Original Article

Cukurova Anestezi ve Cerrahi Bilimler Dergisi

Comparison of the Therapeutic Efficacy of Antibiotic Therapy, Nasal Steroids, Isotonic Saline, and Hypertonic Saline in Patients with Acute Rhinosinusitis

Özge Berber[1], *Ertap Akoğlu*[2]

[1] Department of Otolaryngology, Tarsus State Hospital, Mersin, Türkiye
[2] Department of Otolaryngology, Acıbadem Bodrum Hospital, Muğla, Türkiye

Correspondence: Özge Berber, MD; ozgeberber01@gmail.com

Abstract

Aim: Acute rhinosinusitis (ARS) is a common upper respiratory tract disorder characterized by inflammation of the nasal and paranasal sinus mucosa. Many factors play a significant role in its etiology, particularly viruses. The optimal treatment approach remains controversial. The aim of this study was to investigate the effects of various treatment methods on sinusitis symptoms in patients with ARS. **Methods:** Patients were divided into five groups: antibiotic therapy, intranasal steroid, nasal irrigation with isotonic saline, nasal irrigation with hypertonic saline, and a control group. Symptoms were assessed and compared using a Visual Analog Scale (VAS) before and after treatment. All evaluations were performed by a physician blinded to the treatment groups. **Results:** The differences between pre- and post-treatment VAS scores were statistically significant within all treatment groups. However, the change in the control group was not significant. Furthermore, the post-treatment VAS scores of patients who received antibiotic therapy were significantly better than those of the other groups. **Conclusion:** In this study, all active treatment modalities significantly improved ARS symptoms compared with the control group. The antibiotic-treated group was associated with a greater reduction in VAS scores under the conditions of this study. However, these findings should be interpreted cautiously because bacterial etiology was not microbiologically confirmed. Antibiotic therapy may provide additional benefit in patients with a clinical presentation suggestive of bacterial ARS, whereas supportive treatments such as nasal steroids and saline irrigation can also provide meaningful symptom relief.

Keywords: Acute rhinosinusitis; antibiotic therapy; nasal steroid; nasal lavage

Received: 29.11.2025
Accepted: 09.06.2026
Published: 30.06.2026

1. Introduction

Regardless of etiology, inflammation of the mucosa lining the nasal cavity and paranasal sinuses is defined as rhinosinusitis. Rhinosinusitis is a common health problem[1]. Patients with symptoms lasting between 0 and 4 weeks are classified as having acute rhinosinusitis (ARS)[2]. In 50–70% of ARS cases, the causative microorganisms are viruses—most frequently rhinovirus, influenza, parainfluenza, coronavirus, and adenovirus[3-6]. The main bacterial pathogens include

Regardless of etiology, inflammation of the mucosa lining the nasal cavity and paranasal sinuses is defined as rhinosinusitis. Rhinosinusitis is a common health problem[1]. Patients with symptoms lasting between 0 and 4 weeks are classified as having acute rhinosinusitis (ARS)[2]. In 50–70% of ARS cases, the causative microorganisms are viruses—most frequently rhinovirus, influenza, parainfluenza, coronavirus, and adenovirus[3-6]. The main bacterial pathogens include *Streptococcus pneumoniae* (25–30%), *Haemophilus influenzae* (20–30%), and *Moraxella catarrhalis* (15–20%)[7].

The diagnosis of ARS is clinical. In patients whose symptoms last fewer than 10 days, viral etiology is assumed, and symptomatic treatment is recommended. Intranasal steroids (NS) and isotonic saline solution (ISS) irrigation have been reported to be effective for symptomatic relief [8,9]. If symptoms worsen or persist beyond 10 days, bacterial superinfection is suspected, and antibiotic therapy is added. However, recent meta-analyses have reported that antibiotic treatment may be unnecessary even in patients whose symptoms last longer than 10 days[7].

Antibiotic resistance remains a major global health problem. Moreover, treatment costs impose a significant financial burden on social security systems and governments. Therefore, choosing the most cost-effective and efficient treatment is crucial. Based on these considerations, this study aimed to investigate the effects of different treatment modalities on symptom improvement in patients diagnosed with ARS.

2. Materials and Methods

Ethical approval was obtained from the Mustafa Kemal University Tayfur Ata Sökmen Faculty of Medicine Local Ethics Committee (approval code: 23/06/2014/121; research protocol: 2014/116).

