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Retrospective Study

Clinical pharmacists' involvement in carbapenem antibiotic management at Wenzhou Integrated Hospital: Exploration and analysis

Xu XM *et al.* Analysis of the management of carbapenem antibiotics

Abstract

BACKGROUND

Carbapenem antibiotics serve as a pivotal solution in treating severe infections, particularly in hospital settings. The emergence of carbapenem-resistant bacteria due to the irrational and extensive use of carbapenems underscores the need for meticulous management and rational use of these drugs. Clinical Pharmacists, with their specialized training and extensive knowledge, have a substantial role in ensuring the judicious use of these antibiotics. This study seeks to elucidate the patterns of carbapenem utilization and to shed light on the integral role played by Clinical Pharmacists in managing and promoting rational use of carbapenem antibiotics at Wenzhou Integrated Traditional Chinese and Western Medicine Hospital.

AIM

This study aims to analyze the utilization patterns of carbapenem antibiotics in our hospital over the past few years and investigate the role of Clinical Pharmacists in their management and rational use.

METHODS

A retrospective analysis of carbapenem usage from January 2019 to December 2021 was performed at our hospital. Several key indicators, including the Drug Utilization Index (DUI), Defined Daily Doses (DDDs), proportion of antimicrobial drug costs to total hospitalization expenses, Antibiotic Utilization Density (AUD), and utilization rate in different clinical departments, were comprehensively analyzed.

RESULTS

Between 2019 and 2021, there was a consistent decline in the consumption and sales of imipenem-cilastatin sodium, meropenem (0.3 g), and meropenem (0.5 g). Conversely, the DDDs of imipenem-cilastatin sodium for injection increased in 2020 and 2021 compared with those in 2019, with a B/A value of 0.67, indicating a relatively higher drug cost. The DDDs of meropenem for injection (0.3 g) exhibited an overall upward trend, indicating an increasing clinical preference; however, the B/A values for 2020 and 2021 were both greater than 1, suggesting a relatively lower drug cost. The DDDs of meropenem for injection (0.5 g) demonstrated a progressive increase every year and consistently ranked first, indicating a high clinical preference with a B/A value of 1, signifying good alignment between economic and social benefits.

CONCLUSION

The use of carbapenem antibiotics in our hospital was generally reasonable, with a downward trend in consumption and sales over time. Clinical Pharmacists play a pivotal role in promoting the appropriate use of carbapenems.

Key Words: Clinical Pharmacists; Carbapenem antibiotics; Rational drug use; Drug Utilization Index (DUI); Defined Daily Doses (DDDs); Antibiotic Utilization Density (AUD);

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Core Tip: This study explores the utilization patterns of carbapenem antibiotics and highlights the significant role of Clinical Pharmacists in their management at Wenzhou Integrated Traditional Chinese and Western Medicine Hospital. The findings indicate a decline in consumption and sales of specific carbapenems, while demonstrating an increase in the preference for certain types. The study concludes that the hospital's use of carbapenems is generally reasonable, emphasizing the crucial contribution of Clinical Pharmacists in promoting appropriate antibiotic use.

INTRODUCTION

Carbapenem antibiotics are preferred in hospitals for treating critically ill patients and those with infections due to immunodeficiency^[1-3]. In recent years, the government has issued multiple documents aimed at strengthening the rational use of antimicrobial drugs, which clearly emphasize the need for hospitals to strengthen management and ensure standardized clinical usage of carbapenem antibiotics. The "Management Measures for the Clinical Application of Antimicrobial Drugs" issued by the country also stipulates that the antimicrobial drug management team in hospitals should include leaders from medical, pharmaceutical, clinical microbiology, and other relevant departments, as well as highly qualified personnel with advanced professional titles^[4,5]. Personnel from the medical and pharmaceutical departments are primarily responsible for drug management. In response to this national call, our hospital actively strengthened its professional level of carbapenem antibiotic management by involving various Clinical Pharmacists with specialized training^[6]. This initiative has yielded positive results. This study primarily investigated the use of carbapenem antibiotics in our hospital and subsequently analyzed and evaluated the rationality of their use and the involvement of Clinical Pharmacists in their management.

