Scientific Research Publishing

Advances in Infectious Diseases, 2026, 16(4), 599-613
https://www.scirp.org/journal/aid
ISSN Online: 2164-2656
ISSN Print: 2164-2648

Physician Experience and Clinical Utilization Patterns of Shalbactam TZ (Ceftriaxone + Tazobactam): A Multicentre HPER Survey from the Democratic Republic of the Congo

Munzika François[1], Mukendi Kabengele Onesime[2], Maketama Soki Jeannisse[3], Kingola Nsunda[4], Minos Ndabahweje Minani[5], Homeré Kisimbi[6], Kashal Marc[7]

[1]Hope Clinic, Kinshasa, Democratic Republic of the Congo
[2]Hopital Générale de Reference de Kintambo, Kinshasa, Democratic Republic of the Congo
[3]Matadi Centre Médico Chirurgical PNC Soyo, Matadi, Democratic Republic of the Congo
[4]Hôpital Général de Référence de Matadi, Matadi, Democratic Republic of the Congo
[5]Clinique Les 2 Samaritaines, Goma, Democratic Republic of the Congo
[6]Centre Hospitalier 8ème CEPAC CHAI, Goma, Democratic Republic of the Congo
[7]Cliniques Universitaires, Lubumbashi, Democratic Republic of the Congo
Email: drmunzikafrancois@gmail.com, omukendi87@gmail.com, jeanniamak@gmail.com, kingolansunda@gmail.com, clin2sam@gmail.com, homrekisimbi@yahoo.com, marckashal@yahoo.fr

How to cite this paper: François, M., Onesime, M.K., Jeannisse, M.S., Nsunda, K., Minani, M.N., Kisimbi, H. and Marc, K. (2026) Physician Experience and Clinical Utilization Patterns of Shalbactam TZ (Ceftriaxone + Tazobactam): A Multicentre HPER Survey from the Democratic Republic of the Congo. *Advances in Infectious Diseases*, **16**, 599-613.
https://doi.org/10.4236/aid.2026.164042

Received: August 7, 2026
Accepted: November 10, 2026
Published: November 13, 2026

Copyright © 2026 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/

Open Access

Abstract

Background: Bacterial infections remain a major cause of morbidity in low- and middle-income countries, where delayed microbiological diagnosis often necessitates empirical antibiotic therapy. Shalbactam TZ (ceftriaxone + tazobactam) is a broad-spectrum β-lactam/β-lactamase inhibitor combination increasingly used in routine clinical practice. However, real-world evidence regarding physician prescribing patterns, clinical experience, and perceptions of its effectiveness and safety in the Democratic Republic of the Congo (DRC) remains limited. **Objective:** This paper aims to evaluate physician experience and clinical utilization patterns of Shalbactam TZ in the management of common bacterial infections in the Democratic Republic of the Congo. **Methods:** A multicentre, cross-sectional HPER (Healthcare Professional Experience Research) survey was conducted among 304 physicians practicing in the DRC. A structured questionnaire collected information on monthly caseload, first-line prescribing preference, empirical antibiotic use, treatment expectations, dosing practices, clinical response, physician satisfaction, adverse effects, resistance perception, and economic viability of Shalbactam TZ across community-acquired pneumonia (CAP), complicated typhoid fever, diabetic foot infections (DFI), bone and joint infections, and surgical prophylaxis. Data were analysed

using descriptive statistics and expressed as frequencies and percentages. **Results:** Community-acquired pneumonia and complicated typhoid fever were among the most frequently managed conditions. Shalbactam TZ was most commonly preferred as first-line therapy for complicated typhoid fever (78%) and CAP (76%). Broad-spectrum antimicrobial activity was identified as the principal reason for prescribing the drug (51%). Most clinicians reported clinical improvement within 4 - 6 days, with overall good-to-excellent satisfaction ranging from 91% to 97% across different indications. Injection-site pain (61% - 67%) was the most frequently reported adverse effect across indications, while diarrhoea, rash, and headache occurred less commonly. The majority of physicians (76%) considered Shalbactam TZ economically viable, and resistance was perceived to be infrequent in routine clinical practice. **Conclusion:** The findings indicate that physicians widely perceive Shalbactam TZ as a favourable, well-tolerated, and economically viable empirical antibiotic option for the management of common bacterial infections in the DRC, based on reported clinical experience rather than independently verified outcomes. Further prospective studies incorporating microbiological and patient-level clinical outcomes are recommended to validate these real-world observations.

Keywords

Shalbactam TZ, Ceftriaxone, Tazobactam, Empirical Therapy, Physician Experience, Antimicrobial Resistance, Democratic Republic of the Congo

1. Introduction

The growing global burden of infectious diseases, coupled with the rapid emergence of antimicrobial resistance (AMR), continues to challenge clinicians in selecting effective empirical antibiotic therapies [1]. In resource-constrained healthcare settings, particularly in regions with limited access to advanced microbiological diagnostics, physicians frequently rely on broad-spectrum antibiotics for early infection management [2]. This has increased the clinical importance of β-lactam/β-lactamase inhibitor (BL-BLI) combinations, which offer extended antimicrobial coverage and improved therapeutic reliability against resistant pathogens [3]. Shalbactam TZ is a combination of ceftriaxone and tazobactam. Its broad-spectrum activity, favourable dosing profile, and perceived cost-effectiveness make it a clinically relevant option across multiple indications, including community-acquired pneumonia (CAP), complicated typhoid fever, diabetic foot infections (DFI), bone and joint infections, and surgical prophylaxis [4]-[6].