Between September and December 2014, adult patients aged 18–60 years, who presented to the Otorhinolaryngology outpatient clinic of Mustafa Kemal University Medical Faculty Hospital, had symptoms for 10 to 21 days, and were clinically diagnosed with ARS, were included in the study. Diagnosis was based on the presence of at least two of the following symptoms: facial pain/pressure, nasal obstruction, nasal or postnasal discharge, and hyposmia/anosmia, accompanied by purulent discharge in the middle meatus and/or postnasal drainage on examination. The difference in the presence of postnasal and/or purulent discharge before and after treatment was evaluated.

Patients with systemic diseases were excluded. Additional exclusion criteria included pregnancy, inability to provide consent, allergic rhinitis, cystic fibrosis, primary ciliary dyskinesia, hypertension, immunodeficiency, diabetes mellitus, dementia, Alzheimer's disease, cerebrovascular accident, or cardiovascular/pulmonary diseases. Pediatric patients were also excluded.

A total of 150 eligible patients were randomized into five treatment groups, with 30 patients in each group:

- Group 1: Amoxicillin–clavulanate + paracetamol
- Group 2: Intranasal steroid (NS) + paracetamol
- Group 3: Isotonic saline solution (ISS) irrigation + paracetamol
- Group 4: Hypertonic saline (HS) nasal lavage + paracetamol
- Group 5 (Control): Paracetamol only

Treatment protocols were standardized across the study groups. The antibiotic group received oral amoxicillin–clavulanate (1000 mg twice daily), while the intranasal steroid group used mometasone furoate nasal spray at a dose of 200 μg per day. Patients in the isotonic and hypertonic saline groups performed nasal irrigation twice daily using commercially available saline solutions. In all groups, paracetamol (500 mg, up to three times daily as needed) was permitted for symptomatic relief.

The VAS scoring system used in this study included multiple ARS-related symptoms. Symptoms such as nasal obstruction, nasal discharge/postnasal drip, olfactory disturbance, facial pressure or fullness, headache, fever, halitosis, cough, fatigue, dental pain, and ear pain were each evaluated individually using a 0–10 Visual Analog Scale (VAS). The VAS values reported in the study represent the summed cumulative scores derived from these individual symptom ratings rather than the score of a single symptom. Therefore, the reported VAS values may exceed the conventional 0–10 range used for individual VAS assessments.

After 10 days of treatment, patients were re-examined by an independent physician blinded to treatment allocation. Post-treatment symptoms were reassessed using the VAS. Pre- and post-treatment VAS scores were compared within and between groups.

Statistical analyses were performed using the Mann-Whitney U, Wilcoxon, and Kruskal-Wallis variance analysis tests. A p-value < 0.05 was considered statistically significant.

3. Results

The ages of the patients ranged from 18 to 60 years (mean: 36.10 ± 13.03). Of the participants, 78 were female (52%) and 72 were male (48%). There were no statistically significant differences among the groups with respect to age or sex distribution (p > 0.05).

Regarding treatment response, Group 1 (amoxicillin–clavulanate + paracetamol) showed a substantial reduction in mean VAS scores from 60.70 ± 12.45 pre-treatment to 24.70 ± 9.17 post-treatment. In Group 2 (NS + paracetamol), VAS scores improved from 52.10 ± 10.37 to 26.60 ± 9.95.

