ORIGINAL ARTICLE

Infect Dis Clin Microbiol 2026; 8(4): 361–71

Surgical Antimicrobial Prophylaxis in Neurosurgery: A Nationwide Survey on Guideline Adherence in Türkiye

Ali Akar[1], Mustafa Serhat Şahinoğlu[2]

[1] Department of Neurosurgery, Çanakkale Onsekiz Mart University School of Medicine, Çanakkale, Türkiye

[2] Department of Infectious Diseases and Clinical Microbiology, Mersin University School of Medicine, Mersin, Türkiye

ABSTRACT

Objective: Surgical antimicrobial prophylaxis (SAP) is a key strategy for preventing surgical site infections (SSIs), yet its implementation in clinical practice remains variable despite established guideline recommendations. This study aimed to assess neurosurgeons' knowledge and practices regarding SAP in Türkiye and to evaluate their adherence to current guideline recommendations.

Materials and Methods: This multicenter, cross-sectional study was conducted among actively practicing neurosurgeons across Türkiye using an online survey. A structured questionnaire, informed by relevant national and international guidelines collected data on demographic characteristics and key aspects of SAP, including antibiotic selection, timing of initiation, dosing strategies, and duration of prophylaxis. Categorical variables were analyzed using the chi-square test, and a p-value < 0.05 was considered statistically significant.

Results: A total of 464 participants were included. Overall,30.2% of respondents rated their SAP knowledge as "good," ranging from 21.9% among residents to 80% among professors ($p < 0.001$). Guideline-concordant antibiotic selection was reported by 70.7% of participants; however, in cranial procedures, ceftriaxone was preferred over cefazolin in 50.9% of cases. Adherence to the recommended timing of prophylaxis initiation was reported by 62% of participants, while 68.1% administered additional intraoperative doses during prolonged surgeries. Only 51.7% considered patient body weight when adjusting doses, and 37.9% discontinued prophylaxis within 24 hours postoperatively. Professors demonstrated higher adherence across several parameters, including initiation timing, dosing, and discontinuation (all $p < 0.05$).

Conclusion: Adherence to key components of SAP remains suboptimal among neurosurgeons in Türkiye. Although knowledge levels varied across academic ranks, this did not consistently translate into clinical practice. Structured educational initiatives, institutional protocols, and audit-based interventions may help improve adherence to guideline-based SAP practices.

Keywords: Surgical antimicrobial prophylaxis, neurosurgery, guideline adherence, cross-sectional survey

