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| RESEARCH ARTICLE

The Influence of Ceftriaxone Medicine on Youth Health: A Case Study of Kabul University

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| ABSTRACT

This study investigates patterns and determinants of Ceftriaxone use among Kabul University students, aiming to inform strategies for promoting rational antibiotic use and mitigating antibiotic resistance. A cross-sectional survey was conducted with 165 students using a structured questionnaire to assess Ceftriaxone usage patterns, awareness of antibiotic resistance, healthcare accessibility, and affordability perceptions. Results indicate varying levels of Ceftriaxone use among students, with 40% reporting high usage primarily for bacterial infections. Moderate awareness of antibiotic resistance was observed, yet concerns about resistance development were prevalent among respondents. Healthcare services were perceived as moderately accessible and somewhat affordable, although disparities existed across student demographics and provinces. Key findings underscore the need for targeted educational campaigns to enhance understanding of antibiotic resistance and promote prudent antibiotic use practices among students. The study's implications extend to healthcare policy and practice, advocating for improved communication between healthcare providers and students regarding antibiotic prescriptions. Future research should focus on longitudinal studies to track changes in antibiotic usage patterns and assess the effectiveness of educational interventions in improving antibiotic stewardship among university populations.

| KEYWORDS

Ceftriaxone use, antibiotic resistance, healthcare accessibility, student perceptions, rational antibiotic use.

| ARTICLE INFORMATION

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1. Introduction

Ceftriaxone, a third-generation cephalosporin antibiotic, is widely recognized for its broad spectrum of antimicrobial activity and clinical efficacy in treating various bacterial infections. Introduced in the 1980s, Ceftriaxone has since become indispensable in medical practice, particularly in hospital settings, due to its ability to penetrate tissues effectively and its extended half-life, allowing for once-daily dosing (Schleibinger et al., 2015).

Research on Ceftriaxone spans multiple dimensions, including its clinical use, pharmacokinetics, microbial effects, and therapeutic outcomes across diverse patient populations and healthcare settings. For instance, studies have evaluated its utilization patterns among in-patients in Uganda, highlighting its role in managing serious infections within healthcare facilities (Kutyabami et al., 2021). Similarly, investigations into Ceftriaxone's impact on mortality in patients with spontaneous bacterial peritonitis underscore its critical role in managing life-threatening conditions (Ariza et al., 2012).

Furthermore, the appropriate use of Ceftriaxone has been a subject of scrutiny in emergency departments and intensive care units, emphasizing the importance of optimizing its administration to enhance treatment outcomes and mitigate risks (Durham et al., 2017). Studies also indicate potential long-term effects on gut microbiota and immune responses following prolonged Ceftriaxone therapy, reflecting broader implications for patient health beyond acute infection management (Guo et al., 2017).

In the context of pediatric care, systematic reviews have assessed the safety profile of Ceftriaxone, highlighting considerations for its use in children to minimize adverse effects and ensure therapeutic efficacy (Zeng et al., 2020). Conversely, reports from clinical practice have documented serious neurological adverse events associated with Ceftriaxone administration, necessitating vigilant monitoring and risk assessment during treatment (Lacroix et al., 2021).

Moreover, Ceftriaxone's global usage patterns and quality assessments in different healthcare systems underscore its critical role in combating antibiotic-resistant infections and optimizing treatment protocols (Ali, 2009; Ayele et al., 2018). Studies evaluating Ceftriaxone utilization in diverse hospital wards, such as medical and emergency units, provide insights into prescribing practices, antibiotic resistance patterns, and patient outcomes in various geographical contexts (Sileshi et al., 2016; Ayinalem et al., 2013).
This paper aims to consolidate current knowledge on Ceftriaxone, focusing specifically on its impact on youth health in the educational setting of Kabul University. By synthesizing evidence from diverse studies, this research seeks to elucidate the implications of Ceftriaxone use among young adults, considering socio-economic factors, antibiotic resistance dynamics, and clinical efficacy. Ultimately, this study aims to inform healthcare practices and policy decisions aimed at optimizing antibiotic use and promoting health outcomes among university students.

1.1 Problem Statement

The use of Ceftriaxone medicine among youth at Kabul University presents a multifaceted health concern warranting comprehensive investigation. While Ceftriaxone is pivotal in treating bacterial infections due to its broad-spectrum activity and efficacy, its impact on the health of young adults, particularly in educational settings, remains inadequately understood. The prevalence and patterns of Ceftriaxone use among university students in Kabul, coupled with potential implications for antibiotic resistance and long-term health outcomes, necessitate a focused inquiry.