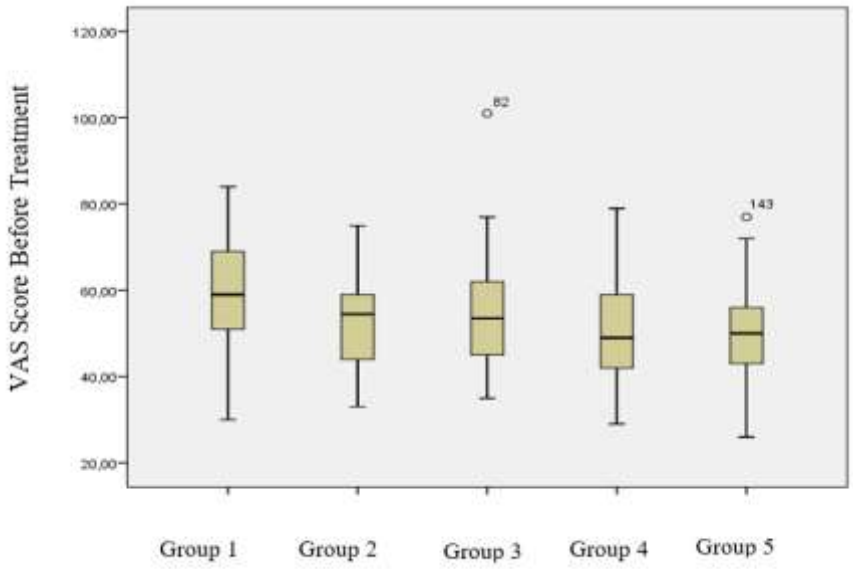

Figure 1. VAS scores of the groups before treatment

Table 1. Mean Pre- and Post-Treatment VAS Scores of the Groups

Groups	VAS (Before treatment)	VAS (After treatment)	P value
Antibiotic therapy	60.7±12.4	24.1±9.1	0.001
Intranasal Steroid	52.1±10.3	26.6±9.9	0.001
Saline Solution	54.7±14.0	28.1±13.7	0.001
Hypertonic Solution	52.0±12.4	30.5±10.3	0.001
Control Group	46.3±12.7	45.8±13.3	>0.05

**Wilcoxon test*

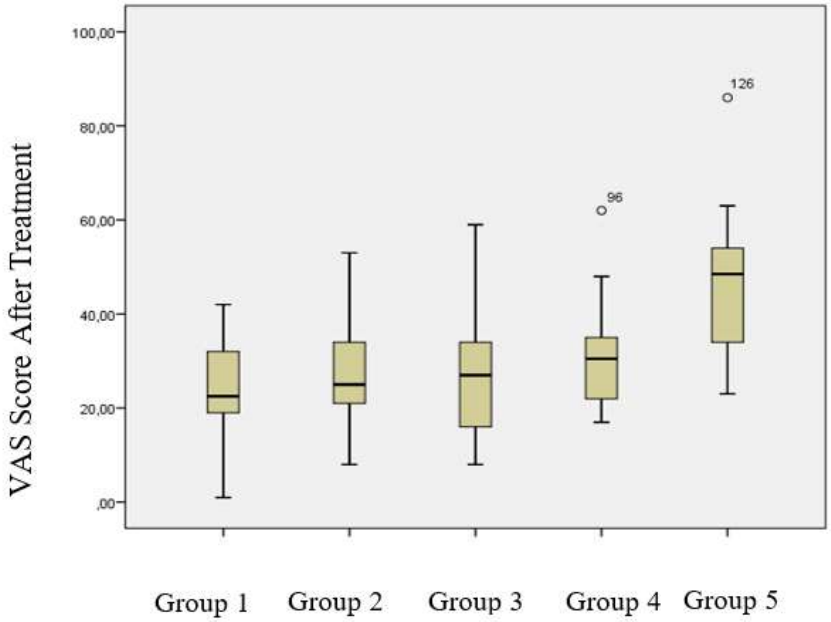

Figure 2. VAS scores of the groups after treatment

Similarly, patients in Group 3 (ISS + paracetamol) demonstrated a decrease from 54.70 ± 14.00 to 28.10 ± 13.70, and Group 4 (HS + paracetamol) showed improvement from 52.03 ± 12.46 to 30.56 ± 10.33. All four treatment groups exhibited statistically significant reductions in VAS scores ($p = 0.001$). In contrast, no significant change was observed in Group 5 (control), with pre- and post-treatment VAS scores of 46.36 ± 12.79 and 45.83 ± 13.35, respectively ($p > 0.05$) (Table 1; Figures 1 and 2).

