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RESEARCH ARTICLE

Meropenem Usage Assessment amid the Antibiotic Resistance Crisis: A Comprehensive Analysis in a Tertiary Care Hospital in Pakistan

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Abstract

Background: With antibiotic resistance posing a growing threat to global health, the prudent use of antibiotics like meropenem is imperative. However, empirical prescribing practices and inadequate adherence to guidelines contribute to challenges in meropenem utilization. This study aims to comprehensively assess prescribing patterns, adherence to guidelines, and patient education practices in a tertiary care hospital in Pakistan.

Methods: A cross-sectional study was conducted over six months, enrolling 100 patients. Data collection included variables such as age, gender, hospital stay duration, indication for meropenem prescription, dosage regimen, basis of prescription, treatment duration, and patient education. Statistical analysis was performed using IBM SPSS version 26.

Results: Empirical prescribing was common, with an initial diagnosis accuracy rate of 64%. Disparities were noted in aligning culture sensitivity with meropenem use, with only 36% of cases following culture results. Regarding treatment duration, an alarming 86% of cases had incorrect durations. Comparative analyses highlighted areas for prescription protocol and clinical outcome improvement. For instance, 96% of cases had the correct initial meropenem dosage. Despite meticulous monitoring, deficiencies persisted in patient education and antibiotic stewardship.

Conclusion: The study underscores the urgent need for standardized guidelines, enhanced diagnostics, and educational initiatives to mitigate antibiotic resistance emergence. Addressing these challenges is crucial for safeguarding antibiotic efficacy and public health.

Introduction

In modern medicine, antibiotics have been heralded as miracle drugs, saving countless lives and revolutionizing how we treat bacterial infections. However, as we bask in the success of these wonder drugs, a silent crisis is unfolding – one that threatens to undo decades of medical progress. Antibiotic resistance, a phenomenon where bacteria evolve to withstand

the effects of these life-saving drugs, is emerging as a formidable challenge, casting a shadow over the future of healthcare.[1]

In the dynamic landscape of antibiotic resistance, Meropenem once celebrated for its efficacy in combating bacterial infections, now confronts a critical juncture characterized by diminishing effectiveness. The ascendancy of Meropenem was marked by its broad-spectrum capabilities, presenting a promising solution for a diverse array of bacterial infections.[2]

However, the laudable attributes of this antibiotic have been undermined by the injudicious deployment stemming from overzealous use. The tendency to prescribe Meropenem excessively, driven by a desire for rapid and comprehensive therapeutic outcomes, has inadvertently provided a conducive environment for the emergence of resistant strains.[3]

The haphazard empirical utilization of drugs, exemplified by the indiscriminate use of meropenem, underscores the necessity for a focused drug utilization study. Such a study is essential to rationalize and streamline the seemingly extravagant use of this medication. A drug utilization study involves a systematic analysis of the usage patterns, trends, and influential factors shaping the administration of medications within a specific population over a defined timeframe. This comprehensive examination provides valuable insights into prescription practices, patient adherence, potential instances of misuse, and the overall effectiveness of drugs.[4]

Consequently, this study was undertaken at a tertiary care hospital in Pakistan to elucidate the conceptual framework surrounding meropenem prescription. The study specifically focused on key aspects such as indications for prescription, dosage regimens, considerations related to culture sensitivity, and the level of patient education accompanying the use of meropenem. This endeavour contributes to a more comprehensive understanding of prescription practices, paving the way for potential improvements in patient care, antibiotic stewardship, and overall healthcare outcomes.

Methods

Study Design and Population

Conducted as a cross-sectional investigation, this study aimed to assess the prescribing patterns of meropenem within the confines of a tertiary care institution in Pakistan. Spanning a duration of six months, from August 2023 to February 2024, the study received approval from the hospital's ethical review board.

Inclusion Criteria

Included in the study were patients of both genders, aged 16 years and older, who were admitted to the medical unit and received a prescription for meropenem for any medical condition.

Exclusion Criteria

Patients who declined consent and those admitted to the intensive care unit were excluded from the study.

Study Sample

A sample size of 100 was determined using the WHO sample size calculator. Participants were selected through convenient non-probability sampling, involving regular visits to medical units, direct interviews with patients or their caregivers, and a thorough review of treatment records. Informed consent was obtained from all participants before data collection.

