

Predictors of Antibiotic Overuse in Pediatric Upper Respiratory Tract Infections: A Review

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DOI: <https://doi.org/10.36347/sajp.2026.v15i08.003>

| Received: 08.07.2026 | Accepted: 24.08.2026 | Published: 29.08.2026

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Abstract

Review Article

Antibiotic overuse in pediatric upper respiratory tract infections (URTIs) is a persistent antimicrobial-stewardship problem. Most pediatric URTIs are viral and self-limiting, yet antibiotics continue to be prescribed when bacterial infection is unconfirmed or when clinical criteria for treatment are not met. This narrative review synthesizes evidence on the prevalence of inappropriate antibiotic use, predictors of prescribing, clinical syndromes commonly associated with overuse, consequences, and strategies for reduction. Available studies indicate that prescribing is influenced by both clinical and behavioral factors, including diagnostic uncertainty, parental expectations, physician characteristics, workload, access to diagnostic testing, local prescribing culture, and the strength of stewardship infrastructure. In a prospective multicentre study, 37% of children with adjudicated viral respiratory tract infection received antibiotics. In a Saudi Arabian study of children and other patients with URTI symptoms, 30.1% received antibiotics; prescribing was higher in the pediatric emergency department than in primary healthcare centres. Recent evidence also suggests that prescribing varies by care modality, with lower antibiotic prescribing during primary-care telemedicine visits than during in-person visits. Reducing overuse requires a multifaceted approach combining evidence-based guidelines, diagnostic stewardship, communication with caregivers, audit and feedback, and organizational commitment to antimicrobial stewardship. The goal is not simply to reduce antibiotic volume, but to ensure that every prescription has a clear clinical indication, uses an appropriate agent, dose, and duration, and minimizes avoidable harm.

Keywords: pediatric upper respiratory tract infection; antibiotic overuse; antimicrobial stewardship; antibiotic prescribing; predictors; diagnostic uncertainty; parental expectations; antimicrobial resistance.

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1. INTRODUCTION

Upper respiratory tract infections are among the most frequent reasons for pediatric healthcare encounters and are a major source of antibiotic exposure. Although antibiotics are essential for selected bacterial respiratory infections, they provide no benefit for uncomplicated viral illnesses. The American Academy of Pediatrics emphasizes judicious antibiotic prescribing for pediatric upper respiratory infections and recommends avoiding antibiotics when a bacterial diagnosis is not established or strongly supported by clinical criteria [1].

Antibiotic overuse is not explained by microbiology alone. Prescribing decisions are made under uncertainty and are influenced by clinician beliefs, perceived patient expectations, time pressure, diagnostic resources, previous experiences, and the organizational environment. A behavioral scoping review concluded that antimicrobial overuse is a complex phenomenon

requiring attention to psychological and contextual mechanisms in addition to knowledge of guidelines [2].

Evidence from pediatric emergency practice also demonstrates a gap between guideline knowledge and actual behavior. In a multicentre Saudi Arabian study of pediatric emergency physicians, only 27.3% met the study definition of adherence to recommended diagnostic testing before antibiotic treatment for suspected group A beta-hemolytic streptococcal pharyngitis [3]. These findings illustrate why stewardship interventions must address both clinical knowledge and the practical determinants of prescribing.

The objective of this review is to summarize the available evidence regarding the prevalence and predictors of antibiotic overuse in pediatric URTIs, identify the clinical syndromes most commonly associated with inappropriate prescribing, describe the

consequences of unnecessary exposure, and discuss evidence-based strategies for reducing overuse.

2. Prevalence and Patterns of Antibiotic Overuse

The magnitude of inappropriate antibiotic use varies according to population, setting, diagnostic definitions, and whether prescribing is assessed against a clinical reference standard. In the prospective multicentre TAILORED Treatment study, 284 children with respiratory tract infection were evaluated using an expert-panel reference standard. Viral infection was identified in 209 children (74%), and 77 of these 209 children (37%) received antibiotics, representing overuse according to the study definition [4].

Regional data similarly demonstrate substantial prescribing. In a prospective study conducted in primary healthcare centres and a pediatric emergency department in Dammam, Saudi Arabia, 141 of 469 patients with URTI symptoms (30.1%) received an antibiotic. Prescribing was higher in the pediatric emergency department (46.3%) than in primary healthcare centres (24.4%). Positive rapid antigen detection testing, tonsillar exudate, tender or swollen anterior cervical lymph nodes, fever, and higher modified Centor scores were associated with antibiotic prescription; absence of cough was not a significant predictor [5]. Importantly, the authors concluded that most antibiotic prescriptions were not justified, indicating that clinical predictors of prescribing are not necessarily equivalent to predictors of bacterial disease.