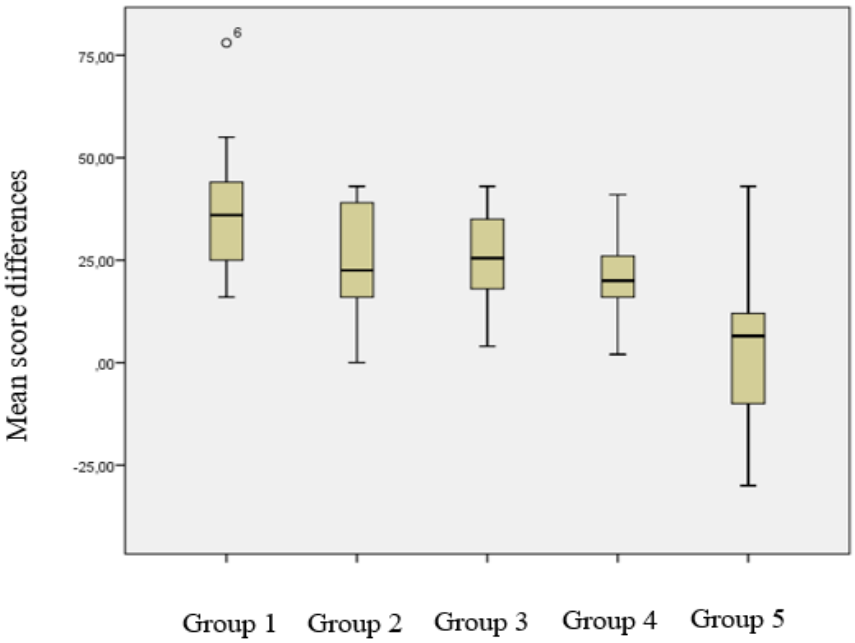

Figure 3. Mean difference in VAS scores before and after treatment

When comparing the change in VAS scores between groups, the reduction in symptom severity was significantly greater in all treatment groups compared with the control group ($p = 0.001$) (Table 2, Figure 3). A 59.7% reduction in postnasal discharge symptoms and an 88.6% reduction in purulent discharge in the middle meatus were observed after

total treatments. The detailed comparison of the differences in pre- and post-treatment VAS scores among the five groups is presented in Table 3.

Table 2. Mean Differences in Pre- and Post-Treatment Scores Between Groups

Groups	Mean difference in pre- and post-treatment VAS scores	P value
Antibiotic therapy	36.6±13.5	0.001
Intranasal Steroid	25.5±11.7	0.001
Saline Solution	26.5±9.5	0.001
Hypertonic Solution	21.4±8.9	0.001
Control Group	3.5±16.2	>0.05

**Kruskal–Wallis One-Way Analysis of Variance*

Table 3. Detailed comparison of the differences in pre- and post-treatment VAS scores

Groups	P value
Group 1 vs Group 2	0.03
Group 1 vs Group 3	0.04
Group 1 vs Group 4	0.001
Group 1 vs Group 5	0.001
Group 2 vs Group 3	0.149
Group 2 vs Group 4	0.201
Group 2 vs Group 5	0.001
Group 3 vs Group 4	0.001
Group 3 vs Group 5	0.001
Group 4 vs Group 5	0.001

**Mann Whitney U test*

4. Discussion

Treatment guidelines generally recommend symptomatic therapy—including analgesics and decongestants—for patients whose symptoms last fewer than 10 days, assuming a viral etiology. When symptoms worsen or persist beyond 10 days, bacterial superinfection is suspected, and antibiotics may be considered [7-9]. However, several recent meta-analyses have suggested that antibiotics are often unnecessary even in prolonged cases [7,8]. Studies have also demonstrated the efficacy of NS and saline irrigation in symptom relief [10].

Antibiotic resistance remains one of today's most pressing health concerns [7-9]. Moreover, the cost burden of unnecessary antibiotic use on healthcare systems underscores the importance of cost-effective management[7].

Although many ARS cases are viral and may resolve without antibiotics, clinical suspicion of bacterial infection increases when symptoms persist beyond 10 days or worsen after initial improvement. In such cases, antibiotic therapy may provide additional symptomatic benefit. Therefore, appropriate patient selection remains essential to balance effective treatment and antibiotic stewardship. In this study, we aimed to evaluate the effectiveness of various treatment options in ARS patients with symptoms persisting beyond 10 days. Our findings showed that post-treatment VAS scores were significantly lower in all treatment groups compared to the control group, and significantly lower than pre-treatment values within each treatment group.

Although a previous randomized study reported that amoxicillin was not superior to placebo in ARS [11,12], that study included patients with symptoms lasting fewer than 10 days, likely of viral origin. In contrast, our study involved patients with symptoms

exceeding 10 days, where bacterial etiology is more probable. Accordingly, antibiotic therapy resulted in greater symptom improvement compared with control.

Numerous studies have shown that NS are highly effective in ARS management [13,14]. Potter et al. reported that NS were more effective than antibiotics, particularly in allergic rhinosinusitis[15]. NS exert their effect by suppressing cellular infiltration and reducing edema in the ostiomeatal complex, thereby improving sinus drainage and aeration[16,17]. In our study, symptom scores decreased significantly in the NS group both compared to baseline and to the control group. This symptomatic improvement in the NS group may be attributed to these mechanisms, as the reduction in mucosal inflammation and edema likely facilitated better sinus drainage and ventilation, thereby alleviating patient complaints.