Variables and Operational Definitions

Data were collected on various variables, including age, gender, duration of hospital stay, the reason for meropenem prescription (initial diagnosis), appropriateness of prescription, basis of prescription (empirical or guided by culture results), dosage and its accuracy, treatment duration and its correctness, creatinine clearance (estimated using the Cockcroft-Gault formula), and other relevant factors. Patients were monitored for adverse effects, treatment outcomes, and any modifications to therapy throughout their hospitalization. Clinical response was defined as the alleviation of infection symptoms, absence of symptom exacerbation, and clinical stability sustained for at least 24 hours. The appropriateness of meropenem indication, dosage, and treatment duration was evaluated based on clinical practice guidelines and authoritative references.[5][6]

Statistical Analysis

Data analysis was performed using IBM SPSS version 26.

Results

This study encompassed an analysis of 100 patients, all subjected to an evaluation of meropenem utilization. Among this cohort, 61% were male. The average age of the patients, represented as the mean ± standard deviation, was 37.84 ± 20.34 years.

Remarkably, meropenem was universally prescribed empirically across all cases. The predominant indication for its use was Enteric fever, accounting for 34%, followed by Pyrexia of unknown origin at 21%, and Urinary tract infection at 10%. Notably, upon initial indications, 64% were deemed accurate, while 36% were classified as incorrect.

The distribution of dosages corresponding to the initial diagnosis is visually represented in Figure 1. Notably, the prevailing initial dosing regimen employed was 1g IV TDS, particularly in cases of enteric fever. Impressively, the dose initially prescribed based on the presumed diagnosis was found to be correct in an overwhelming 96% of cases.