Currently, there is limited empirical evidence on how Ceftriaxone affects the health dynamics of young adults, specifically within the educational context of Kabul University. This gap in knowledge hinders the development of targeted interventions and guidelines tailored to mitigate potential health risks associated with its use. Furthermore, socio-economic factors, accessibility issues, and healthcare-seeking behaviors among university students may influence the patterns of Ceftriaxone administration and subsequent health outcomes.
Therefore, this study seeks to address these gaps by examining the influence of Ceftriaxone medicine on youth health at Kabul University. By conducting a case study that integrates clinical data, socio-economic analyses, and healthcare practices, this research aims to provide insights into optimizing Ceftriaxone use, promoting antibiotic stewardship, and safeguarding the health of young adults in educational settings.

1.2 Research Objectives

- To investigate Ceftriaxone usage among students, assessing factors influencing antibiotic resistance and health outcomes to promote rational antibiotic use strategies.
- To assess the prevalence and patterns of Ceftriaxone administration among youth at Kabul University, focusing on the frequency, indications, and duration of use.
- To investigate the impact of Ceftriaxone on antibiotic resistance among student populations, examining resistance patterns and associated factors within the educational setting.
- To explore the socio-economic determinants influencing Ceftriaxone utilization among young adults at Kabul University, analyzing accessibility, affordability, and healthcare-seeking behaviors related to antibiotic treatment.

1.3 Research questions

- What are the prevalence and patterns of Ceftriaxone administration among youth at Kabul University, including the frequency, indications, and duration of use?
- How does Ceftriaxone usage impact antibiotic resistance among student populations at Kabul University, and what are the associated resistance patterns within this educational setting?
- What socio-economic factors influence the utilization of Ceftriaxone among young adults at Kabul University, particularly regarding accessibility, affordability, and healthcare-seeking behaviors related to antibiotic treatment?
- What are the patterns and factors influencing Ceftriaxone use among students, and how do they impact antibiotic resistance and health outcomes?

2. Literature Review

Ceftriaxone, a third-generation cephalosporin antibiotic, is renowned for its broad-spectrum antimicrobial activity and clinical efficacy in treating diverse bacterial infections. Introduced in the 1980s, Ceftriaxone has revolutionized medical practice, particularly in hospital settings, due to its ability to effectively penetrate tissues and its extended half-life, allowing for once-daily dosing

(Schleibinger et al., 2015). Research into Ceftriaxone spans various facets, encompassing clinical use, pharmacokinetics, microbial effects, and therapeutic outcomes across diverse patient populations and healthcare environments.

Studies evaluating Ceftriaxone's utilization patterns among in-patients in Uganda underscore its pivotal role in managing severe infections within healthcare facilities, emphasizing its critical impact on treatment outcomes (Kutyabami et al., 2021). Similarly, investigations into Ceftriaxone's influence on mortality rates among patients with spontaneous bacterial peritonitis highlight its essentiality in combating life-threatening conditions (Ariza et al., 2012).

The appropriate use of Ceftriaxone has been scrutinized across emergency departments and intensive care units, stressing the significance of optimizing its administration to enhance treatment efficacy and mitigate potential risks (Durham et al., 2017). Furthermore, long-term Ceftriaxone therapy has been associated with alterations in gut microbiota and immune system dynamics, underscoring broader implications for patient health beyond acute infection management (Guo et al., 2017).

In pediatric care, systematic reviews have assessed the safety profile of Ceftriaxone, providing insights into minimizing adverse effects and ensuring therapeutic efficacy in children (Zeng et al., 2020). Conversely, reports from clinical practice have documented serious neurological adverse events linked to Ceftriaxone administration, necessitating vigilant monitoring during treatment (Lacroix et al., 2021).

Moreover, global assessments of Ceftriaxone's usage patterns and quality in diverse healthcare systems underscore its crucial role in addressing antibiotic-resistant infections and optimizing treatment protocols (Ali, 2009; Ayele et al., 2018). Studies evaluating Ceftriaxone utilization across various hospital wards, such as medical and emergency units, provide critical insights into prescribing practices, resistance patterns, and patient outcomes across different geographical contexts (Sileshi et al., 2016; Ayinalem et al., 2013).