Other studies have also demonstrated the benefit of ISS and HS irrigations in ARS [18,19]. Saline or seawater solutions enhance mucociliary clearance by increasing humidity and may improve sinus ventilation through mild vasoconstrictive effects [20,21]. However, some authors argue that highly concentrated solutions may disrupt the mucosal pH balance and cause dryness. Consistent with these proposed mechanisms, our study also demonstrated a significant reduction in symptoms in both the HS and ISS groups, suggesting that saline irrigation—regardless of tonicity—can provide meaningful clinical improvement in ARS.

Previous research has shown that children without nasopharyngeal bacterial colonization benefit significantly less from antibiotic therapy than those colonized with pathogens[22], highlighting the limited value of antibiotics in certain patient subgroups. Similarly, in our study, both ISS and HS irrigation groups demonstrated significant symptom improvement compared with the control group, suggesting that non-antibiotic supportive treatments may offer substantial clinical benefit in ARS, particularly even when bacterial involvement is absent.

The inclusion of only acute, non-allergic, non-chronic rhinosinusitis cases may explain the consistent improvement observed. Considering the prevalence of ARS, its significant impact on the quality of life, and high costs, both direct and indirect, proper diagnosis and appropriate treatment avoiding unnecessary therapeutic escalation can have a significant impact on public health in its broadest sense[23]. Previous research indicates that general physicians are more prone to diagnostic errors than specialists when applying established ARS criteria [24], underscoring the importance of accurate diagnosis because treatment selection—particularly the decision to prescribe antibiotics—should be based on true clinical suspicion of bacterial involvement. Indeed, antibiotics have been shown to significantly reduce treatment failure in children with clinically confirmed ARS compared with placebo [25]. In our study, both ISS and HS irrigation groups demonstrated significant symptom improvement compared with the control group, supporting the utility of non-antibiotic supportive therapies, especially when bacterial infection is less likely. However, it is noteworthy that the antibiotic-treated group (Group 1) showed the most pronounced reduction in symptom scores among all treatment arms. These findings suggest that while supportive treatments can provide meaningful clinical benefit, antibiotic therapy may lead to more pronounced symptom improvement in patients with suspected bacterial ARS, particularly when bacterial involvement is likely or when clinical severity warrants antimicrobial treatment. These findings collectively emphasize the need for precise diagnostic assessment to avoid unnecessary antibiotic exposure while ensuring that antibiotics are appropriately used in patients who are most likely to benefit.

The earliest laboratory indicator of bacterial ARS is an elevated C-reactive protein (CRP) level. The presence of elevated CRP levels, purulent nasal discharge, and a physician's high or intermediate suspicion of acute bacterial sinusitis have been identified as early indicators that help confirm bacterial involvement in ARS [26]. Although most cases

are self-limited, these infections still have a considerable impact on patients' daily functioning, often leading to the use of multiple medications—many of which are unnecessary and associated with adverse effects [27]. In this context, our study demonstrated that while all active treatment modalities significantly reduced symptom scores, the antibiotic-treated group showed the most substantial improvement. This finding suggests that when clinical or laboratory indicators raise suspicion for bacterial sinusitis, antibiotic therapy may provide added benefit. Nevertheless, the pronounced symptom reduction observed in both the ISS and HS irrigation groups indicates that supportive treatments can provide meaningful relief even in patients with suspected bacterial sinusitis, thereby helping to reduce unnecessary medication exposure despite the presence of bacterial concern.

To our knowledge, few studies have directly compared multiple treatment modalities—including antibiotics, NS, ISS, and HS—within the same patient cohort. By evaluating these approaches in patients with symptoms persisting beyond 10 days, our study helps fill an important gap in the literature regarding optimal management strategies for suspected bacterial ARS. This study has several limitations. First, it was conducted at a single center with a relatively small sample size. Second, bacterial etiology was not microbiologically confirmed. Laboratory markers such as C-reactive protein (CRP), microbiological cultures, or molecular diagnostic tests were not performed. Instead, the diagnosis of acute rhinosinusitis was established based on clinical evaluation, including patient history and physical examination findings. Therefore, the study population should be interpreted as patients with clinically suspected ARS rather than microbiologically confirmed bacterial ARS, and the findings regarding antibiotic efficacy should be interpreted with caution. Third, only short-term outcomes were evaluated, and long-term relapse rates or sustained improvements could not be assessed. Finally, symptom severity was measured using subjective VAS scores without endoscopic or radiologic confirmation. These limitations should be taken into account when interpreting our findings. Future studies with larger, multicenter populations are needed to confirm these findings and to better define patient subgroups that benefit most from each treatment modality. Incorporating microbiological confirmation, and long-term follow-up data would further strengthen the evidence base. Additionally, comparative studies evaluating different concentrations and delivery methods of saline irrigation may provide deeper insight into the optimal supportive treatment for ARS.