Corresponding Author:
Mustafa Serhat Şahinoğlu

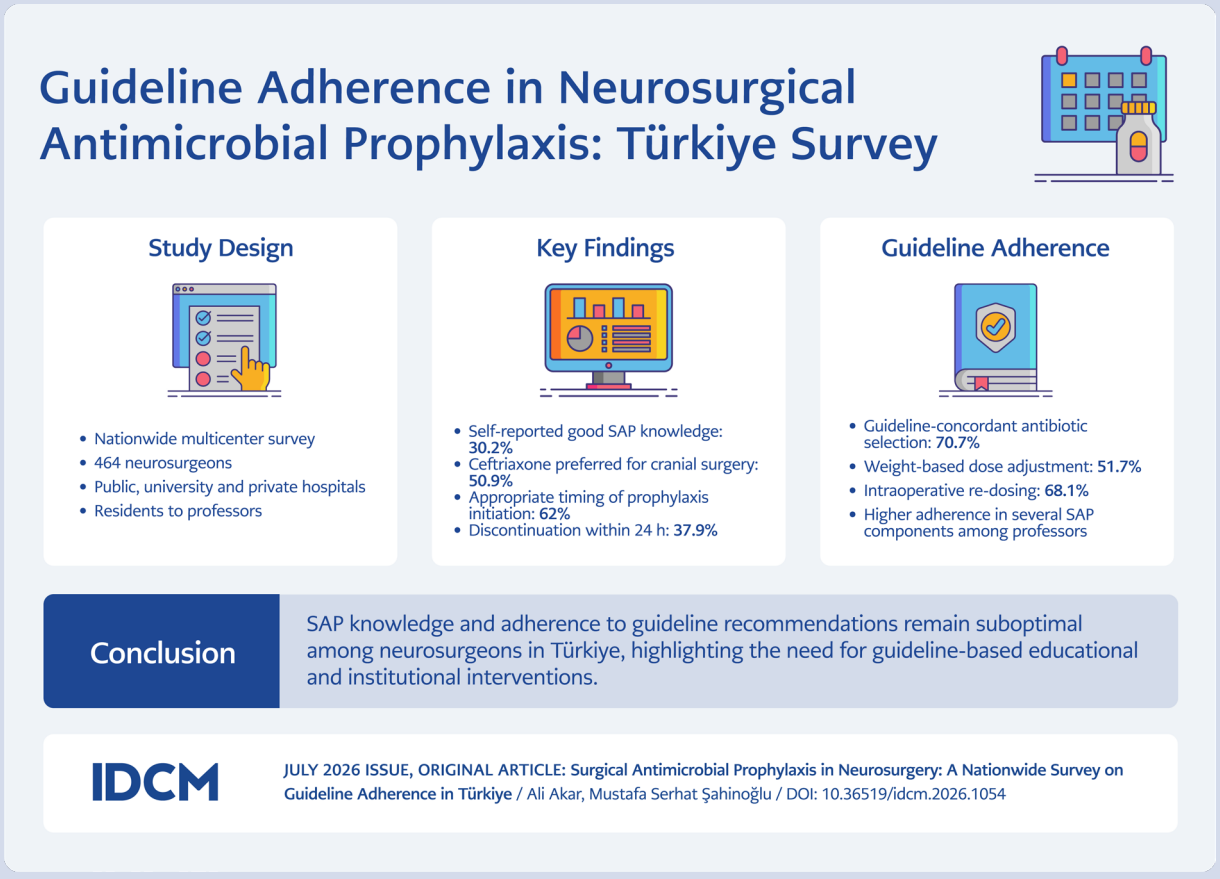
E-mail:
mserhatsahinoglu@mersin.edu.tr

Received: February 23, 2026
Accepted: May 7, 2026
Published: July 28, 2026

Suggested citation:
Akar A, Şahinoğlu MS. Surgical antimicrobial prophylaxis in neurosurgery: A nationwide survey on guideline adherence in Türkiye. Infect Dis Clin Microbiol. 2026;8(4):361–71.

DOI: 10.36519/idcm.2026.1054

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.



Graphical Abstract

INTRODUCTION

Surgical site infections (SSIs) remain one of the most common and serious hospital-acquired infections (HAIs), despite continuous technological advancements in modern medicine (1). Depending on the type of surgery, the incidence of SSIs ranges from 0.6% to 9.5%; a meta-analysis published in 2023 reported a global pooled incidence of approximately 2.5% (2,3). SSIs are associated with several adverse outcomes, including increased morbidity and mortality, prolonged hospital stays, a higher likelihood of reoperation, and substantially elevated healthcare costs (2).

Multiple national and international guidelines have outlined strategies to prevent SSIs (4–6). These include reducing patient-specific risk factors (e.g., smoking cessation, nutritional support), preoperative antiseptic bathing, appropriate preparation of the surgical field, and intraoperative management of blood glucose and temperature. Such interventions have been shown to reduce the risk of SSIs by up to 60% (4). Among these strategies, surgical antimicrobial prophylaxis (SAP) is recognized as a critical component. When antibiotic selection, dosing, and timing are optimized, SAP has been shown to significantly reduce the risk of postoperative infections (5).

Despite well-established guideline recommendations, clinical practice often diverges from these standards. This discrepancy is particularly evident in developing countries, where data on SAP practices are limited, and existing studies frequently report significant inconsistencies, particularly in antibiotic selection and timing (7,8). Factors contributing to suboptimal SAP implementation include challenges in maintaining up-to-date professional knowledge, entrenched clinical habits, lack of institutional policies, and practical difficulties in implementing guideline recommendations (9). Reported adherence rates to SAP guidelines

across different hospital types, specialties, and geographic regions vary widely, ranging from 40% to 90% (10–12).

In Türkiye, SAP is predominantly managed by surgeons and anesthesiologists, highlighting the critical need for targeted education and awareness initiatives among these healthcare professionals. However, the literature contains only a limited number of studies assessing surgeons' knowledge and attitudes toward SAP (7,13–15). The present study represents one of the most comprehensive surveys to date in this area, involving neurosurgeons at various professional levels—including residents, specialists, and academicians—working in public, university, and private foundation hospitals across diverse regions of Türkiye.

The primary aim of this study was to assess the knowledge and clinical practices of neurosurgeons in Türkiye regarding SAP and to compare these practices with current national and international guideline recommendations. A secondary objective was to evaluate clinicians' awareness of current SAP guidelines and to explore the associations between knowledge levels and professional characteristics such as institution type and academic title. As one of the first large-scale investigations focusing specifically on SAP practices in Turkish neurosurgical settings, this study aimed to identify gaps between knowledge and practice and to provide foundational data for improving clinical standardization and adherence to prophylaxis protocols.

HIGHLIGHTS

- Guideline adherence to surgical antimicrobial prophylaxis (SAP) among neurosurgeons in Türkiye was suboptimal.
- Only 30.2% of participants rated their SAP knowledge as "good."
- Guideline-concordant SAP antibiotic selection was 70.7% overall but only 39.7% in cranial procedures.
- Adherence to key SAP components was limited: appropriate initiation timing (62%), weight-based cefazolin dosing (51.7%), and discontinuation within 24 hours (37.9%).
- Academic seniority was associated with better compliance in SAP dosing and discontinuation practices.

MATERIALS AND METHODS

This multicenter, cross-sectional, descriptive study was conducted between January 15 and March 15, 2023, using an online survey administered to physicians actively practicing in the field of neurosurgery across Türkiye. The survey was designed using the Google Forms platform (Google LLC, Mountain View, CA, USA), distributed through email and professional communication groups, and remained accessible for 60 days. Inclusion criteria included physicians holding a professional title in neurosurgery and actively practicing in Türkiye who voluntarily completed the questionnaire in full. Incomplete responses and entries that did not meet the eligibility criteria were excluded from the analysis. A total of 464 valid responses were included in the final dataset. All data were collected anonymously, were used exclusively for research purposes, and contained no personally identifiable information.