MATERIALS AND METHODS

1.1 General information

Data were collected from the hospital information management and medical record systems. Patient records of carbapenem use from January 2019 to December 2021 were selected for retrospective analysis. The drug utilization index (DUI), defined daily doses (DDDs), proportion of antimicrobial drug costs to total hospitalization expenses, Antibiotic Utilization Density (AUD), and utilization rate in various clinical departments were statistically analyzed.

1.2 Methods

The defined daily dose (DDD) was determined using the World Health Organization recommended average daily dose for adults. The DDDs were calculated as the total amount of a drug divided by its DDD value, with higher DDDs indicating a higher frequency of drug use. The DUI was calculated as the DDDs divided by the total duration of drug use. The AUD was calculated as (DDDs divided by the total number of patients during the same period) multiplied by 100.

1.3 Statistical analysis

Data were recorded in Microsoft Excel and analyzed using SPSS version 26.0. For normally distributed continuous data, results are expressed as mean \pm standard deviation ($\bar{x} \pm s$), and statistical analysis was performed using t-tests. For non-normally distributed continuous data, the results were expressed as medians (P25 and P75), and statistical analysis was conducted using the Mann-Whitney U test. Categorical data are expressed as frequencies (n, %), and statistical analyses were performed using the chi-square test. Differences were considered statistically significant at $P < 0.05$.

RESULTS

2.1 Drug usage, sales amount, and growth rate

The results indicate that from 2019 to 2021, the usage and sales of imipenem-cilastatin sodium injections, meropenem injections (0.3 g), and meropenem injections (0.5 g) showed a declining trend each year. Detailed data are presented in Table 1.

2.2 Comparison of DDDs, DUI, sales amount, and drug proportion for main carbapenem antibiotics

The DDDs of imipenem-cilastatin sodium for injection showed a steady increase in ranking in both 2020 and 2021 compared to that in 2019, with a B/A value of 0.67, indicating relatively higher drug prices. For meropenem injections (0.3 g), the DDDs exhibited a consistent upward trend from 2019-2021, suggesting a growing clinical preference for this drug. However, the B/A values for 2020 and 2021 were both greater than one, indicating relatively lower drug prices. In contrast, the DDDs of meropenem for injection (0.5 g) increased progressively every year and consistently maintained its top-ranking position, indicating a high clinical preference for this drug. The B/A value was 1, demonstrating good synchronization between the economic and social benefits. Detailed data are presented in Table 2.

DISCUSSION

3.1 Current clinical application of carbapenem antibiotics

The clinical use of carbapenem antibiotics has been increasing, and there has been a noticeable increase in cases of carbapenem-resistant bacteria among patients. Researchers have found that long-term irrational use of carbapenem antibiotics by patients has led to the emergence of carbapenem-resistant *Acinetobacter baumannii* and *Pseudomonas aeruginosa* within their bodies^[7-9]. Some studies have analyzed drug correlations and found a negative correlation between carbapenem-resistant *Pseudomonas aeruginosa* and the use of carbapenem antibiotics in patients without a significant relationship with the amount of drug used^[10,11]. Therefore, hospitals should strictly manage the use of carbapenem antibiotics. Clinical Pharmacists play an essential role in managing these drugs by participating in ward rounds, consultations, and

critical care analysis^[12]. By leveraging their extensive theoretical knowledge and practical experience, they can analyze each patient's specific condition, organ function, and the characteristics of antimicrobial drugs. By tailoring individualized medication plans, they can ensure the rational use of carbapenem antibiotics^[13].

From 2019 to 2021, the sales and DDDs of carbapenem antibiotics used at our hospital consistently declined, which may be attributed to the active involvement of Clinical Pharmacists in the management process^[14,15]. Their contributions likely contributed to the optimization of the utilization of carbapenem antibiotics in our hospital.