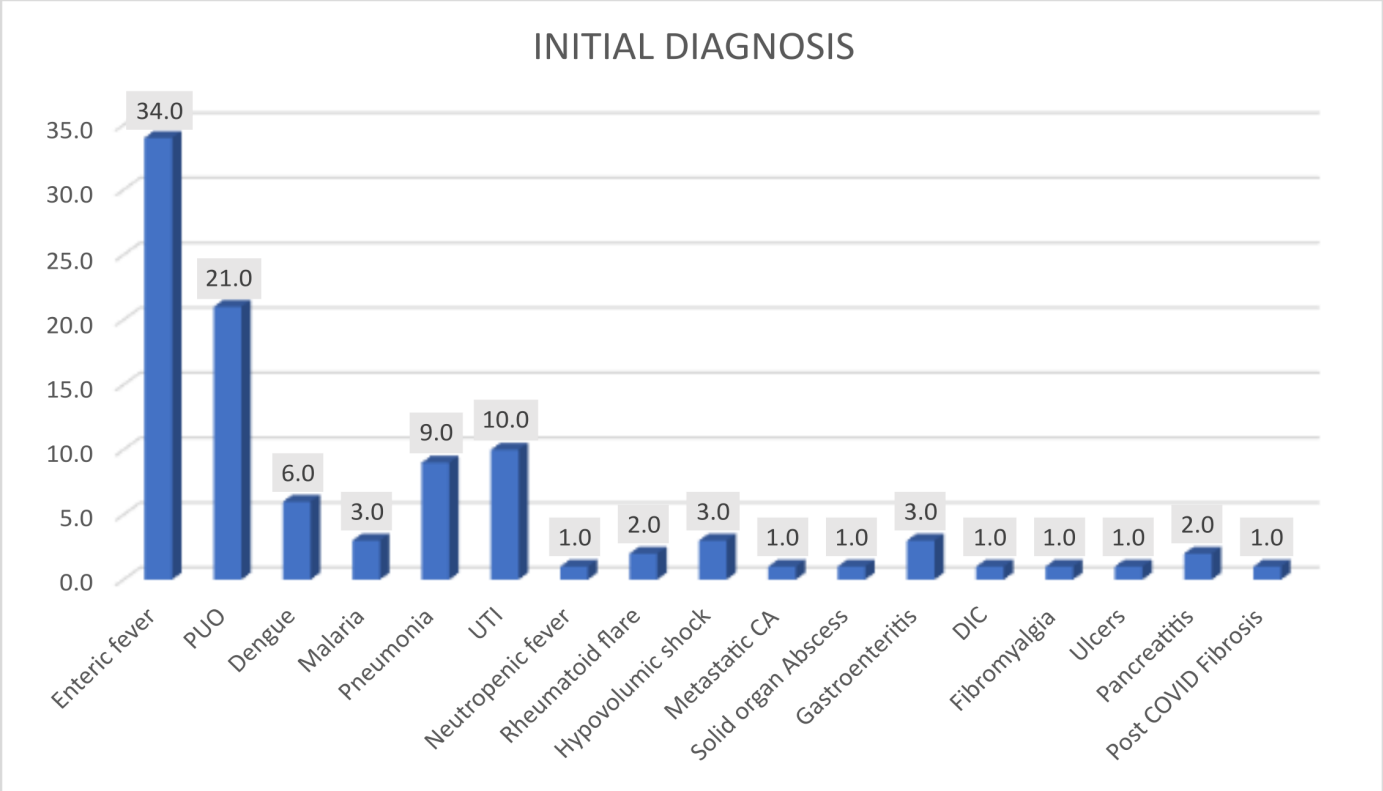
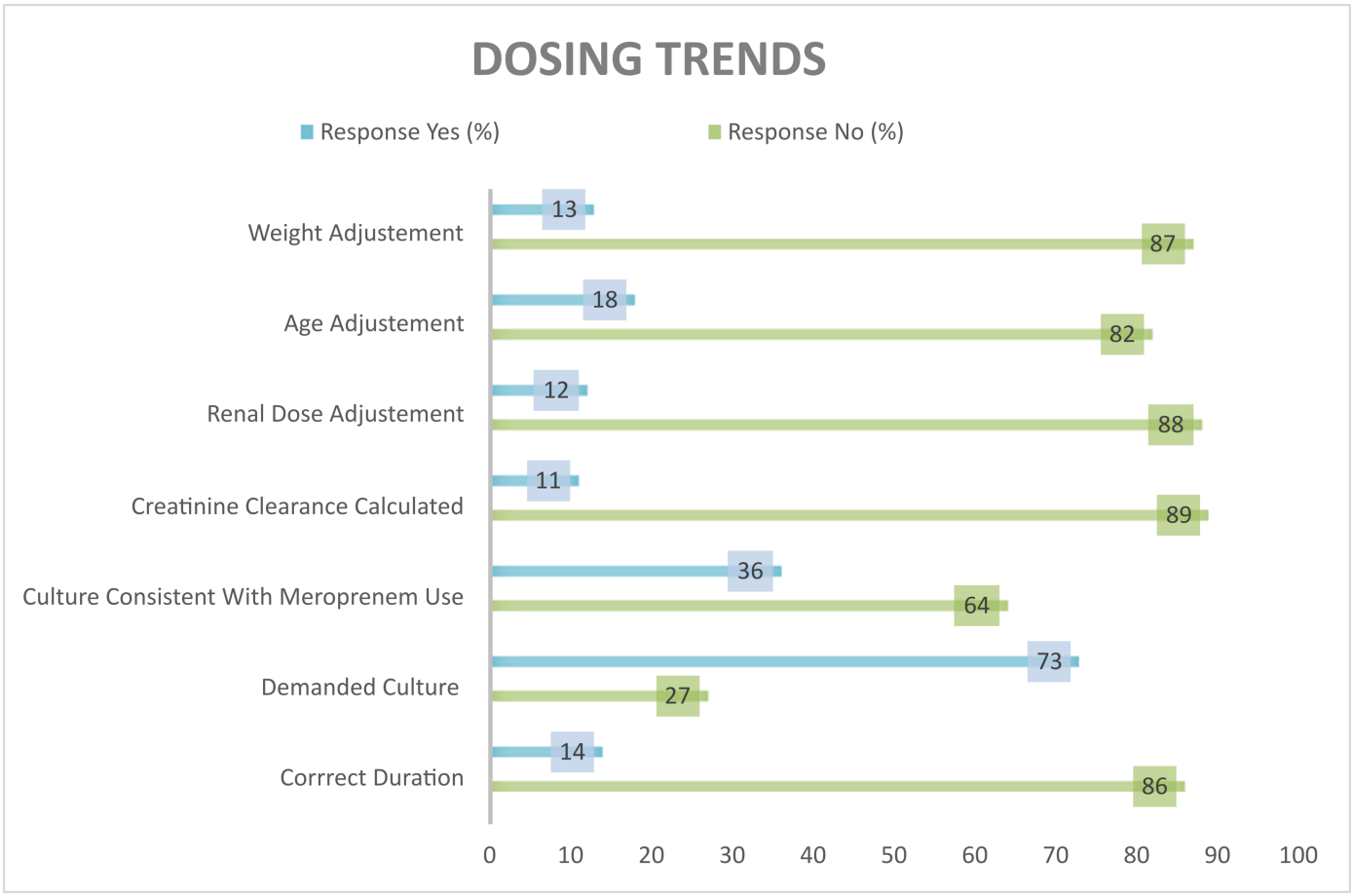


Figure 1.