The questionnaire was developed by the principal investigator following an extensive review of the literature and relevant guideline recommendations and institutional SAP practices (4,5,16,17). To ensure content validity, the draft version was reviewed by a multidisciplinary panel consisting of an anesthesiologist, an infectious diseases and clinical microbiology specialist, and a general surgeon. Revisions were made to enhance the clarity, relevance, and consistency of the questions. A pilot study was subsequently conducted with five neurosurgery specialists, and the final version of the questionnaire was revised based on their feedback.

Questionnaire Structure

The survey consisted of two main sections. The first section collected participants' demographic and professional characteristics, including age, sex, years of professional experience, academic title (resident, specialist, assistant professor, associate professor, or professor), and type of institution (secondary-level public hospital, secondary-level private hospital, tertiary training and research

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

hospital, public university hospital, or private foundation university hospital).

The second section focused on evaluating participants' knowledge and clinical practices regarding SAP. The questionnaire included items assessing participants' self-perceived level of knowledge about SAP, sources of information, whether approval from an infectious diseases specialist was required before SAP administration, preferred prophylactic antibiotics for cranial and spinal procedures, timing of prophylaxis initiation, administration of additional intraoperative cefazolin doses during prolonged procedures, consideration of patient body weight when determining cefazolin dosage, and the duration and timing of prophylaxis discontinuation.

The study was approved by the Scientific Research Ethics Committee of Çanakkale Onsekiz Mart University on December 29, 2022 (Decision No. 23/38).

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 29.0 (IBM Corp., Armonk, NY, USA). Assistant professors, associate professors, and professors were grouped as "academic staff" for primary analyses. Descriptive statistics were presented as frequencies (n) and percentages (%). Associations between categorical variables were assessed using the Pearson chi-square test. When more than 20% of the expected cell counts were less than 5, Fisher's exact test was used instead. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 464 neurosurgeons participated in the study. The majority were male (82.8%), with a mean age of 39.5 ± 10.9 years. In terms of institutional distribution, most participants were from tertiary training and research hospitals (34.5%), followed by secondary-level public hospitals (26.7%), public university hospitals (18.1%), private hospitals (12.9%), and foundation university hospitals (7.8%).

Regarding academic rank, specialists constituted the largest group (52.6%), followed by residents (27.6%), associate professors (9.5%), assistant professors (6.0%), and professors (4.3%).

Self-reported SAP knowledge differed significantly across professional groups (Figure 1). The proportion of participants reporting a "good" level of knowledge was highest among academic staff and lowest among residents ($p < 0.001$). Participants reported multiple sources of information on SAP, as illustrated in Figure 2.

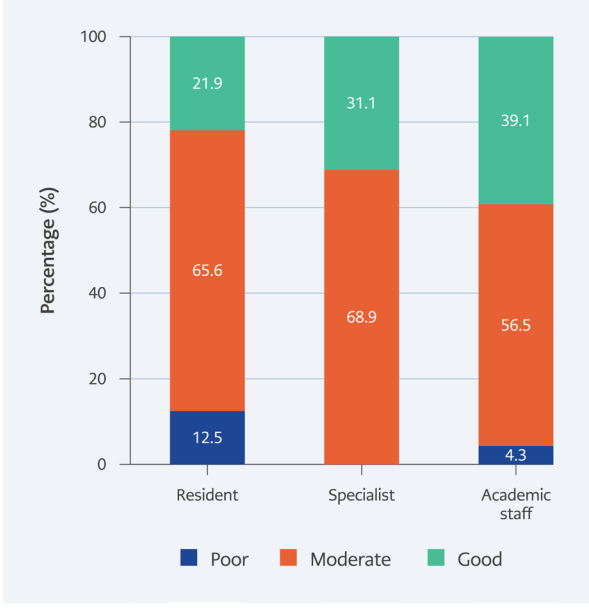


Figure 1. Self-reported surgical antimicrobial prophylaxis knowledge by professional category.

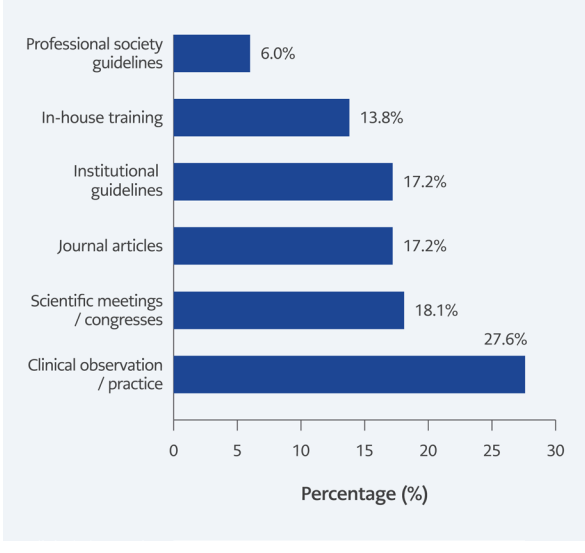


Figure 2. Sources of information on surgical antimicrobial prophylaxis.

