, van Doorn HR. Factors influencing choices of empirical antibiotic treatment for bacterial infections in a scenario-based survey in Vietnam. JAC Antimicrob Resist. 2020;2(4):dlaa087. https://doi.org/10.1093/jacamr/dlaa087

21] Couto M, Freire M, Mozar Castro Neto, Rodrigues C, Melo M, Leite EMM, et al. 189. Optimizing Empiric Antibiotic Therapy: a Probabilistic Approach. Open forum infectious diseases. 2022; 9(Supplement_2). https://academic.oup.com/ofid/article/9/Supplement_2/ofac492.267/6902478

22] Lamb HM, Ormrod D, Scott LJ, Figgitt DP. Ceftriaxone: an update of its use in the management of community-acquired and nosocomial infections. Drugs. 2002;62(7):1041-89. https://doi.org/10.2165/00003495-200262070-00005.

23] Crader MF, Varacallo M. Preoperative Antibiotic Prophylaxis. In: StatPearls Publishing, editors. StatPearls, 2023.

24] Parulekar VV, Badar VA, Gupta V, Garate P. A Drug Utilization Study of Antimicrobials in Major Surgical Patients in Tertiary Care Teaching Hospital- A Prospective Observational Study. J Med Sci Clin Res. 2020;8(4):228-240. https://doi.org/10.18535/jmscr/v8i4.44.

25] American Society of Health-System Pharmacists. Clinical practice guidelines for antimicrobial prophylaxis in surgery. 2013. https://www.ashp.org/surgical-guidelines

26] WHO Access, Watch, Reserve (AWaRe) classification of antibiotics for evaluation and monitoring of use, 2021. Geneva: World Health Organization; 2021 (WHO/MHP/HPS/EML/2021.04). Licence: CC BY-NC-SA 3.0 IGO.

27] Esposito S, Noviello S, Vanasia A, Venturino P. Ceftriaxone versus Other Antibiotics for Surgical Prophylaxis: A Meta-Analysis. Clin Drug Investig. 2004;24(1):29-39. https://doi.org/10.2165/00044011-200424010-00004.

28] Ahmed NJ, Haseeb A, Alamer A, Almalki ZS, Alahmari AK, Khan AH. Meta-Analysis of Clinical Trials Comparing Cefazolin to Cefuroxime, Ceftriaxone, and Cefamandole for Surgical Site Infection Prevention. Antibiotics (Basel). 2022 Nov 3;11(11):1543. https://doi.org/10.3390/antibiotics11111543

29] Kumar S, Kumar KS. Evaluation of Suspected Adverse Drug Reaction and Prescribing Patterns of Perioperative Antimicrobials in Major Surgical Patients of Tertiary Care Hospital of Bihar. International Journal of Pharmaceutical Sciences Review and Research 2023; 78:25-31. http://dx.doi.org/10.47583/ijpsrr.2023.v78i02.004.