3. Methodology

A quantitative research approach was employed to investigate the patterns and factors influencing Ceftriaxone use among students at Kabul University, focusing on survey methodology. The research aimed to assess perceptions of antibiotic resistance awareness, concerns, and healthcare accessibility and affordability among students, aiming to inform strategies for promoting rational antibiotic use.

3.1 Research Design:

This study utilized a cross-sectional survey design, which allowed for the collection of data at a single point in time from a representative sample of Kabul University students. This approach facilitated the exploration of Ceftriaxone usage patterns and associated factors among a diverse student population.

3.2 Sampling Strategy:

The sample size of 165 students was determined using the Yamane formula, considering the total student population at Kabul University. Stratified random sampling was employed to ensure proportional representation across different faculties and departments within the university. This method aimed to capture a diverse range of perspectives on Ceftriaxone use among students aged 18-40 years.

3.3 Data Collection Instrument:

A structured questionnaire was developed based on relevant literature and included sections on demographic information, Ceftriaxone usage patterns, reasons for use, awareness of antibiotic resistance, concerns about resistance development, and perceptions of healthcare accessibility and affordability. The questionnaire was pre-tested with a pilot group to ensure clarity and reliability of responses.

3.4 Data Collection Procedure:

Data collection was conducted through in-person surveys administered by trained researchers. The survey process included obtaining informed consent, administering the questionnaire, and ensuring confidentiality and anonymity of responses. The survey was conducted during convenient times at various locations within Kabul University to maximize participation.

3.5 Data Analysis:

Quantitative data obtained from the surveys were analyzed using descriptive statistics such as frequencies and percentages for categorical variables (e.g., reasons for Ceftriaxone use awareness levels). Cross-tabulations and chi-square tests were used to explore associations between variables, providing insights into factors influencing Ceftriaxone use and related perceptions among students.

3.6 Ethical Considerations:

Ethical approval was obtained from Kabul University's Institutional Review Board prior to data collection. Participants were informed about the voluntary nature of participation, confidentiality of responses, and their right to withdraw from the study at any time without consequences.

3.7 Limitations:

Limitations of the study include potential response bias and generalizability, which are limited to Kabul University students. Additionally, self-reported data may be subject to recall bias, impacting the accuracy of responses regarding past Ceftriaxone usage and awareness levels.

4. Results and Discussion

In examining the survey responses on Ceftriaxone use among Kabul University students, the following section analyzes key findings regarding perceptions of antibiotic resistance awareness, concerns, and accessibility and affordability of healthcare services. These insights provide a comprehensive understanding of student perspectives on Ceftriaxone treatment dynamics.

Table 1: Demographic Distribution of Students by Age Groups and Provinces

Province	Age Group 18-25	Age Group 25-40	Total
Kabul	50	25	75
Bamyan	20	10	30
Baghlan	15	7	22
Paktia	10	5	15
Zabul	5	3	8
Kunar	3	2	5
Badakhshan	2	1	3
Herat	5	2	7
Total	**110**	**55**	**165**

Table 1 highlights demographic variations among students aged 18-25 and 25-40 across several Afghan provinces. Kabul retains the highest student count in both age groups, underscoring its prominence as an educational hub. Bamyan, Baghlan, and Paktia also show substantial participation, reflecting regional educational diversity. The inclusion of Zabul, Kunar, Badakhshan, and Herat, albeit with smaller numbers, provides a broader perspective on student demographics in diverse Afghan provinces.

Table 2. Levels of Ceftriaxone Medicine Use in the Past Year

Rank of Antibiotic Use	Number of Individuals	Percentage
High	66	40%
Moderate	50	30.3%
Low	33	20%
None	16	9.7%
Total	**165**	**100%**

Table 2 demonstrates varying levels of Ceftriaxone use among 165 students over the past year. A significant portion, 40%, reported high usage, suggesting a considerable reliance on this antibiotic. Moderate usage was noted by 30.3% of respondents, indicating a substantial middle-ground group. Low usage was observed in 20% of the participants, while a minority, 9.7%, reported no use of Ceftriaxone. These figures highlight a broad spectrum of Ceftriaxone utilization among the students, potentially pointing to differences in health conditions, access to healthcare, and prescribing practices within the student population. The data suggests the need for further investigation into the factors influencing these usage patterns and their implications for antibiotic resistance and student health outcomes.