5. Conclusion

In this study, all active treatment modalities—including antibiotics, intranasal steroids, and both isotonic and hypertonic saline irrigation—significantly improved symptoms of acute rhinosinusitis compared with the control group. The antibiotic-treated group was associated with a greater reduction in symptom scores in this study. However, because bacterial etiology was not microbiologically confirmed, these findings should be interpreted cautiously. Antibiotic therapy may provide additional benefit in patients with suspected bacterial ARS, whereas supportive treatments such as nasal steroids and saline irrigation can also provide meaningful symptom relief. These findings highlight the importance of accurate diagnosis and appropriate patient selection to optimize treatment outcomes while avoiding unnecessary antibiotic use.

genAI: No artificial intelligence-based tools or generative AI technologies were used in this study. The entire content of the manuscript was originally prepared, reviewed, and approved by all authors.

Statement of Ethics: Ethical approval was obtained from the Mustafa Kemal University Tayfur Ata Sökmen Faculty of Medicine Local Ethics Committee (approval code: 23/06/2014/121; research protocol: 2014/116).

Data Availability: The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author Contributions: Conceptualization: ÖB, EA; Methodology: ÖB; Data collection: EA; Statistical analysis: ÖB; Visualization: EA; Writing – original draft preparation: ÖB; Writing – review and editing: EA; Supervision: EA; Resources: ÖB

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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

References

1. Fokkens WJ, Lund VJ, Hopkins C, et al. European position paper on rhinosinusitis and nasal polyps 2020. Rhinology. 2020;58:1-464. https://doi.org/10.4193/Rhin20.401
2. Fokkens W, Lund V, Mullol J. European position paper on rhinosinusitis and nasal polyps 2007. Rhinol Suppl. 2007;20:1-136.
3. Kuiper JR, Hirsch AG, Bandeen-Roche K, et al. Prevalence, severity, and risk factors for acute exacerbations of nasal and sinus symptoms by chronic rhinosinusitis status. Allergy. 2018;73:1244-1253. https://doi.org/10.1111/all.13409
4. Hayward G, Thompson MJ, Perera R, Del Mar CB, Glasziou PP, Heneghan CJ. Corticosteroids for the common cold. Cochrane Database Syst Rev. 2015:CD008116. https://doi.org/10.1002/14651858.CD008116.pub3
5. King D, Mitchell B, Williams CP, Spurling GK. Saline nasal irrigation for acute upper respiratory tract infections. Cochrane Database Syst Rev. 2015:CD006821. https://doi.org/10.1002/14651858.CD006821.pub3
6. Kenealy T, Arroll B. Antibiotics for the common cold and acute purulent rhinitis. Cochrane Database Syst Rev. 2013;2013:CD000247. https://doi.org/10.1002/14651858.CD000247.pub3
7. Winther B, Gwaltney JM Jr. Therapeutic approach to sinusitis: antiinfectious therapy as the baseline of management. Otolaryngol Head Neck Surg. 1990;103:876-878. https://doi.org/10.1177/019459989010303S507
8. Druce HM. Adjuncts to medical management of sinusitis. Otolaryngol Head Neck Surg. 1990;103:880-883. https://doi.org/10.1177/019459989010303S508
9. Nash DR, Harman J, Wald ER, Kelleher KJ. Antibiotic prescribing by primary care physicians for children with upper respiratory tract infections. Arch Pediatr Adolesc Med. 2002;156:1114-1119. https://doi.org/10.1001/archpedi.156.11.1114
10. Monto AS, Malosh RE, Petrie JG, Thompson MG, Ohmit SE. Frequency of acute respiratory illnesses and circulation of respiratory viruses in households with children over 3 surveillance seasons. J Infect Dis. 2014;210:1792-1799. https://doi.org/10.1093/infdis/jiu327
11. Pouwels KB, Dolk FCK, Smith DRM, Robotham JV, Smieszek T. Actual versus "ideal" antibiotic prescribing for common conditions in English primary care. J Antimicrob Chemother. 2018;73:19-26. https://doi.org/10.1093/jac/dkx502
12. Martin CL, Njike VY, Katz DL. Back-up antibiotic prescriptions could reduce unnecessary antibiotic use in rhinosinusitis. J Clin Epidemiol. 2004;57:429-434. https://doi.org/10.1016/j.jclinepi.2003.09.008
13. Merenstein D, Whittaker C, Chadwell T, Wegner B, D'Amico F. Are antibiotics beneficial for patients with sinusitis complaints? A randomized double-blind clinical trial. J Fam Pract. 2005;54:144-151.
14. Bachmann G, Hommel G, Michel O. Effect of irrigation of the nose with isotonic salt solution on adult patients with chronic paranasal sinus disease. Eur Arch Otorhinolaryngol. 2000;257:537-541. https://doi.org/10.1007/s004050000271
15. Harvey R, Hannan SA, Badia L, Scadding G. Nasal saline irrigations for the symptoms of chronic rhinosinusitis. Cochrane Database Syst Rev. 2007:CD006394. https://doi.org/10.1002/14651858.CD006394
16. Nayak AS, Settipane GA, Pedinoff A, et al. Effective dose range of mometasone furoate nasal spray in the treatment of acute rhinosinusitis. Ann Allergy Asthma Immunol. 2002;89:271-278. https://doi.org/10.1016/S1081-1206(10)61954-0
17. Rahmati MB, Mohebi S, Shahmohammadi S, Rezai MS. Fluticasone nasal spray as an adjunct to amoxicillin for acute sinusitis in children: a randomized controlled trial. Eur Rev Med Pharmacol Sci. 2013;17:3068-3072.
18. Wormald PJ, Cain T, Oates L, Hawke L, Wong I. A comparative study of three methods of nasal irrigation. Laryngoscope. 2004;114:2224-2227. https://doi.org/10.1097/01.mlg.0000149463.95950.c5