The burden of bacterial infections remains particularly high in sub-Saharan Africa, where community-acquired pneumonia (CAP), typhoid fever, diabetic foot infections (DFI), bone and joint infections, and surgical site infections contribute substantially to morbidity and healthcare utilization. Limited microbiological diagnostic facilities and delayed availability of culture and susceptibility reports of-

ten necessitate the initiation of empirical broad-spectrum antimicrobial therapy. Consequently, selecting an antibiotic with broad antimicrobial coverage, good safety, and cost-effectiveness is essential in resource-limited healthcare settings. The World Health Organization (WHO) has emphasized that rational empirical antibiotic prescribing, supported by antimicrobial stewardship programmes, is critical to combating antimicrobial resistance while ensuring timely treatment of serious bacterial infections [7] [8].

Ceftriaxone is a third-generation cephalosporin that exerts bactericidal activity by inhibiting bacterial cell wall synthesis through binding to penicillin-binding proteins, resulting in disruption of peptidoglycan formation and bacterial cell death. However, resistance mediated by β-lactamase enzymes limits its activity against several Gram-negative pathogens. Tazobactam is an irreversible β-lactamase inhibitor that protects ceftriaxone from enzymatic degradation by many plasmid-mediated β-lactamases, including class A (TEM, SHV), class C, and group 1, 2a, 2b, and 2b′ enzymes, thereby protecting ceftriaxone from enzymatic degradation. Compared with earlier β-lactamase inhibitors, tazobactam exhibits broader inhibitory activity and restores the in vitro activity of ceftriaxone against several β-lactamase-producing pathogens, including Escherichia coli, Klebsiella pneumoniae, Morganella morganii, Citrobacter freundii, Enterobacter cloacae, Serratia marcescens, and certain strains of Pseudomonas aeruginosa. It also significantly improves activity against anaerobic pathogens, particularly β-lactamase-producing *Bacteroides fragilis* group and *Prevotella* species, with studies demonstrating an increase in inhibitory activity compared with ceftriaxone alone [9]. Owing to its ability to broaden antimicrobial coverage and overcome β-lactamase-mediated resistance, the ceftriaxone-tazobactam combination has emerged as a valuable therapeutic option in regions with a high burden of resistant bacterial infections. The ceftriaxone-tazobactam combination has therefore become an important empirical therapeutic option for moderate-to-severe bacterial infections, particularly where resistance to conventional cephalosporins is increasing [3] [4] [10].

Despite the increasing clinical use of ceftriaxone-based BL-BLI combinations, real-world evidence regarding physician prescribing behaviour, therapeutic expectations, satisfaction patterns, resistance perception, and treatment outcomes remains limited in many developing healthcare environments [8]. Understanding physician experiences and usage trends is essential for optimizing antibiotic stewardship strategies, minimizing unnecessary escalation to higher antibiotics, and preserving the effectiveness of reserve antimicrobial agents such as carbapenems [11]. The present survey-based study was conducted among clinicians in the Democratic Republic of the Congo (DRC) to evaluate the real-world utilization patterns and clinical perceptions associated with Shalbactam TZ. The study aimed to assess first-line prescribing preferences, empirical therapy trends, dosage and duration patterns, clinical response timelines, physician satisfaction, safety observations, resistance experiences, and economic value perception across major infec-

tious disease indications. The findings of this survey are expected to provide meaningful insights into contemporary prescribing practices and help define the positioning of Shalbactam TZ within the antibiotic ladder approach in resource-sensitive clinical settings [11].

Real-world clinical evidence from Nigeria also supports the use of ceftriaxone-tazobactam in surgical practice. In a randomized comparative study conducted at Lagos University Teaching Hospital, authors compared ceftriaxone alone with ceftriaxone-tazobactam as surgical prophylaxis. Although the overall difference in surgical site infection (SSI) rates was not statistically significant, the ceftriaxone-tazobactam group demonstrated a lower infection rate, with no surgical site infections reported at 30 days compared with 2.5% in the ceftriaxone group. The authors concluded that the addition of tazobactam may enhance prophylactic efficacy and highlighted the need for further clinical evaluation of the combination, particularly in resource-limited settings where prevention of postoperative infections is critical [12]. Howard *et al.* highlighted substantial variation in antimicrobial stewardship implementation across hospitals internationally, underscoring the need to evaluate local antibiotic prescribing practices and strengthen stewardship strategies to promote rational antimicrobial use [13].