Table 1. Comparison of surgical antimicrobial prophylaxis (SAP) practices according to academic rank.

Variable	Response	All participants (n=464)	Resident (n=128)	Specialist (n=244)	Academic staff (n=92)	*p*
Overall SAP	Cefazolin	328 (70.7)	68 (53.1)	196 (80.3)	64 (69.6)	<0.001
	Ceftriaxone	104 (22.4)	56 (43.8)	28 (11.5)	20 (21.7)	
	Ciprofloxacin	24 (5.2)	0 (0.0)	16 (6.6)	8 (8.7)	
	SAM/Lincosamide	8 (1.7)	4 (3.1)	4 (1.6)	0 (0.0)	
Cranial surgery	Cefazolin	184 (39.7)	48 (37.5)	104 (42.6)	32 (34.8)	0.003
	Ceftriaxone	236 (50.9)	72 (56.2)	108 (44.3)	56 (60.9)	
	Ciprofloxacin	24 (5.2)	0 (0.0)	20 (8.2)	4 (4.3)	
	SAM/Lincosamide	20 (4.3)	8 (6.2)	12 (4.9)	0 (0.0)	
Spinal surgery	Cefazolin	316 (68.1)	72 (56.2)	176 (72.1)	68 (73.9)	<0.001
	Ceftriaxone	96 (20.7)	48 (37.5)	32 (13.1)	16 (17.4)	
	Ciprofloxacin	20 (4.3)	4 (3.1)	12 (4.9)	4 (4.3)	
	SAM/Lincosamide	32 (6.9)	4 (3.1)	24 (9.8)	4 (4.3)	
Timing of prophylaxis initiation	Before the day of surgery	24 (5.2)	0 (0)	24 (9.8)	0 (0)	0.001
	Morning of surgery	152 (32.8)	36 (28.1)	84 (34.4)	32 (34.8)	
	At induction	288 (62.1)	92 (71.9)	136 (55.7)	60 (65.2)	
Intraoperative redosing	No	148 (31.9)	44 (34.4)	88 (36.1)	16 (17.4)	<0.001
	Yes	316 (68.1)	84 (65.6)	156 (63.9)	76 (82.6)	
Weight-based dosing	No	224 (48.3)	56 (43.8)	132 (54.1)	36 (39.1)	0.045
	Yes	240 (51.7)	72 (56.2)	112 (45.9)	56 (60.9)	
Duration of prophylaxis	<24 hours	176 (37.9)	52 (40.6)	88 (36.1)	36 (39.1)	<0.001
	3 days	100 (21.6)	20 (15.6)	52 (21.3)	28 (30.4)	
	7 days	108 (23.3)	24 (18.8)	60 (24.6)	24 (26.1)	
	Until discharge	80 (17.2)	32 (25.0)	44 (18.0)	4 (4.3)	

Note: Academic staff included assistant professors, associate professors, and professors. Residents were physicians undergoing neurosurgical training. Percentages were calculated within each column. *P* values were calculated using Pearson's chi-square test or Fisher's exact test, as appropriate. **SAM:** ampicillin-sulbactam.

Regarding clinical decision-making authority, 55.2% of participants reported independently determining the antibiotic selection, dose, and duration without approval from an infectious diseases specialist. By contrast, 24.1% stated that approval from an infectious diseases specialist was mandatory in their institution, while 20.7% reported that, although formally required, they occasionally acted on their own clinical judgment when necessary.

Overall, cefazolin was the most frequently selected antibiotic for SAP, accounting for 70.7% of responses. Its use differed significantly across academic ranks ($p < 0.001$), with the lowest rate observed among residents (53.1%). For cranial surgery, ceftriaxone was the most commonly preferred agent overall (50.9%), whereas cefazolin was preferred by 39.7% of participants. The distribution of antibiotic preferences differed significantly across academic ranks ($p = 0.003$).

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Table 2. Comparison of surgical antimicrobial prophylaxis (SAP) practices according to institution type.