Cultural investigation demands were observed in 73% of cases, with only 36% of them aligning with meropenem use. This disjunction emphasizes a potential discordance between empirical prescription practices and culture results.

The mean ± standard deviation duration of the administered dose was calculated at 4.56 ± 2.709 days. Intriguingly, this duration was deemed incorrect in a substantial 86% of cases, shedding light on a noteworthy area for potential refinement in the duration of meropenem therapy.

Furthermore, the study explored additional trends related to dose adjustments based on factors such as age, weight, and renal function, all of which are graphically depicted in Figure 2.



Remarkably, despite the absence of a specific system of scheduled review in 91% of cases, the therapy was diligently monitored. This monitoring was intricately tailored to the individual patient's clinical response. Consequently, therapy was modified in an impressive 95% of cases, encompassing adjustments in terms of dosage, duration, and the addition or removal of other drugs that could potentially interfere with the treatment process.

The overall state of patient education was suboptimal, reflecting a deficiency in various dimensions, as depicted comprehensively in Figure 3. This visual representation underscores that multiple facets of patient education were inadequately covered as a whole.

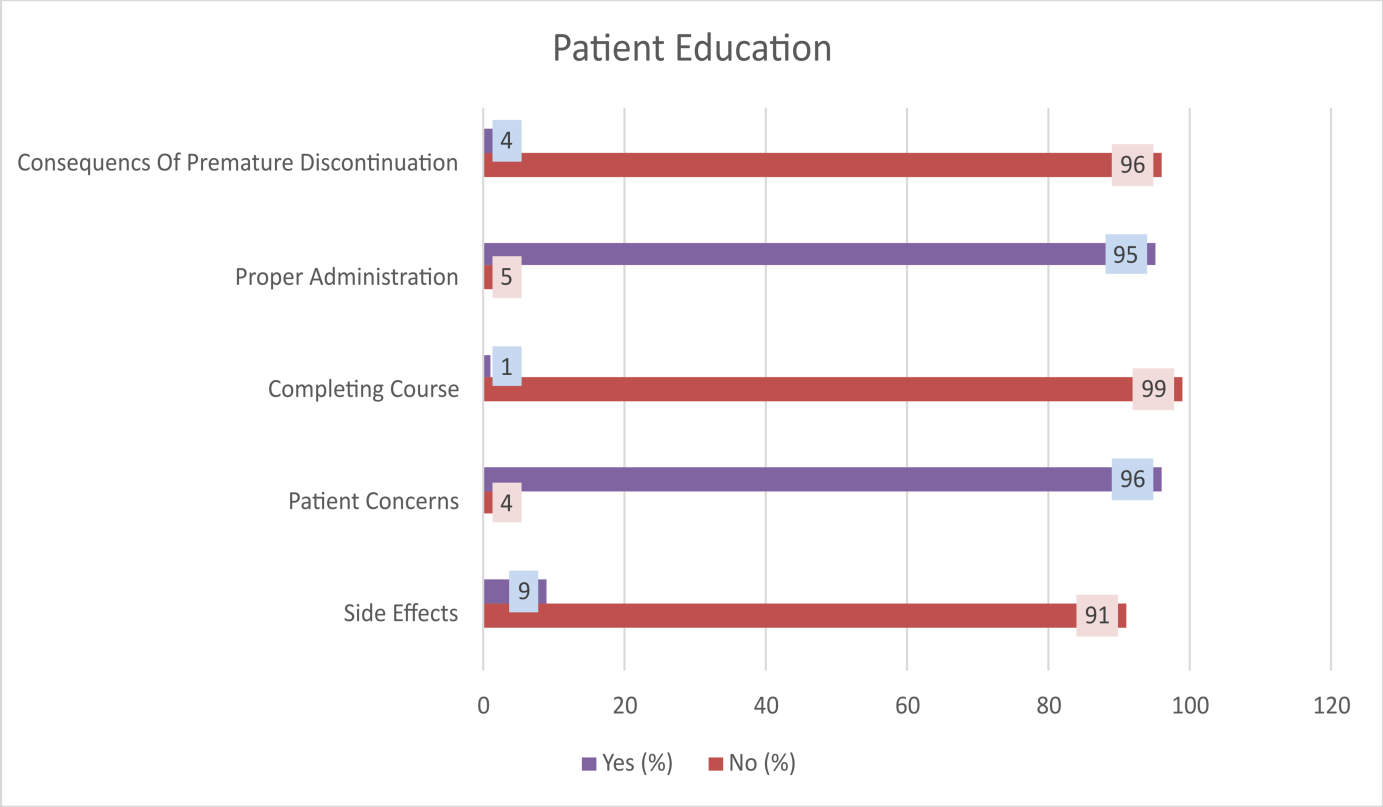


Figure 3.