2. Methodology

2.1. Study Design and Participants

A cross-sectional, questionnaire-based observational survey was conducted to evaluate the real-world prescribing practices, clinical perceptions, and therapeutic experiences associated with Shalbactam TZ (ceftriaxone + tazobactam) among physicians in the Democratic Republic of the Congo (DRC). The study aimed to capture clinician-reported insights regarding the utilization of Shalbactam TZ across various infectious disease indications encountered in routine clinical practice. The study included 304 practicing physicians actively involved in the management of infectious diseases across different healthcare settings in the DRC. Participants were selected based on their involvement in prescribing antimicrobial therapy for conditions such as community-acquired pneumonia (CAP), complicated typhoid fever, diabetic foot infections (DFI), bone and joint infections, and surgical prophylaxis.

304 doctors mainly from the field of General Medicine participated in this survey. The data collection period spanned a period of 4 months. Various general hospitals and clinics across DRC ranging from Kinshasa, Goma, Bukavo, Butembo, Lubumbashi, Kisangini, Kamituga, participated in the study. The recruitment pattern followed the routine use of Shalbactam TZ in their patients, as determined by the clinician, were enrolled in the study, reflecting the practice patterns and use of Shalbactam TZ in DRC.

Data were collected using a structured questionnaire designed to assess various aspects of antimicrobial prescribing practices and clinical experiences. The Ques-

tions were developed using regular indications for the usage of Shalbactam TZ. There questions were developed and confirmed with the Investigators' who validated the same. The questions were then translated into French to be administered to the doctors during the survey.

The questionnaire evaluated the burden of infections encountered in routine clinical practice, first-line prescribing preferences, the use of empirical versus culture-guided therapy, preferred dosage regimens, treatment duration, time to symptom improvement, side effects and tolerability, perceptions regarding antimicrobial resistance, overall clinician satisfaction, and the economic viability of treatment options. The responses reflect the overall clinicians' s real time experience with the usage of Shalbactam TZ in their patients. There was no recall period of follow-up of these patients. However, they measured the clinical cure rates, responses rates as per their clinical knowledge in their settings. Culture data was not collected.

In Surgical Infections & Bone & Joint Infections the responses are less in number. In 2 questions assessing the resistance encountered with Shalbactam TZ & economic impact of its use, the number of responses are more because few doctors ticked multiple options.

Data were collected using a structured, predesigned questionnaire comprising multiple-choice and perception-based questions. The survey assessed infection burden and patient load, first-line prescribing preferences, empirical versus culture-guided antibiotic use, physician expectations from therapy, dosage regimen preferences, treatment duration, time to clinical improvement, physician satisfaction, safety and tolerability perceptions, resistance experiences, and economic value assessments. The questionnaire was administered through direct physician interactions, and responses were compiled for analysis.

2.2. Statistical Analysis

Data collected through the structured questionnaire were entered into Microsoft Excel and analysed using descriptive statistical methods. Categorical variables were summarized as frequencies and percentages. Physician responses regarding prescribing preferences, empirical antibiotic use, dosing patterns, treatment duration, clinical response, satisfaction, adverse events, resistance perception, and economic viability were analysed descriptively. The findings are presented using tables, bar charts, and pie charts to facilitate interpretation. As the study was descriptive and questionnaire-based, inferential statistical tests were not performed.

2.3. Data Analysis

Collected responses were tabulated and analysed using descriptive statistical methods. Data were expressed as frequencies and percentages to summarize physician responses across various clinical domains and therapeutic indications. Comparative interpretation of prescribing trends and satisfaction patterns was performed to identify major real-world utilization trends associated with Shal-

bactam TZ.

In a physician survey, the denominator can vary when questions are conditional, optional, or allow multiple responses. Therefore, percentages should not automatically be interpreted as being calculated from the total study population unless this is explicitly stated.

2.4. Ethical Considerations

Participation was voluntary, and all responses were anonymized to preserve confidentiality. The study involved clinician-reported perceptions only and did not include patient interaction s. Since this is a real-life study (HPER doctors' Survey) reflecting the routine clinical practices of practicing doctors, no formal ethics committee approval was sought. The drug in use Shalbactam TZ is approved for use in these indications in DRC by the Regulatory body.

3. Result

A total of 304 physicians from the Democratic Republic of the Congo (DRC) participated in the survey, which evaluated real-world prescribing practices and clinical perceptions regarding the use of Shalbactam TZ (ceftriaxone + tazobactam) across multiple infectious disease indications, including community-acquired pneumonia (CAP), complicated typhoid fever, diabetic foot infections (DFI), bone and joint infections, and surgical prophylaxis. The survey findings showed that CAP and complicated typhoid fever were among the most commonly encountered infectious conditions in routine clinical practice. Approximately 67% of physicians reported actively treating CAP, while 36% managed 10 - 20 cases of complicated typhoid fever per month. In contrast, DFI and bone and joint infections were comparatively less frequent but were perceived as clinically severe and resource-intensive conditions.

Shalbactam TZ was frequently reported as a first-line therapeutic option across major infectious indications as shown in Table 1. The highest first-line preference was observed in complicated typhoid fever, where 78% of physicians reported using Shalbactam TZ as initial therapy. Similarly, 76% of respondents preferred the drug for CAP management, while 67% favoured its use in surgical prophylaxis. In DFI and bone and joint infections, physician preference remained favourable, with 59% and 68% of clinicians, respectively, reporting its use as first-line therapy. These findings suggest that many surveyed physicians perceived Shalbactam TZ as a useful option for empirical therapy in moderate-to-severe bacterial infections.