Variable	Response	Institution type n (%)					
		Secondary-level public hospital (n = 124)	Secondary-level private hospital (n = 60)	Tertiary training and research hospital (n = 160)	Public university hospital (n = 84)	Foundation university hospital (n = 36)	*p*
Overall SAP	Cefazolin	112 (90.3)	44 (73.3)	96 (60.0)	52 (61.9)	24 (66.7)	<0.001
	Ceftriaxone	4 (3.2)	4 (6.7)	56 (35.0)	28 (33.3)	12 (33.3)	
	Ciprofloxacin	8 (6.5)	12 (20.0)	4 (2.5)	0 (0.0)	0 (0.0)	
	SAM/Lincosamide	0 (0.0)	0 (0.0)	4 (2.5)	4 (4.8)	0 (0.0)	
Cranial surgery	Cefazolin	60 (48.4)	20 (33.3)	72 (45.0)	24 (28.6)	8 (22.2)	<0.001
	Ceftriaxone	48 (38.7)	36 (60.0)	76 (47.5)	52 (61.9)	24 (66.7)	
	Ciprofloxacin	12 (9.7)	4 (6.7)	4 (2.5)	0 (0.0)	4 (11.1)	
	SAM/Lincosamide	4 (3.2)	0 (0.0)	8 (5.0)	8 (9.5)	0 (0.0)	
Spinal surgery	Cefazolin	104 (83.9)	40 (66.7)	92 (57.5)	56 (66.7)	24 (66.7)	<0.001
	Ceftriaxone	4 (3.2)	8 (13.3)	52 (32.5)	20 (23.8)	12 (33.3)	
	Ciprofloxacin	4 (3.2)	8 (13.3)	8 (5.0)	0 (0.0)	0 (0.0)	
	SAM/Lincosamide	12 (9.7)	4 (6.7)	8 (5.0)	8 (9.5)	0 (0.0)	
Timing of prophylaxis initiation	Before the day of surgery	16 (12.9)	8 (13.3)	0 (0.0)	0 (0.0)	0 (0.0)	<0.001
	Morning of surgery	32 (25.8)	20 (33.3)	60 (37.5)	28 (33.3)	12 (33.3)	
	At induction	76 (61.3)	32 (53.3)	100 (62.5)	56 (66.7)	24 (66.7)	
Intraoperative redosing	No	60 (48.4)	16 (26.7)	32 (20.0)	36 (42.9)	4 (11.1)	<0.001
	Yes	64 (51.6)	44 (73.3)	128 (80.0)	48 (57.1)	32 (88.9)	
Weight-based dosing	No	60 (48.4)	24 (40.0)	88 (55.0)	36 (42.9)	16 (44.4)	0.219
	Yes	64 (51.6)	36 (60.0)	72 (45.0)	48 (57.1)	20 (55.6)	
Duration of prophylaxis	<24 hours	32 (25.8)	24 (40.0)	92 (57.5)	16 (19.0)	12 (33.3)	<0.001
	3 days	32 (25.8)	20 (33.3)	16 (10.0)	28 (33.3)	4 (11.1)	
	7 days	44 (35.5)	12 (20.0)	24 (15.0)	20 (23.8)	8 (22.2)	
	Until discharge	16 (12.9)	4 (6.7)	28 (17.5)	20 (23.8)	12 (33.3)	

Note: Percentages were calculated within each institution type. P values were calculated using Pearson's chi-square test or Fisher's exact test, as appropriate. **SAM:** ampicillin-sulbactam.

Administration of cefazolin prophylaxis at the time of anesthesia induction differed significantly between groups ($p = 0.001$), with the lowest rate observed among specialists. Intraoperative redosing of cefazolin during prolonged surgery also varied significantly across groups ($p < 0.001$), with academic staff reporting the highest rate. Weight-based dosing and the duration of prophylaxis also differed significantly between groups ($p = 0.045$ and $p < 0.001$, respectively). These findings are summarized in Table 1.

Antimicrobial selection for SAP differed significantly according to institution type (Table 2). Cefazolin use was highest in secondary-level public hospitals (90.3%) and substantially lower in tertiary training and university hospitals. For cranial procedures, ceftriaxone was the predominant agent

Table 3. Guideline-concordant surgical antimicrobial prophylaxis (SAP) practices by academic rank.

Variable	Academic ranks, %						
	Total (n = 464)	Resident (n = 128)	Specialist (n = 244)	Assistant professor (n = 28)	Associate professor (n = 44)	Professor (n = 20)	*p*
Cefazolin use*							
Overall SAP	70.7	53.1	80.3	57.1	81.8	60.0	<0.001
In cranial surgery	39.7	37.5	42.6	28.6	36.4	40.0	0.59
In spinal surgery	68.1	56.2	72.1	85.7	72.7	60.0	0.004
Prophylaxis at induction*	62.1	71.9	55.7	57.1	63.6	80.0	0.014
Intraoperative redosing*	68.1	65.6	63.9	85.7	81.8	80.0	0.022
Weight-based dosing*	51.7	56.2	45.9	28.6	63.6	100.0	<0.001
Discontinuation within 24 hours *	37.9	40.6	36.1	28.6	27.3	80.0	0.001

*Variables represent adherence to guideline-recommended SAP practices.

Note: Each variable was analyzed separately using Pearson's chi-square test or Fisher's exact test, as appropriate. Percentages were calculated within each academic rank.

across most institution types, particularly in university and foundation hospitals, whereas cefazolin use remained relatively higher only in secondary-level public hospitals.

Prophylaxis practices also varied across institutions. Intraoperative redosing was more frequently performed in tertiary and university-affiliated centers compared to secondary-level hospitals ($p < 0.001$). Weight-based dosing did not differ significantly between institution types ($p = 0.219$). In contrast, the duration of prophylaxis varied markedly across institutions ($p < 0.001$), with discontinuation within 24 hours more common in training and research hospitals, while prolonged prophylaxis and continuation until discharge were more frequently reported in university-affiliated centers. These findings are summarized in Table 2.

Cefazolin use for SAP was approximately 70% overall, whereas its use in cranial procedures was substantially lower. Adherence to guideline-recommended practices was suboptimal for several key components, including initiation of prophylaxis at the time of anesthesia induction, weight-based cefazolin dosing, and discontinuation within 24 hours. Guideline-concordant SAP practices differed significantly across academic ranks (Table 3).