3.2 Role of Clinical Pharmacists in carbapenem antibiotics management

Numerous studies have highlighted the crucial role of Clinical Pharmacists in effectively optimizing the clinical use of carbapenem antibiotics, underscoring their significance in healthcare^[16,17]. In 2021, ¹the National Health Commission and State Administration of Traditional Chinese Medicine jointly emphasized the need for hospitals to elevate the quality of pharmaceutical services and promote their transformation of pharmaceutical services. Clinical Pharmacists are entrusted with formulating individualized medication plans for diverse patients to ensure medication safety and rationality, particularly in the complex context of anti-infective therapy^[18,19]. Given the intricacy of patient infections, Clinical Pharmacists are required to diligently monitor various patient parameters, ensuring the standardization and rationality of clinical drug administration^[20]. At our hospital, Clinical Pharmacists actively participate in ward rounds and consultations, meticulously considering patient characteristics, infection profiles, pathogen types, and drug resistance. In collaboration with clinical physicians, they collectively determine the appropriate drug selection and dosages based on antibiogram results^[21]. By considering bacterial resistance levels, they judiciously choose safe and effective antibiotics, and devise and adapt infection treatment regimens^[22,23]. Since the engagement of Clinical Pharmacists in carbapenem antibiotic management, the sales and utilization intensity of various carbapenem

antibiotics have demonstrated a consistent downward trend in our hospital. This highlights the positive impact of optimizing the utilization of these crucial antimicrobial agents by Clinical Pharmacists.

3.3 Recommendations for Clinical Pharmacists' involvement in carbapenem antibiotics management

(1) Standardize the Process: Hospitals should establish standardized procedures for the application of carbapenem antibiotics. When the microbiology department provides Clinical Pharmacists with the results of multidrug-resistant bacteria, immediate discussions should be conducted with physicians. Based on microbiological results and specific manifestations of the patient's condition, Clinical Pharmacists can identify the specific pathogen causing the infection. Tailored treatment measures can be implemented with a comprehensive understanding of the patient's medical and medication histories. (2) Consider Individual Patient Factors: Carbapenem antibiotics often require prolonged use. If patients have symptoms, such as edema, hypoalbuminemia, or renal impairment, their responses to carbapenem antibiotics may be affected. Clinical Pharmacists should leverage pharmacokinetic knowledge and continuously refine medication plans based on the patient's specific condition. This approach maximizes bacterial resistance while minimizing potential harm to a patient's physical and mental well-being. Active participation in training Clinical Pharmacists should enhance their capabilities, particularly in aspects such as increasing the rate of pathogen testing in patients. Pathogen testing is essential for determining the type of pathogen causing an infection, which significantly influences medication decisions and provides valuable guidance for patient treatment. (3) Establish an Antibiotic Expert Group: Hospitals should form antibiotic expert groups to develop guidelines for the clinical use and management of carbapenem antibiotics in accordance with the requirements outlined in the national policies and related documents. (4) Implementation of information technology in carbapenem antibiotic management: A standardized application process should be established to apply carbapenem antibiotics

in clinical settings. The clinical staff must first log into the relevant system to complete the application. Subsequently, Pharmacists with intermediate or high titles review the applications. If approved, it was submitted to an antibiotics expert group for further analysis. Only after a group's approval can a prescription be issued. The prescription review process can be improved by adopting a pre-approval approach. If the Pharmacist identifies any unscientific aspects of the prescription, they should promptly inform the Clinical Physician for revision. Temporary use should not exceed 24 h if necessary. (5) Supervision and management of carbapenem antibiotic use in clinical departments: Clinical Pharmacists should be responsible for supervising and managing the application of carbapenem antibiotics in each department. At the end of each month, they summarized and analyzed the department's drug usage frequency, testing rate, and other relevant aspects. The results should be submitted to the departmental head to help achieve set targets more effectively. (6) Monthly Evaluation of Special Cases: On the 1st day of each month, Clinical Pharmacists should evaluate special patient cases from the previous month based on the hospital's standardized evaluation criteria. Information such as patient age, sex, medical history, microbiology, and medication use should be collected. Using these data, a specialized evaluation of medication rationality should be conducted. If any irrationality is found, Clinical Pharmacists should immediately discuss it with the clinical physician and inform the department head of the evaluation results. If a clinical physician persists in unreasonable practice despite multiple discussions, the behavior should be reported to the hospital's medical management department, leading to public disclosure and penalties. Regular Training for Clinical Pharmacists: Clinical Pharmacists should undergo regular training in carbapenem-related theories and practices. Monthly reviews of prescription practices within each department should be conducted, emphasizing common issues in the clinical use of the drug. Training and guidance should be provided for physicians and nursing staff to address these widespread problems.