Across all major indications, Shalbactam TZ was predominantly utilized as empirical therapy as shown in Table 2. Approximately 63% - 65% of physicians-initiated treatment empirically rather than waiting for culture sensitivity reports. Post-culture initiation was reported by nearly one-third of respondents, whereas a small proportion reported using both empirical and culture-guided approaches. The highest empirical usage was observed in DFI (65%) and complicated typhoid

fever (64%), reflecting the need for early antimicrobial coverage in clinically urgent infections.

Table 1. Infection burden and first-line prescribing preference for Shalbactam TZ among physicians in the Democratic Republic of the Congo (N = 304 physicians surveyed; denominators for individual questions range from n = 303 to n = 306 owing to non-response on specific items, as indicated per row).

Indication	Infection Burden/Patient Load	First-Line Use n (%)	Not First-Line n (%)
Community-Acquired Pneumonia (CAP)	67% physicians actively treating CAP	233 (76%)	73 (24%)
Complicated Typhoid Fever	36% physicians treat 10 - 20 cases/month	240 (78%)	66 (22%)
Diabetic Foot Infection (DFI)	78% physicians treat < 10 cases/month	179 (59%)	124 (41%)
Bone & Joint Infections	68% physicians treat < 10 cases/month	207 (68%)	96 (32%)
Surgical Prophylaxis	41% physicians manage < 10 and 35% manage 10 - 20 cases/month	203 (67%)	101 (33%)

As also summarized in Table 2, the principal reason for selecting Shalbactam TZ was its broad-spectrum antimicrobial coverage. More than half of the physicians (51%) identified wide pathogen coverage as the primary therapeutic expectation. Additional factors influencing prescribing preference included perceived superiority over ceftriaxone plus sulbactam combinations (18%) and perceived reduced risk of antimicrobial resistance (16%). Faster symptom resolution and improved tolerability were considered secondary benefits, indicating that antimicrobial coverage and reliability were important determinants of physician choice.

As shown in Table 3, twice-daily (BD) dosing emerged as the most preferred regimen across the majority of indications. Approximately 68% - 81% of physicians favoured BD administration for complicated typhoid fever, DFI, bone and joint infections, and surgical prophylaxis. In contrast, once-daily (OD) dosing was predominantly preferred for CAP management, with 74% of clinicians selecting this regimen, possibly reflecting perceived convenience. Thrice-daily (TDS) dosing was minimally utilized across indications. Long-duration therapy (>14 days) was the most commonly preferred treatment duration for DFI, bone and joint infections, and CAP. For complicated typhoid fever and surgical prophylaxis, physicians predominantly evaluated therapy in terms of clinical outcome rather than fixed duration.

Clinical improvement was reported by many physicians within 4 - 6 days of initiating Shalbactam TZ therapy. This pattern was observed in 87% of complicated typhoid cases, 67% of CAP cases, and over 50% of DFI and bone and joint infection cases. Delayed response beyond 10 days was uncommon, suggesting that physicians frequently observed symptom improvement during the first week of treatment.

Table 2. Utilization pattern and physician expectations for Shalbactam TZ among physicians in the democratic republic of the Congo (denominators range from n = 303 to n = 308 depending on the question; see text for details).

Parameter	Category	n (%)
Usage Pattern - Complicated Typhoid Fever	Empirical use	195 (64%)
	Post-culture use	100 (33%)
	Both approaches	11 (4%)
Usage Pattern - CAP	Empirical use	192 (63%)
	Post-culture use	99 (33%)
	Both approaches	9 (3%)
Usage Pattern - DFI	Empirical use	198 (65%)
	Post-culture use	94 (31%)
	Both approaches	12 (4%)
Usage Pattern - Bone & Joint Infections	Empirical use	194 (64%)
	Post-culture use	100 (33%)
	Both approaches	10 (3%)
Physician Expectations	Broad-spectrum antimicrobial coverage	155 (51%)
	Perceived superiority over ceftriaxone + sulbactam	55 (18%)
	Reduced risk of antimicrobial resistance	49 (16%)
	Faster symptom resolution	30 (10%)
	Fewer side effects/improved quality of life	7 - 9 (≈2% - 3%)

Table 3. Dosing preferences, duration of therapy, and time to clinical improvement with Shalbactam TZ across clinical indications.

Indication	Preferred Dosing Regimen	Most Common Duration	Earliest Reported Clinical Improvement
Complicated Typhoid Fever	BD (81%)	Clinical outcome-based assessment*	4 - 6 days (87%)
Diabetic Foot Infection	BD (68%)	>14 days (62%)	4 - 6 days (52%)
Bone & Joint Infections	BD (70%)	>14 days (59%)	4 - 6 days (55%)
Surgical Prophylaxis	BD (52%)	Clinical outcome-based assessment*	Not assessed
Community-Acquired Pneumonia (CAP)	OD (74%)	>14 days (63%)	4 - 6 days (67%)

*Clinical Outcomes based on the clinical signs and Symptoms as assessed by the treating doctor and as per their clinical experience.