Adherence to guideline-recommended antibiotic selection was highest among specialists and associate professors and lowest among residents ($p < 0.001$). For spinal procedures, adherence to cefazolin use varied significantly across groups, with the highest rates observed among assistant professors and the lowest among residents ($p = 0.004$), whereas no significant difference was observed for cranial procedures ($p = 0.59$).

Adherence to prophylaxis initiation at the time of anesthesia induction differed significantly across academic ranks ($p = 0.014$), with the highest rates among professors. Discontinuation of prophylaxis within 24 hours also differed significantly across groups ($p = 0.001$), with the highest adherence observed among professors. These findings are summarized in Table 3.

DISCUSSION

This study is among the first large-scale investigations to comprehensively evaluate both knowledge levels and guideline adherence regarding SAP among neurosurgeons in Türkiye. Our findings indicate that adherence to key components of SAP remains suboptimal across multiple domains.

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Significant heterogeneity was observed across several critical parameters of SAP implementation, including antibiotic selection, timing of prophylaxis initiation, intraoperative redosing practices, weight-based dose adjustment, and duration of prophylaxis. Similar variability has been reported in other settings; for example, a multicenter study from Japanese university hospitals demonstrated that overall SAP appropriateness was moderate and varied considerably between institutions, with prolonged duration and non-optimal antimicrobial selection being the most common reasons for non-compliance (18). These findings suggest that adherence to SAP recommendations may differ across clinical settings and highlight the challenges of achieving consistent implementation of guideline-based practices.

In addition to this variability, a discrepancy was observed between participants' self-reported knowledge levels and their adherence to guideline-recommended practices. While residents tended to report lower levels of knowledge and professors reported higher levels, this difference did not fully translate into clinical practice. These findings suggest that although professional seniority may be associated with higher perceived knowledge, it does not necessarily result in consistent implementation of guideline-based practices.

Analysis of participants' knowledge sources indicated that the most commonly cited method of learning was "observation and practice." This suggests that experiential, practice-based learning continues to play a dominant role in surgical settings, whereas structured, guideline-oriented education appears to be less prominent. Such reliance on informal learning—often shaped by institutional norms and mentor practices—may contribute to variability in clinical practice and limit the consistent application of evidence-based recommendations. To address this issue, structured educational initiatives supported by audit systems, feedback mechanisms, and interdisciplinary collaboration—particularly with infectious diseases specialists—may be beneficial. Similar patterns have been reported in previous studies, where awareness of guidelines does not consistently translate into adherence in clinical practice, particularly in antibiotic selection and timing of prophylaxis (7,8,13).

In our study, cefazolin emerged as the most commonly preferred antibiotic for SAP; however, third-generation cephalosporins—particularly ceftriaxone—were more frequently used in cranial surgeries. This finding represents a deviation from established guidelines, which consistently recommend first-generation cephalosporins, especially cefazolin, as the agent of choice for most clean neurosurgical procedures. The use of broader-spectrum agents such as ceftriaxone may reflect concerns regarding postoperative infections, but it also raises concerns about unnecessary broad-spectrum antibiotic exposure and its potential contribution to antimicrobial resistance.

The literature presents variable results regarding adherence to SAP recommendations. For example, Tan et al. (13) reported a 99% adherence rate to guideline-recommended antibiotic selection in their cohort, whereas our study demonstrated lower compliance, particularly in cranial procedures. A similar pattern has been observed in other settings; for instance, a study from India reported frequent use of third-generation cephalosporins despite recognition of cefazolin as the first-line agent (14). In addition, large-scale data from the United States have shown that adherence to SAP guidelines remains suboptimal, with unnecessary use of broader-spectrum agents, such as vancomycin, being a major contributor to non-adherence and associated with an increased risk of adverse outcomes (20). Taken together, these findings suggest that deviations from guideline-recommended antibiotic selection are not uncommon and may reflect variability in translating guideline recommendations into routine clinical practice.

Our findings regarding the timing of SAP initiation showed that adherence in our cohort was lower than that reported in several previous studies. In our study, 62% of participants reported initiating prophylaxis within the recommended time frame. This rate was lower than those reported by Schmitt et al. (7) (77.1%), Matsuda et al. (19) (65%), and Kondo et al. (21) (85%). Similar to our study, a study conducted among anesthetists in South Africa identified knowledge deficiencies related to the appropriate timing of SAP administration (22). Meanwhile, Tan et al. (13) reported that, despite

near-complete adherence to antibiotic selection recommendations, inconsistencies persisted in the timing and duration of prophylaxis. Although the reasons for suboptimal timing were not directly assessed in our study, this finding may reflect challenges in translating guideline recommendations into routine perioperative practice.

In addition, nearly half of the participants did not consider patient body weight when administering cefazolin for SAP. This suggests that weight-based dose adjustment may be insufficiently incorporated into routine neurosurgical practice, despite its importance in guideline-based prophylaxis. Current guidelines emphasize that standard dosing may be inadequate in patients with obesity or elevated body mass index, potentially increasing the risk of postoperative infections (4,5). However, studies specifically addressing awareness and implementation of weight-adjusted SAP dosing remain limited. Accordingly, our findings draw attention to this relatively underemphasized aspect of SAP practice.