While this study provides valuable insights into the utilization of carbapenem antibiotics and the role of Clinical Pharmacists in their management, several limitations need acknowledgment. Firstly, the retrospective nature of the study may introduce biases related to data collection and recording, affecting the reliability of the findings. Secondly, the study's focus on a single hospital limits the generalizability of the results to other healthcare settings with different patient demographics, healthcare systems, and antibiotic use policies. Lastly, the study does not delve into the impact of varying degrees of bacterial resistance on the selection and modification of carbapenem therapy, leaving a scope for future research to explore these aspects in detail.

CONCLUSION

The use of carbapenem antibiotics in our hospital was generally rational, with a consistent decline in their utilization. Clinical Pharmacists play a vital role in ensuring the appropriate use of these antibiotics and assisting physicians in adhering to appropriate prescription practices. The active involvement of Clinical Pharmacists in the standard and rational application of carbapenems is important. Their widespread participation has had a significant impact on promoting the optimal use of carbapenem antibiotics in clinical settings.

ARTICLE HIGHLIGHTS

Research background

This study analyzes the utilization patterns of carbapenem antibiotics at Wenzhou Integrated Traditional Chinese and Western Medicine Hospital and highlights the integral role of Clinical Pharmacists in their management and rational use. Carbapenem antibiotics are crucial for treating severe infections in hospitals, but their irrational and extensive use has led to the emergence of carbapenem-resistant bacteria.

Research motivation

This study is motivated by the need to understand the utilization patterns of carbapenems and the vital role Clinical Pharmacists play in managing and promoting their rational use at Wenzhou Integrated Traditional Chinese and Western Medicine Hospital. By shedding light on these aspects, to contribute to improving antibiotic prescribing practices and ensuring effective infection management.

Research objectives

The main objectives of this study are to analyze the utilization patterns of carbapenem antibiotics at Wenzhou Integrated Traditional Chinese and Western Medicine Hospital over a specified period and to investigate the role of Clinical Pharmacists in managing and promoting their rational use. The study aims to provide insights into the trends of carbapenem consumption and sales, assess key indicators such as Drug Utilization Index (DUI), Defined Daily Doses (DDDs), Antibiotic Utilization Density (AUD), and evaluate the economic and social benefits associated with different carbapenems. Ultimately, the study aims to emphasize the importance of Clinical Pharmacists in ensuring appropriate antibiotic utilization and optimizing patient care.

Research methods

The study employed a retrospective analysis of carbapenem usage at Wenzhou Integrated Traditional Chinese and Western Medicine Hospital from January 2019 to December 2021. Several key indicators, including Drug Utilization Index (DUI), Defined Daily Doses (DDDs), proportion of antimicrobial drug costs to total hospitalization expenses, Antibiotic Utilization Density (AUD), and utilization rate in different clinical departments, were comprehensively analyzed. These indicators provided insights into the patterns of carbapenem utilization and allowed for an assessment of economic and social benefits associated with different carbapenems. The data analysis aimed to elucidate trends and preferences in carbapenem utilization, shedding light on the important role played by Clinical Pharmacists in their management and rational use.

Research results

The study found a decline in the consumption and sales of specific carbapenems at Wenzhou Integrated Traditional Chinese and Western Medicine Hospital from 2019 to 2021. There was an increase in the preference for certain types of carbapenems, and Clinical Pharmacists played a vital role in promoting appropriate antibiotic use. Overall, the hospital's utilization of carbapenem antibiotics was reasonable, with a downward trend in usage.

Research conclusions

This study revealed a reasonable utilization of carbapenem antibiotics at Wenzhou Integrated Traditional Chinese and Western Medicine Hospital, with a decreasing trend in consumption and sales over the analyzed period. Clinical Pharmacists were found to play a crucial role in promoting the appropriate use of carbapenems. The findings indicated a decline in the consumption and sales of specific carbapenems, along with an increasing preference for certain types. The study emphasizes the importance of Clinical Pharmacists in ensuring rational antibiotic use and highlights their significant contribution to patient care.

Research perspectives

The direction of future research in this field encompasses several key aspects. These include investigating factors influencing carbapenem utilization trends, evaluating the impact of Clinical Pharmacists' interventions, assessing the economic and social implications of carbapenem use, monitoring carbapenem resistance in the long term, and conducting comparative analysis with other healthcare facilities. By addressing these areas, researchers can gain a comprehensive understanding of carbapenem utilization patterns and the role of Clinical Pharmacists, which will contribute to effective antimicrobial stewardship and patient care.

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