Overall physician satisfaction ratings were predominantly positive as shown in Figure 1. Good-to-excellent satisfaction ratings were reported by approximately 91% - 97% of clinicians across all indications. The highest "excellent" ratings were observed in complicated typhoid fever, surgical prophylaxis, and CAP, whereas DFI and bone and joint infections more frequently received "good" ratings, pos-

sibly reflecting the complexity and chronicity of these infections.

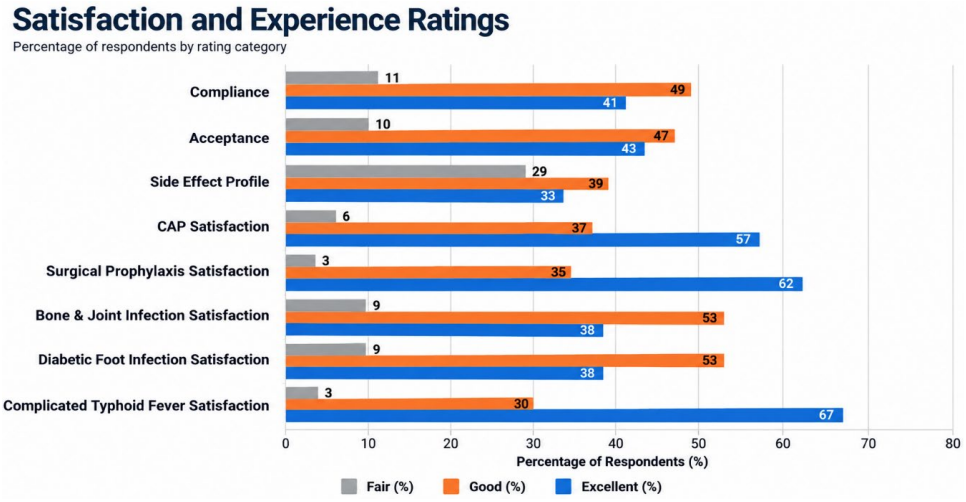


Figure 1. Physician reported perceptions of Satisfaction, Safety, Acceptance, and Compliance Profile of Shalbactam TZ.

Survey respondents (physician-reported perceptions) generally reported acceptable tolerability of Shalbactam TZ. Most physicians rated patient acceptance and treatment compliance as good or excellent. As shown in Table 4, Injection site pain was the most commonly observed adverse effect across all indications, reported in approximately 61% - 67% of cases. Other commonly reported adverse events included mild diarrhoea, rash, and headache. All reported side effects were described as non-serious, transient, and manageable, with no major limitations to continued therapy reported by respondents.

Table 4. Most frequently reported adverse effects associated with Shalbactam TZ across clinical indications.

Indication	Most Common Adverse Effect (%)	Second Most Common Adverse Effect (%)	Third Most Common Adverse Effect (%)	Nature of Adverse Events
Complicated Typhoid Fever	Injection site pain (61%)	Diarrhoea (15%)	Headache (9%)	Non-serious
Diabetic Foot Infection	Injection site pain (61%)	Rash (14%)	Diarrhoea (10%)	Non-serious
Bone & Joint Infections	Injection site pain (62%)	Rash (11%)	Diarrhoea (10%)	Non-serious
Surgical Prophylaxis	Injection site pain (67%)	Rash (11%)	Headache (10%)	Non-serious
Community-Acquired Pneumonia (CAP)	Injection site pain (63%)	Diarrhoea (12%)	Rash (9%)	Non-serious

As shown in Figure 2, the majority of physicians reported minimal resistance experience with Shalbactam TZ. Frequent resistance was reported by less than 10% of respondents across all indications. In complicated typhoid fever and surgical prophylaxis, "never encountering resistance" was the most commonly reported response. In DFI, bone and joint infections, and CAP, resistance was more

commonly described as occasional rather than frequent, suggesting that physicians infrequently encountered resistance during routine clinical use.

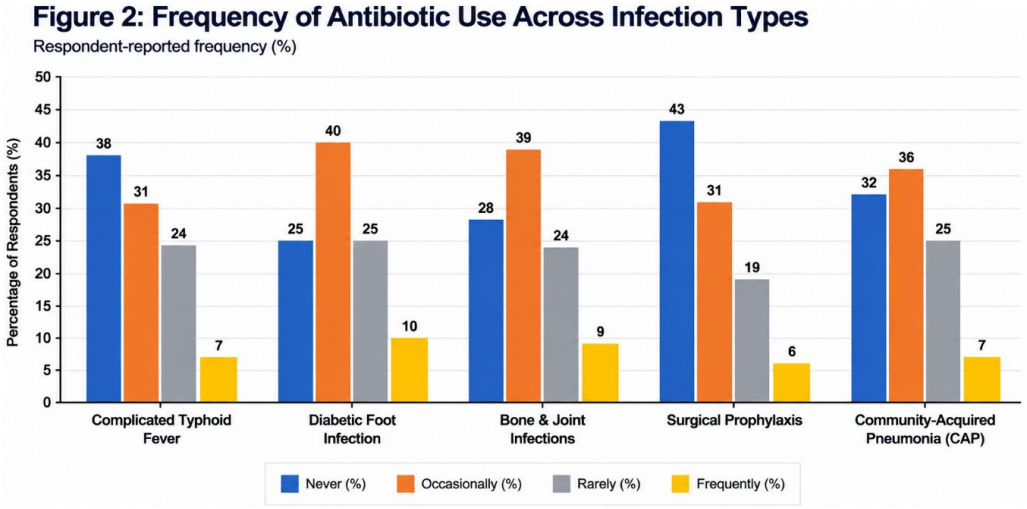


Figure 2. Physician-reported resistance experience.