19. Parsons DS. Chronic sinusitis: a medical or surgical disease? Otolaryngol Clin North Am. 1996;29:1-9. https://doi.org/10.1016/S0030-6665(20)30412-6
20. Georgitis JW. Nasal hyperthermia and simple irrigation for perennial rhinitis. Changes in inflammatory mediators. Chest. 1994;106:1487-1492. https://doi.org/10.1378/chest.106.5.1487
21. Gwaltney JM Jr, Jones JG, Kennedy DW. Medical management of sinusitis: educational goals and management guidelines. The International Conference on Sinus Disease. Ann Otol Rhinol Laryngol Suppl. 1995;167:22-30. https://doi.org/10.1177/000348949510410s03
22. Shaikh N, Hoberman A, Shope TR, et al. Identifying children likely to benefit from antibiotics for acute sinusitis: a randomized clinical trial. JAMA. 2023;330(4):349-358. https://doi.org/10.1001/jama.2023.10854
23. Arcimowicz M. Rational treatment of acute rhinosinusitis in the context of increasing antibiotic resistance. Otolaryngol Pol. 2024;78(6):1-11. https://doi.org/10.5604/01.3001.0054.7506
24. Doğan K, Öncel S, Alvur TM, Kilci F. Approaches to pediatric acute bacterial rhinosinusitis of physicians with different specialties. KOU Sag Bil Derg. 2023;9(1):48-51. https://doi.org/10.30934/kusbed.1183339
25. Conway SJ, Mueller GD, Shaikh N. Antibiotics for acute sinusitis in children: a meta-analysis. Pediatrics. 2024;153(5):e2023064244. https://doi.org/10.1542/peds.2023-064244
26. Speizman S, Merenstein D. Early clinical findings for predicting a bacterially caused sinusitis. Georgetown Med Rev. 2025;9(1):e128533. https://doi.org/10.52504/001c.128533
27. Romano FR, Anselmo-Lima WT, Macoto Kosugi E, Sakano E, Cardoso Pereira Valera F, Lessa M, et al. Rhinosinusitis: evidence and experience - 2024. Braz J Otorhinolaryngol. 2025;91:101595. https://doi.org/10.1016/j.bjorl.2025.101595