In our study, 62% of participants reported prolonging SAP beyond the recommended duration. Although 80% of professors indicated that they discontinued prophylaxis within the recommended timeframe, this rate was considerably lower among other academic ranks. Current guidelines recommend administering a single dose or discontinuing SAP within 24 hours postoperatively (4,5,16). However, prolonged use of prophylaxis has been consistently reported both in our cohort and in previous studies, indicating that extended SAP remains a common deviation from guideline recommendations (7,19,23).

Schmitt et al. (7) identified extended antibiotic administration as the most prominent area of non-compliance in their multicenter evaluation, with 62.2% of cases showing unnecessary prolongation, while Matsuda et al. (19) reported that 80% of prophylactic regimens exceeded 24 hours. In line with these findings, a recent multicenter study from Türkiye demonstrated that overall SAP compliance remains low, with prolonged prophylaxis and continuation of antibiotics at discharge being major contributors to non-compliance (23). These observations reinforce that unnecessary prolongation of prophylaxis remains one of the most persistent deviations from guideline recommendations across different healthcare settings.

This study has several limitations that should be acknowledged. First, the data were obtained through a self-reported survey and may reflect perceived practices rather than actual clinical behavior, introducing the potential for response bias. Second, as participation was voluntary, the sample may be biased toward individuals with greater interest or awareness regarding SAP, potentially limiting the generalizability of the findings. Information on the geographic distribution of participants was not collected; therefore, regional representativeness could not be formally assessed. Additionally, the relatively small number of participants in some academic subgroups should be considered when interpreting subgroup comparisons. Third, although the questionnaire was developed based on relevant guideline recommendations, it may not fully capture the complexity of real-world clinical scenarios. Finally, the cross-sectional design precludes any inference about causal relationships.

Despite these limitations, this study has several notable strengths. The relatively large sample size and inclusion of participants from different institutional types and academic ranks enhance the representativeness of the findings and provide a comprehensive overview of current SAP practices in neurosurgical settings across Türkiye.

In conclusion, adherence to guideline-recommended SAP practices among neurosurgeons in Türkiye remains suboptimal. While knowledge levels varied across academic ranks, this knowledge did not consistently translate into clinical practice. Lower adherence was particularly evident in key domains, including antibiotic selection, timing of prophylaxis initiation, weight-based dose adjustment, and duration of prophylaxis.

These findings suggest that improving SAP practice will likely require more than educational interventions alone. Institutional protocols, audit and feedback systems, and multidisciplinary collaboration may help promote consistent adherence to evidence-based recommendations and improve the quality of SAP implementation in neurosurgical settings.

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Ethical Approval: The study was approved by the Scientific Research Ethics Committee of Çanakkale Onsekiz Mart University on December 29, 2022, with decision number 23/38.

Informed Consent: The requirement for informed consent was waived by the Ethics Committee.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – A.A., M.S.Ş.; Design – A.A., M.S.Ş.; Supervision – A.A., M.S.Ş.; Fundings – A.A.; Data Collection and/or Processing – A.A., M.S.Ş.; Analysis and/or Interpretation – A.A., M.S.Ş.; Literature Review – A.A., M.S.Ş.; Writer – A.A., M.S.Ş.; Critical Reviews – A.A., M.S.Ş.

Conflict of Interest: The authors declare no conflict of interest.

Financial Disclosure: The authors declared that this study has received no financial support.

AI Statement: During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to assist with language editing and to improve grammar and readability. All AI-generated suggestions were critically reviewed and revised by the authors, who take full responsibility for the accuracy, integrity, and final content of the manuscript.

REFERENCES

1 Badia JM, Casey AL, Petrosillo N, Hudson PM, Mitchell SA, Crosby C. Impact of surgical site infection on healthcare costs and patient outcomes: a systematic review in six European countries. J Hosp Infect. 2017;96(1):1–15. [CrossRef]

2 Annual Epidemiological Report 2016 – Surgical site infections [Internet]. Stockholm: European Centre for Disease Prevention and Control (ECDC); 2016. [cited February 23, 2026]. Available from: https://www.ecdc.europa.eu/en/publications-data/healthcare-associated-infections-surgical-site-infections-annual-0

3 Mengistu DA, Alemu A, Abdukadir AA, Mohammed Husen A, Ahmed F, Mohammed B, et al. Global incidence of surgical site infection among patients: systematic review and meta-analysis. Inquiry. 2023;60:469580231162549. [CrossRef]

4 Global Guidelines for the Prevention of Surgical Site Infection, Second edition [Internet]. Geneva: World Health Organization (WHO). [cited February 23, 2026]. Available from: https://iris.who.int/handle/10665/277399

5 Berríos-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al; Healthcare Infection Control Practices Advisory Committee. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. JAMA Surg. 2017;152(8):784–91. Erratum in: JAMA Surg. 2017;152(8):803. [CrossRef]

6 T.C. Sağlık Bakanlığı. Türkiye Sağlık Hizmeti ile İlişkili Enfeksiyonları Önleme ve Kontrol Programı 2019–2024. Ankara: T.C. Sağlık Bakanlığı; 2019.