Survey findings positioned Shalbactam TZ as a commonly utilized empirical antibiotic within the clinical antibiotic ladder approach. Physicians reported using the drug before considering escalation to broader-spectrum agents such as piperacillin-tazobactam and carbapenems. The drug was most frequently reported in CAP, complicated typhoid fever, and surgical prophylaxis, while also being used in DFI and bone and joint infections.

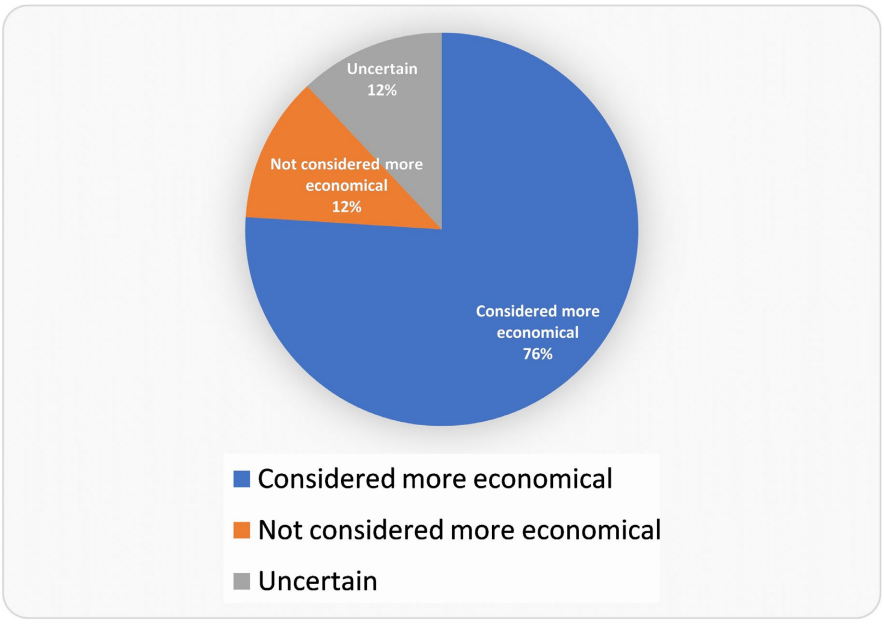


Figure 3. Economic perception of Shalbactum TZ.

Approximately 76% of physicians considered Shalbactam TZ to be a cost-effec-

tive therapeutic option, shown in **Figure 3**. This economic perception, together with reported clinical utility and tolerability, may contribute to its use in resource-constrained healthcare environments such as the DRC.

4. Discussion

The present survey provides real-world information regarding physician prescribing behaviour and clinical perceptions associated with the use of Shalbactam TZ (ceftriaxone + tazobactam) in the Democratic Republic of the Congo (DRC). The findings indicate that Shalbactam TZ is utilized as an empirical antibiotic across multiple infectious disease indications, including community-acquired pneumonia (CAP), complicated typhoid fever, and surgical prophylaxis [4] [14]. The observed physician acceptance may reflect the clinical requirement for broad-spectrum antimicrobial agents in resource-constrained healthcare settings [15].

One of the principal observations of the study was the predominance of empirical antibiotic initiation across major indications. Approximately two-thirds of physicians reported initiating therapy empirically rather than relying on culture sensitivity reports. This observation may be associated with delayed microbiological diagnostics, limited laboratory infrastructure, and high infectious disease burden in routine clinical settings [15]. The preference for empirical use suggests that physicians consider Shalbactam TZ suitable for initial antimicrobial coverage during early infection management [16]. The first-line preference observed in complicated typhoid fever and CAP indicates that Shalbactam TZ is commonly used in these infections [4] [14]. These conditions continue to contribute substantially to morbidity in developing healthcare settings, where physicians often require antimicrobial agents with broad pathogen coverage, acceptable tolerability, and affordability [7]. The physician responses in this survey suggest that ceftriaxone-tazobactam combinations are being incorporated into routine prescribing practices in such environments [17]. Clinical improvement within 4 - 6 days was reported across several indications, including DFI and bone and joint infections. Early clinical response is frequently considered during assessment of empirical therapy in routine practice [5]. The observed response pattern in this survey may reflect the perceived clinical activity of the drug in the evaluated conditions.

The survey also demonstrated high physician satisfaction levels, with approximately 91% - 97% of respondents rating treatment outcomes as good or excellent. Satisfaction ratings were comparatively higher in typhoid fever, CAP, and surgical prophylaxis, whereas DFI and bone and joint infections more frequently received "good" ratings. This variation may be related to differences in infection chronicity, polymicrobial involvement, and treatment complexity [18]. The dosing and duration trends identified in the study provide additional information regarding prescribing practices. Twice-daily (BD) administration was the most commonly preferred dosing strategy across most indications, while once-daily (OD) dosing was more frequently preferred in CAP [19]. Prolonged therapy durations (>14 days) were more commonly reported in DFI and bone and joint infections, which

may reflect physician preference for extended treatment in chronic or deep-seated infections [20].