Discussion

One of the primary causes of illness and mortality worldwide is infectious diseases, and antibiotics, once hailed as miraculous medications, are now facing issues of resistance and decreased potency. Our study aimed to determine the appropriateness of meropenem use in a Pakistani tertiary care hospital.

The results of our study revealed significant rates of errors in meropenem prescription, with all prescriptions being empirical. Moreover, only 63% of empirical prescriptions were deemed accurate. This indicates that meropenem prescription mainly relies on clinical judgment and experience rather than standard guidelines.

Comparative analysis of three hospitals—Alzahra Hospital in Asfahan, a tertiary care facility; a hospital in Karachi; and our setting in Pakistan—provides insights into empirical prescribing practices and treatment outcomes.[7][8] While pneumonia emerges as the primary indication in Alzahra (100%) and the Karachi hospital (majority), enteric fever prevails prevails in our setting.

The variability in empirical initial prescription rates underscores the need for standardized protocols across settings. Interestingly, despite moderate success rates in aligning indications with culture results (Alzahra: 37.4%, Karachi: 43%, our setting: 36%), there is significant disparity in the correct duration of treatment, particularly notable in our setting (Alzahra: 53.7%, Karachi: 64.6%, our setting: 14%). Alzahra Hospital demonstrates superiority in providing the correct dose (Alzahra: 86.2%, Karachi: 70.6%, our setting: 96%), highlighting potential areas for knowledge exchange and

improvement. Moreover, disparities in culture acquisition rates prompt further exploration into diagnostic practices and resource allocation (Alzahra: 52%, Karachi: 38.8%, our setting: 73%).[7][8] This comprehensive examination offers valuable insights for refining clinical practices and optimizing patient outcomes across diverse healthcare settings.

In light of the data acquired, errors in obtaining cultures and adjusting antibiotics according to culture results, as well as the duration of antibiotic treatment, are areas of antibiotic therapy that need focused attention as they may necessitate antibiotic adjustments or de-escalation.

A comparison between Sukhothai Hospital in Thailand and our setting in Pakistan highlights significant differences in various healthcare metrics.[9] Sukhothai Hospital demonstrates notably higher rates of correct indication alignment (95.7%) compared to our setting's 36%. Similarly, Sukhothai Hospital excels in culture acquisition, reporting 96.6% compared to our setting's 73%. However, in terms of appropriate dose administration, our setting surpasses Sukhothai with a rate of 96% compared to Sukhothai's 81%. Additionally, Sukhothai Hospital maintains higher rates of correct treatment duration, with 81%, while our setting lags significantly behind at 14%. (Figure 2) These findings suggest potential areas of improvement in clinical practices at our setting, particularly in ensuring accurate indication alignment and treatment duration, despite its commendable performance in culture acquisition and appropriate dosing. Further analysis and exchange of best practices between these institutions could enhance overall patient care and outcomes.

The incorrect prescription of antibiotics and duration of treatment may result from diagnostic inaccuracy where the initial and final diagnoses differ, but the patient inappropriately receives the medication. Additionally, the study examined other patterns regarding dosage adjustments based on factors like age, weight, and renal function.[10][11] These revealed areas of negligence, although 95% of patients had their treatment meticulously monitored based on their clinical response, only 11% had their creatinine clearance calculated, and there was little to no dose adjustment based on age and weight. (Figure 2)

Antibiotic use must be limited to the right indications to reduce the evolution of resistant microorganisms. It is concerning that the improper review system and local hospital policies on antibiotic prescription contribute to the dangerous use of these medications.

Conclusion

In conclusion, educational initiatives emphasizing antibiotic use and the critical problem of antibiotic resistance, as well as the creation of local hospital guidelines for prescribing antibiotics, ordering cultures with an accurate antibiogram, and adjusting treatment accordingly, can all contribute to reducing the emergence of resistance.

Statements and Declarations

Ethical Approval

The Ethical Review Board of the institution has reviewed the Article in accordance with the declaration of Helsinki (2013) and found it to meet the requirements and be approved.

Approval number: 1755

Consent

Informed consent was obtained from the respondents before filling out the questionnaire. All sorts of identifying details were fully omitted.

Provenance and peer review

Not commissioned, externally peer-reviewed.

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