7 Schmitt C, Lacerda RA, Turrini RNT, Padoveze MC. Improving compliance with surgical antibiotic prophylaxis guidelines: A multicenter evaluation. Am J Infect Control. 2017;45(10):1111–5. [CrossRef]

8 Khan Z, Khan J, Khan FU, Kamran M. Audit of antimicrobial prophylaxis for the prevention of surgical infection: A call to action for antimicrobial stewardship [Letter]. Klimik Derg. 2019;32(3):344–5. [CrossRef]

9 Gouvêa M, Novaes Cde O, Pereira DM, Iglesias AC. Adherence to guidelines for surgical antibiotic prophylaxis: a review. Braz J Infect Dis. 2015;19(5):517–24. [CrossRef]

10 Satti MZ, Hamza M, Sajid Z, Asif O, Ahmed H, Zaidi SMJ, et al. Compliance rate of surgical antimicrobial prophylaxis and its association with knowledge of guidelines among surgical residents in a tertiary care public hospital of a developing country. Cureus. 2019;11(5):e4776. [CrossRef]

11 Morris AJ, Roberts SA, Grae N, Hamblin R, Shuker C, Merry AF. The New Zealand Surgical Site Infection Improvement (SSII) Programme: a national quality improvement programme reducing orthopaedic surgical site infections. N Z Med J. 2018;131(1479):45–56.

12 van der Sandt N, Schellack N, Mabope LA, Mawela MPB, Kruger D, Godman B. Surgical antimicrobial prophylaxis among pediatric patients in South Africa comparing two healthcare settings. Pediatr Infect Dis J. 2019;38(2):122–6. [CrossRef]

13 Tan BH, Goh SSL, Ganesan D, Sri La Sri Ponnampalavanar S. Study of the practice of surgical antibiotic prophylaxis use for elective neurosurgical cases in a tertiary hospital and understanding the rationale. World Neurosurg. 2024;189:e612–23. [CrossRef]

14 Turel MK, Meshram B, Rajshekhar V. Survey of prophylactic use of antibiotics among Indian neurosurgeons. Neurol India. 2021;69(6):1737–42. [CrossRef]

15 Pelullo CP, Pepe A, Napolitano F, Coppola N, Di Giuseppe G. Perioperative antibiotic prophylaxis: knowledge and attitudes among resident physicians in Italy. Antibiotics (Basel). 2020;9(6):357. [CrossRef]

16 Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, et al; American Society of Health-System Pharmacists; Infectious Diseases Society of America; Surgical Infection Society; Society for Healthcare Epidemiology of America. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm. 2013;70(3):195–283. [CrossRef]

17 Stanford Antimicrobial Safety and Sustainability Program. SHC surgical antimicrobial prophylaxis guideline [Internet]. Stanford (CA): Stanford Medicine; July 2, 2025. [cited February 23, 2026]. Available from: https://med.stanford.edu/content/dam/sm/bugsanddrugs/documents/clinicalpathways/SHC-Surgical-Prophylaxis-ABX-Guideline.pdf

18 Morioka H, Ohge H, Nagao M, Kato H, Kokado R, Yamada K, et al; Research Group of Japan Infection Prevention and Control Conference for National and Public University Hospitals. Appropriateness of surgical antimicrobial prophylaxis in Japanese university hospitals. J Hosp Infect. 2022;129:189–97. [CrossRef]

19 Matsuda S, Ikawa F, Ohba H, Yoshiyama M, Hidaka T, Kurisu K, et al. Questionnaire survey regarding prevention of surgical site infection after neurosurgery in Japan: Focus on perioperative management and administration of surgical antibiotic prophylaxis. Neurol Med Chir (Tokyo). 2019;59(6):197–203. [CrossRef]

20 Cabral SM, Harris AD, Cosgrove SE, Magder LS, Tamma PD, Goodman KE. Adherence to antimicrobial prophylaxis guidelines for elective surgeries across 825 US hospitals, 2019–2020. Clin Infect Dis. 2023;76(12):2106–15. [CrossRef]

21 Kondo H, Ikawa F, Mayumi T, Takesue Y, Uchimura M, Mikuni N, et al. Questionnaire-based Survey on the prevention of surgical site infection after the publication of its guidelines for neurosurgery in Japan. Neurol Med Chir (Tokyo). 2025;65(3):141–7. [CrossRef]

22 Jocum J, Lowman W, Perrie H, Scribante J. Anaesthetists' knowledge of surgical antibiotic prophylaxis: a prospective descriptive study. South Afr J Anaesth Analg. 2018;24(4):97–102. [CrossRef]

23 Çelik Ekinci S, Yenilmez E, Akengin Öcal G, Sönmezer MÇ, Tarakçı A, Aygün C, et al. Surgical antimicrobial prophylaxis compliance in Turkey: Data from the prospective, observational, multicenter survey including 7,978 surgical patients. Surg Infect (Larchmt). 2024;25(3):231–9. [CrossRef]

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.