The safety findings reported in the survey were generally acceptable (physician-reported perceptions). Injection site pain was the most frequently reported adverse effect, whereas diarrhoea, rash, and headache were reported less commonly [21]. Most reported adverse effects were described as mild and non-serious. No major safety concerns were identified by respondents during the survey period. The majority of physicians reported either never or only occasionally encountering resistance with Shalbactam TZ, while frequent resistance was reported by less than 10% of respondents [22]. In the context of increasing antimicrobial resistance, these findings provide information regarding physician perception of resistance patterns in routine clinical use. However, these observations were based on physician experience rather than microbiologically confirmed resistance data [1]. Approximately three-fourths of physicians considered Shalbactam TZ to be cost-effective. In resource-limited healthcare environments, economic considerations may influence antibiotic selection alongside clinical considerations [2].

The findings of the present survey are consistent with previous reports demonstrating widespread use of broad-spectrum β-lactam/β-lactamase inhibitor combinations as empirical therapy in resource-limited healthcare settings. The high proportion of physicians initiating Shalbactam TZ empirically reflects the limited availability of rapid microbiological diagnostics and the need for prompt antimicrobial therapy in patients with suspected bacterial infections. Similar prescribing patterns have been reported in antimicrobial stewardship studies from other low- and middle-income countries [8].

The high physician preference for Shalbactam TZ observed in CAP, complicated typhoid fever, and surgical prophylaxis is consistent with current treatment recommendations emphasizing timely initiation of broad-spectrum antibiotics in moderate-to-severe infections. The observed clinical improvement within 4 - 6 days and favourable satisfaction ratings further support clinicians' confidence in the combination as an effective empirical treatment option.

The safety findings of the present survey are also comparable with previous observational studies evaluating ceftriaxone-tazobactam combinations. Injection-site pain was the most commonly reported adverse event, whereas diarrhoea, rash, and headache occurred less frequently and were generally mild and self-limiting. No serious safety concerns were identified, indicating an acceptable tolerability profile in routine clinical practice.

Most physicians reported encountering antimicrobial resistance only occasionally or rarely while using Shalbactam TZ. Although these observations were perception-based rather than microbiologically confirmed, they suggest that the combination continues to maintain satisfactory clinical effectiveness in routine practice. Similar findings have been reported in previous studies evaluating β-lactam/β-lactamase inhibitor combinations, which remain important components of antimicrobial stewardship programmes by reducing unnecessary escalation to carbapenems.

The majority of clinicians also considered Shalbactam TZ to be economically viable. In low-resource healthcare systems, treatment cost is an important determinant of antibiotic selection. Therefore, the combination of favourable efficacy, acceptable safety, and perceived cost-effectiveness may explain the widespread physician preference observed in the present survey.

The survey additionally indicated that physicians frequently positioned Shalbactam TZ as an empirical antibiotic prior to escalation to broader-spectrum agents such as piperacillin-tazobactam and carbapenems. This prescribing pattern may have relevance in the context of antibiotic stewardship practices aimed at limiting unnecessary use of higher-generation antimicrobials [23].

5. Conclusion

This multicentre HPER survey demonstrates that Shalbactam TZ is widely utilized as an empirical first-line antibiotic by physicians in the Democratic Republic of the Congo, particularly for community-acquired pneumonia, complicated typhoid fever, and surgical prophylaxis. Physicians reported high levels of clinical satisfaction, favourable therapeutic response, acceptable tolerability, low perceived antimicrobial resistance, and good economic value. These findings support physicians' favourable perception of Shalbactam TZ as a broad-spectrum antimicrobial option in routine clinical practice, particularly in resource-limited healthcare settings where early empirical therapy remains essential. These findings reflect physician-reported experience rather than independently verified clinical or microbiological outcomes; further prospective clinical studies incorporating microbiological confirmation and patient-level outcomes are required to validate these observations and strengthen the evidence base for its clinical use.

Conflicts of Interest

The authors declare no conflict of interest.

References

[1] Murray, C.J.L., Ikuta, K.S., Sharara, F., Swetschinski, L., Robles Aguilar, G., Gray, A., *et al.* (2022) Global Burden of Bacterial Antimicrobial Resistance in 2019: A Systematic Analysis. *The Lancet*, **399**, 629-655. https://doi.org/10.1016/s0140-6736(21)02724-0

[2] World Bank (2017) Drug-Resistant Infections: A Threat to Our Economic Future. World Bank Group.