Table 3: Reasons for Using Ceftriaxone in the Past Year

Reasons	Number of Individuals	Percentage
Bacterial Infections	66	40%
Fever	33	20%
Respiratory Infections	30	18.2%
Urinary Tract Infections	21	12.7%
Other	15	9.1%
Total	**165**	**100%**

Table 3 provides insights into the reasons for Ceftriaxone use among 165 students in the past year. A significant 40% of respondents used Ceftriaxone for bacterial infections, indicating a prevalent reliance on this antibiotic for such conditions. Fever was the second leading reason, with 20% of students self-medicating for this symptom. Respiratory infections accounted for 18.2% of the usage, reflecting the drug's application in managing these illnesses. Urinary tract infections prompted 12.7% of the students to use Ceftriaxone, highlighting its perceived effectiveness for this condition. Additionally, 9.1% of the respondents used Ceftriaxone for other unspecified health issues. This distribution underscores the need for targeted education on the appropriate use of antibiotics to prevent misuse and potential resistance. Understanding these usage patterns is crucial for developing strategies to promote rational antibiotic use among students.

Table 4: Frequency of Ceftriaxone Use Among Kabul University Students

Frequency of Ceftriaxone Use	Number of Individuals	Percentage (%)
Never	**33**	**20**
Rarely	49	29.7
Occasionally	42	25.5
Often	26	15.8
Very frequently	15	9.1
Total	**165**	**100**

Table 4 displays the frequency of Ceftriaxone use among 165 students at Kabul University. The majority of students, 29.7%, reported using Ceftriaxone rarely, while 25.5% used it occasionally. About 20% of the students never used Ceftriaxone. Those who used it often and very frequently accounted for 15.8% and 9.1%, respectively. This distribution suggests varied patterns of Ceftriaxone prescription, with a significant portion of the student population being prescribed the antibiotic infrequently. Understanding these patterns can help develop better guidelines for antibiotic use and ensure appropriate healthcare practices among students.

Table 5: Indications for Ceftriaxone Use

Clarity of Reasons for Prescribing Ceftriaxone	Number of Individuals	Percentage (%)
Not clear at all	18	12
Somewhat unclear	27	18
Neutral	45	30
Somewhat clear	42	28
Very clear	18	12
Total	**150**	**100**

Table 5 presents students' perceptions of the clarity of reasons provided by healthcare providers for prescribing Ceftriaxone. Out of 150 respondents, 28% found the reasons somewhat clear, while 30% were neutral. A smaller group, 18%, found the reasons somewhat unclear, and 12% each reported the reasons as either not clear at all or very clear. This distribution highlights a range of experiences with healthcare communication, with a significant portion of students expressing uncertainty or neutrality regarding the clarity of their prescriptions. This underscores the need for improved communication strategies to ensure students understand the rationale behind their antibiotic treatments.

Table 6: Awareness of Antibiotic Resistance

Awareness Level	Number of Individuals	Percentage (%)
Not aware at all	25	15.2
Slightly aware	35	21.2
Moderately aware	45	27.3
Very aware	30	18.2
Extremely aware	30	18.2
Total	**165**	**100**

Table 6 illustrates the distribution of awareness levels regarding antibiotic resistance among 165 respondents before receiving Ceftriaxone treatment. It reveals that 27.3% of the respondents were moderately aware, while 21.2% were slightly aware of the concept. Both the very aware and extremely aware categories accounted for 18.2% each, indicating that a significant portion of the respondents had a high level of awareness. However, 15.2% of the individuals were not aware of antibiotic resistance at all, highlighting the necessity for increased educational efforts on antibiotic resistance, especially prior to administering treatments like Ceftriaxone.

Table 7: Concerns about Antibiotic Resistance

Concern Level	Number of Individuals	Percentage (%)
Not concerned at all	15	10.0
Slightly concerned	25	16.7
Neutral	55	26.7
Somewhat concerned	45	30.0
Very concerned	25	16.7
Total	**165**	**100**

Table 7 presents the levels of concern regarding antibiotic resistance among 150 respondents due to the use of Ceftriaxone. It shows that 30.0% of the respondents are somewhat concerned, while 26.7% remain neutral about the issue. Both the slightly concerned and very concerned categories account for 16.7% each, indicating a notable level of apprehension among a significant portion of respondents. Only 10.0% of the participants are not concerned at all. This data suggests a general awareness and concern about antibiotic resistance, emphasizing the importance of addressing these concerns through proper education and stewardship practices.

Table 8: Accessibility of Healthcare Services

Accessibility Level	Number of Individuals	Percentage (%)
Very inaccessible	15	10.0
Moderately inaccessible	20	13.3
Neutral	35	23.3
Moderately accessible	50	33.3
Very accessible	45	20.0
Total	**165**	**100**

Table 8 illustrates the accessibility of healthcare services prescribing Ceftriaxone at Kabul University among 150 respondents. A significant portion, 33.3%, finds these services moderately accessible, while 20.0% rate them as very accessible. Conversely, 10.0% consider the services very inaccessible, and 13.3% moderately inaccessible, indicating barriers exist for some students. The neutral category comprises 23.3% of responses. These findings suggest that while many students find healthcare services relatively accessible, there is room for improvement to ensure all students can easily obtain necessary medical care.

Table 9: Affordability of Ceftriaxone Treatment

Affordability Level	Number of Individuals	Percentage (%)
Not affordable at all	25	16.7
Slightly affordable	30	20.0
Neutral	50	26.7
Fairly affordable	40	23.3
Very affordable	20	13.3
Total	**165**	**100**

Table 9 presents the perception of 150 respondents regarding the affordability of Ceftriaxone treatment at Kabul University relative to their financial situation. The majority, 66.7%, find the treatment either somewhat affordable (23.3%), fairly affordable (26.7%), or very affordable (13.3%). However, 36.7% of respondents feel that Ceftriaxone is either not affordable at all (16.7%) or only slightly affordable (20.0%). The neutral category accounts for 26.7% of responses, indicating uncertainty about the affordability of the treatment. These findings underscore the need for financial considerations in healthcare planning to ensure equitable access to essential medications like Ceftriaxone among university students.

4.1. Discussion

The findings from this study provide valuable insights into the perceptions and experiences of Kabul University students regarding the use of Ceftriaxone, an essential antibiotic in clinical practice. These insights encompass various aspects, including frequency of use, reasons for use, awareness, and concerns about antibiotic resistance, accessibility, and affordability of healthcare services.

The study revealed diverse patterns in the frequency of Ceftriaxone use among students, with a significant proportion (40%) reporting high usage, followed by moderate (30.3%) and low (20%) usage levels (Table 2). This variation likely reflects different health conditions among students, as well as prescribing practices within the university's healthcare facilities. Bacterial infections emerged as the primary reason for Ceftriaxone use (40%), indicating its predominant role in treating such conditions. Fever (20%), respiratory infections (18.2%), and urinary tract infections (12.7%) were also notable reasons cited by students, highlighting the antibiotic's broad applicability in managing common ailments (Table 3).

The study found a mixed level of awareness among students regarding antibiotic resistance, with a notable portion (15.2%) reporting no awareness at all. However, a significant majority demonstrated varying levels of awareness, with 36.4% (combined moderately to extremely aware) showing a high level of understanding (Table 6). This indicates a foundational knowledge base among students, though efforts are needed to bridge gaps in awareness, especially among those who are less informed.

Concerns about antibiotic resistance were also evident, with 46.7% of respondents expressing moderate to high levels of concern (Table 7). This finding underscores the relevance of educating students about the implications of antibiotic resistance, particularly in the context of Ceftriaxone use, to promote responsible antibiotic stewardship and mitigate the development of resistance.

Regarding healthcare services, a significant portion of students (53.3%) perceived them as either moderately or very accessible. However, challenges remain, as 23.3% found them either moderately or very inaccessible (Table 8). This disparity highlights the need for ongoing efforts to improve healthcare accessibility within the university setting, ensuring equitable access for all students regardless of their geographical or economic backgrounds.

Financial considerations also play a crucial role, with 36.7% of students perceiving Ceftriaxone treatment as either not affordable at all or only slightly affordable (Table 9). This perception underscores the importance of addressing cost barriers to healthcare access, particularly for medications essential to student health.

The findings suggest several implications for healthcare practices and policy at Kabul University. First, enhancing educational initiatives on antibiotic resistance could empower students to make informed decisions about antibiotic use (Ali, 2009). This could include integrating antibiotic stewardship programs into the curriculum and promoting awareness campaigns on responsible antibiotic use.

Second, efforts to improve healthcare accessibility should be prioritized, potentially through expanding healthcare facilities or implementing telemedicine services to reach remote or underserved student populations (Ayele et al., 2018). Addressing

affordability concerns may involve exploring subsidized healthcare options or student health insurance schemes to alleviate financial burdens associated with medical treatments (Durham et al., 2017).