[3] Tamma, P.D., Heil, E.L., Justo, J.A., Mathers, A.J., Satlin, M.J. and Bonomo, R.A. (2024) Infectious Diseases Society of America 2024 Guidance on the Treatment of Antimicrobial-Resistant Gram-Negative Infections. *Clinical Infectious Diseases*, ciae403. https://doi.org/10.1093/cid/ciae403

[4] Metlay, J.P., Waterer, G.W., Long, A.C., Anzueto, A., Brozek, J., Crothers, K., *et al.* (2019) Diagnosis and Treatment of Adults with Community-Acquired Pneumonia. an Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America. *American Journal of Respiratory and Critical Care*

Medicine, **200**, e45-e67. https://doi.org/10.1164/rccm.201908-1581st

[5] Senneville, É., Albalawi, Z., van Asten, S.A., Abbas, Z.G., Allison, G., Aragón-Sánchez, J., *et al.* (2023) IWGDF/IDSA Guidelines on the Diagnosis and Treatment of Diabetes-Related Foot Infections. *Diabetes/Metabolism Research and Reviews*, **40**, e3687. https://doi.org/10.1002/dmrr.3687

[6] World Health Organization (2018) Typhoid Vaccines: WHO Position Paper. *Weekly Epidemiological Record*, **93**, 153-172.

[7] World Health Organization (2023) Antimicrobial Resistance Fact Sheet. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance

[8] Pauwels, I., Versporten, A., Vermeulen, H., Vlieghe, E. and Goossens, H. (2021) Assessing the Impact of the Global Point Prevalence Survey of Antimicrobial Consumption and Resistance (Global-PPS) on Hospital Antimicrobial Stewardship Programmes: Results of a Worldwide Survey. *Antimicrobial Resistance & Infection Control*, **10**, Article No. 138. https://pubmed.ncbi.nlm.nih.gov/34583775/

[9] Bush, K., Macalintal, C., Rasmussen, B.A., Lee, V.J. and Yang, Y. (1993) Kinetic Interactions of Tazobactam with Beta-Lactamases from All Major Structural Classes. *Antimicrobial Agents and Chemotherapy*, **37**, 851-858. https://doi.org/10.1128/aac.37.4.851

[10] European Committee on Antimicrobial Susceptibility Testing (EUCAST) (2024) Guidance on β-Lactam Susceptibility Testing and Resistance Mechanisms. EUCAST, Växjö.

[11] World Health Organization (2019) Antimicrobial Stewardship Programmes in Health-Care Facilities in Low- and Middle-Income Countries: A WHO Practical Toolkit. World Health Organization. https://www.who.int/publications/i/item/9789241515481

[12] Enweluzo, G.O., Akinmokun, O.I., Alabi, E.O., Ohadugha, A.G.U. and Giwa, S.O. (2023) Surgical Site Infection in Nigerian Patients: A Comparative Study of Two Prophylactic Antibiotics. *Journal of Clinical Sciences*, **20**, 59-64. https://doi.org/10.4103/jcls.jcls_24_23

[13] Howard, P., Pulcini, C., Levy Hara, G., West, R.M., Gould, I.M., Harbarth, S., *et al.* (2015) An International Cross-Sectional Survey of Antimicrobial Stewardship Programmes in Hospitals. *Journal of Antimicrobial Chemotherapy*, **70**, 1245-1255. https://doi.org/10.1093/jac/dku497

[14] Crump, J.A. and Mintz, E.D. (2010) Global Trends in Typhoid and Paratyphoid Fever. *Clinical Infectious Diseases*, **50**, 241-246. https://doi.org/10.1086/649541

[15] Okeke, I.N., Aboderin, O.A., Byarugaba, D.K., Ojo, K.K. and Opintan, J.A. (2007) Growing Problem of Multidrug-Resistant Enteric Pathogens in Africa. *Emerging Infectious Diseases*, **13**, 1640-1646. https://doi.org/10.3201/eid1311.070674

[16] Tamma, P.D. and Holmes, A. (2014) The Use of Broad-Spectrum Antibiotics and the Importance of Empirical Therapy. *Clinical Microbiology and Infection*, **20**, 1-6.

[17] Paterson, D.L. (2006) The Role of Antimicrobial Management Programs in Optimizing Antibiotic Prescribing within Hospitals. *Clinical Infectious Diseases*, **42**, S90-S95. https://doi.org/10.1086/499407

[18] Lew, D.P. and Waldvogel, F.A. (2004) Osteomyelitis. *The Lancet*, **364**, 369-379. https://doi.org/10.1016/s0140-6736(04)16727-5

[19] Craig, W.A. (1998) Pharmacokinetic/Pharmacodynamic Parameters: Rationale for Antibacterial Dosing of Mice and Men. *Clinical Infectious Diseases*, **26**, 1-10.

https://doi.org/10.1086/516284

[20] Berbari, E.F., Kanj, S.S., Kowalski, T.J., Darouiche, R.O., Widmer, A.F., Schmitt, S.K., *et al.* (2015) 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adultsa. *Clinical Infectious Diseases*, **61**, e26-e46. https://doi.org/10.1093/cid/civ482

[21] Aronson, J.K. (2015) Meyler's Side Effects of Drugs: The International Encyclopaedia of Adverse Drug Reactions and Interactions. Elsevier.

[22] World Health Organization (2024) Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report. World Health Organization.

[23] Barlam, T.F., Cosgrove, S.E., Abbo, L.M., MacDougall, C., Schuetz, A.N., Septimus, E.J., *et al.* (2016) Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clinical Infectious Diseases*, **62**, e51-e77. https://doi.org/10.1093/cid/ciw118