Finally, fostering interdisciplinary collaborations between healthcare providers, educators, and policymakers is essential to developing comprehensive strategies that promote optimal healthcare delivery and student well-being (Guo et al., 2017).

In conclusion, this study contributes to the understanding of Ceftriaxone use among university students in Kabul, highlighting nuanced perspectives on antibiotic resistance, healthcare access, and affordability. By addressing these insights, stakeholders can work towards enhancing healthcare services and policy frameworks that support sustainable healthcare practices within educational institutions.

5. Conclusion

In conclusion, this study has explored the intricate patterns of Ceftriaxone use among students at Kabul University, shedding light on factors influencing its utilization and their implications for antibiotic resistance and health outcomes. The findings reveal a varied landscape of Ceftriaxone use among students, with significant proportions reporting high and moderate usage levels, primarily for treating bacterial infections and fever. These patterns underscore the antibiotic's perceived efficacy in managing common ailments among the student population.

Moreover, the study highlights concerns regarding antibiotic resistance awareness and healthcare accessibility and affordability at Kabul University. A substantial proportion of students expressed moderate to high levels of awareness about antibiotic resistance, although some gaps remain, particularly in understanding the clarity of reasons provided for Ceftriaxone prescriptions. Accessibility and affordability of healthcare services prescribing Ceftriaxone were perceived variably among students, indicating potential barriers that could impact timely access to necessary medical care.

The implications of these findings extend beyond Kabul University, reflecting broader challenges in antibiotic stewardship and healthcare delivery in educational settings. Addressing these issues is crucial for developing targeted interventions aimed at promoting rational antibiotic use, mitigating antibiotic resistance, and improving overall health outcomes among students. Strategies may include enhancing educational initiatives on antibiotic use and resistance, improving healthcare infrastructure and affordability, and fostering collaborative efforts between healthcare providers and educational institutions.

Moving forward, further research should delve deeper into the socio-economic determinants of Ceftriaxone use, explore healthcare provider perspectives on prescribing practices, and evaluate long-term health impacts associated with antibiotic consumption among university students. By advancing our understanding of these dynamics, policymakers and healthcare providers can develop evidence-based strategies to optimize antibiotic use, safeguard student health, and contribute to global efforts in combating antibiotic resistance effectively.

5.1 Recommendation and Future Research

Based on the findings of this study, several recommendations can be made to optimize Ceftriaxone use among students at Kabul University and similar educational settings. Firstly, there is a need for targeted educational campaigns aimed at enhancing awareness of antibiotic resistance and promoting responsible antibiotic use practices among students. These initiatives should emphasize the importance of completing prescribed courses of antibiotics and discourage self-medication practices without professional guidance.

Secondly, healthcare services at Kabul University should prioritize improving accessibility and affordability to ensure all students have equitable access to necessary medical care, including antibiotics like Ceftriaxone. This could involve expanding clinic hours, enhancing telemedicine options, and implementing student-friendly healthcare financing solutions.

For future research, it would be beneficial to conduct longitudinal studies to assess the long-term impacts of Ceftriaxone use on student health outcomes and antibiotic resistance development. Additionally, exploring the perspectives of healthcare providers on antibiotic prescribing practices and understanding the socio-economic factors influencing antibiotic accessibility and use among students could provide further insights into optimizing antibiotic stewardship in educational environments.

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References

[1] Ali, O. (2009). Quality of ceftriaxone in Pakistan: reality and resonance. *Pakistan Journal of Pharmaceutical Sciences,* 22(2). https://openurl.ebsco.com/contentitem/gcd:39342843?sid=ebsco:plink:scholar&id=ebsco:gcd:39342843&crl=c

[2] Ariza, X., Castellote, J., Lora-Tamayo, J., Girbau, A., Salord, S., Rota, R., ... & Xiol, X. (2012). Risk factors for resistance to ceftriaxone and its impact on mortality in community, healthcare, and nosocomial spontaneous bacterial peritonitis. *Journal of hepatology*, 56(4), 825-832. https://doi.org/10.1016/j.jhep.2011.11.010

[3] Ayele, A. A., Gebresillassie, B. M., Erku, D. A., Gebreyohannes, E. A., Demssie, D. G., Mersha, A. G., & Tegegn, H. G. (2018). Prospective evaluation of Ceftriaxone use in medical and emergency wards of Gondar university referral hospital, Ethiopia. Pharmacology research & perspectives, 6(1), e00383. https://doi.org/10.1002/prp2.383

[4] Ayinalem, G. A., Gelaw, B. K., Belay, A. Z., & Linjesa, J. L. (2013). Drug use evaluation of ceftriaxone in medical ward of Dessie Referral Hospital, North East Ethiopia. Int J Basic Clin Pharmacol, 2(6), 711-717.

[5] Duceac, L. D., Luca, A. C., Mitrea, G., Banu, E. A., Ciuhodaru, M. I., Ciomaga, I., ... & Baciu, G. (2018). Ceftriaxone intercalated nanostructures used to improve medical treatment. Mat. Plast, 55(4), 613-615.

[6] Durham, S. H., Wingler, M. J., & Eiland, L. S. (2017). Appropriate use of ceftriaxone in the emergency department of a Veteran's health care system. *Journal of Pharmacy Technology, 33*(6), 215-218. https://doi.org/10.1177/8755122517720293

[7] Guo, X., Yan, Z., Wang, J., Fan, X., Kang, J., Niu, R., & Sun, Z. (2022). Effect of traditional chinese medicine (TCM) and its fermentation using Lactobacillus plantarum on ceftriaxone sodium-induced dysbacteriotic diarrhea in mice. Chinese Medicine, 17(1), 20. https://link.springer.com/article/10.1186/s13020-022-00575-x

[8] Guo, Y., Yang, X., Qi, Y., Wen, S., Liu, Y., Tang, S., ... & Tang, L. (2017). Long-term use of ceftriaxone sodium induced changes in gut microbiota and immune system. Scientific Reports, 7(1), 43035. https://doi.org/10.1038/srep43035

[9] Kutyabami, P., Munanura, E. I., Kalidi, R., Balikuna, S., Ndagire, M., Kaggwa, B., ... & Ndagije, H. B. (2021). Evaluation of the clinical use of ceftriaxone among in-patients in selected health facilities in Uganda. Antibiotics, 10(7), 779. https://doi.org/10.3390/antibiotics10070779

[10] Lacroix, C., Bera-Jonville, A. P., Montastruc, F., Velly, L., Micallef, J., & Guilhaumou, R. (2021). Serious neurological adverse events of ceftriaxone. Antibiotics, 10(5), 540. https://doi.org/10.3390/antibiotics10050540

[11] Lee, H., Jung, D., Yeom, J. S., Son, J. S., Jung, S. I., Kim, Y. S., ... & Woo, G. J. (2009). Evaluation of ceftriaxone utilization at multicenter study. *The Korean journal of internal medicine*, 24(4), 374. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2784983/

[12] Lee, H., Jung, D., Yeom, J. S., Son, J. S., Jung, S. I., Kim, Y. S., ... & Woo, G. J. (2009). Evaluation of ceftriaxone utilization at multicenter study. *The Korean journal of internal medicine, 2*4(4), 374. https://doi.org/10.1186/s40545-015-0047-1

[13] Schleibinger, M., Steinbach, C. L., Töpper, C., Kratzer, A., Liebchen, U., Kees, F., ... & Kees, M. G. (2015). Protein binding characteristics and pharmacokinetics of ceftriaxone in intensive care unit patients. *British journal of clinical pharmacology*, 80(3), 525-533. https://doi.org/10.1111/bcp.12636

[14] Sileshi, A., Tenna, A., Feyissa, M., & Shibeshi, W. (2016). Evaluation of ceftriaxone utilization in medical and emergency wards of Tikur Anbessa specialized hospital: a prospective cross-sectional study. BMC Pharmacology and Toxicology, 17, 1-10. https://link.springer.com/article/10.1186/s40360-016-0057-x

[15] Yao, Y., Zhou, R., & Wang, Y. (2012). Fatal adverse effects of injected ceftriaxone sodium in China. Pharmacoepidemiology and drug safety, 21(11), 1197-1201. https://onlinelibrary.wiley.com/doi/abs/10.1002/pds.3232

[16] Zeng, L., Wang, C., Jiang, M., Chen, K., Zhong, H., Chen, Z., ... & Choonara, I. (2020). Safety of ceftriaxone in paediatrics: a systematic review. Archives of disease in childhood, 105(10), 981-985. https://adc.bmj.com/content/105/10/981.abstract