Recent pediatric evidence also highlights the effect of healthcare delivery modality. A 2026 analysis of 449,630 pediatric acute respiratory tract infection index visits across 694 primary-care practices found antibiotic prescribing in 46.8% of weighted in-person visits compared with 34.6% of telemedicine visits, an adjusted difference of -12.1 percentage points (95% CI, -19.3 to -5.0). Guideline-concordant antibiotic management was similar between modalities (86.2% vs 85.5%) [6]. This finding suggests that the clinical environment and workflow may influence antibiotic exposure, although it does not establish that telemedicine itself causes lower prescribing.

Microbiological studies further reinforce the need for diagnostic precision. In a 2025 study from Kyrgyzstan, both viral and bacterial pathogens were detected among children with respiratory tract infections, with substantial viral detection in outpatient and inpatient populations [7]. Such findings support the principle that the presence of respiratory symptoms alone should not be treated as evidence of bacterial disease.

3. Predictors of Antibiotic Overuse

3.1 Diagnostic uncertainty

Diagnostic uncertainty is a central driver of antibiotic prescribing. Viral and bacterial respiratory illnesses may share fever, cough, sore throat, rhinorrhea,

and congestion, particularly early in the illness. When clinicians are uncertain, antibiotics may be prescribed as a precaution against missing bacterial disease. Behavioral research identifies uncertainty management as an important mechanism underlying overtreatment [2,8].

3.2 Parental expectations and communication

Perceived expectations from parents or caregivers can influence prescribing even when clinicians recognize that antibiotics are unlikely to provide benefit. The outpatient stewardship literature supports communication strategies that acknowledge caregiver concerns, explain the expected course of illness, and provide explicit safety-netting rather than using antibiotics as reassurance [2,8,9]. Importantly, parental satisfaction is not synonymous with receiving an antibiotic; effective communication can address concerns without unnecessary treatment.

3.3 Physician characteristics and practice setting

Prescribing varies between clinicians and clinical settings. Cadieux *et al.*, found that physician characteristics, including time in practice and practice volume, were associated with inappropriate prescribing patterns in primary care [10]. In pediatric emergency medicine, Alkhazi *et al.*, demonstrated substantial variation in adherence to guideline-recommended assessment of suspected streptococcal pharyngitis [3]. These findings support interventions directed at clinician behavior and practice systems rather than relying solely on dissemination of guidelines.

3.4 Workload and time pressure

High patient volume and limited consultation time can make detailed explanation of viral illness, expected symptom duration, supportive care, and safety-netting difficult. Under these conditions, an antibiotic prescription may appear to be a rapid response to uncertainty or caregiver concern. Behavioral and stewardship literature therefore supports workflow-level interventions in addition to individual education [2,8,9].

3.5 Limited access to diagnostic testing

When appropriate rapid diagnostic testing is unavailable, clinicians may rely more heavily on clinical impression. This is particularly relevant for suspected group A streptococcal pharyngitis, for which diagnostic testing is used to distinguish patients who may benefit from antibiotics from those with likely viral disease. In the Saudi pediatric emergency study, low adherence to recommended testing before antibiotic prescribing was a prominent finding [3,5].

3.6 Local prescribing culture and organizational factors

Prescribing behavior is influenced by the environment in which clinicians work. Peer norms, institutional expectations, access to expertise, and the availability of feedback can reinforce either appropriate

or inappropriate prescribing. The CDC outpatient stewardship framework emphasizes leadership commitment, action, tracking and reporting, and education and expertise as core components of stewardship [9].

3.7 Fear of complications and risk management

Concern about clinical deterioration, missed bacterial infection, complaints, or medicolegal consequences may encourage precautionary prescribing. Rather than responding to uncertainty with unnecessary antibiotics, clinicians can use structured diagnostic criteria, reassessment plans, and explicit safety-net advice. This approach preserves patient safety while reducing avoidable exposure [8,9].

4. Pediatric URTIs Commonly Associated with Antibiotic Overuse

4.1 Common cold and nonspecific viral URI

The common cold and nonspecific viral URIs are predominantly viral. Antibiotics should not be used to treat uncomplicated viral upper respiratory infections. Persistent symptoms, caregiver expectations, and diagnostic uncertainty may nevertheless lead to unnecessary prescriptions [1,9].

4.2 Acute bronchitis

Acute bronchitis is generally viral, and routine antibiotic treatment is not indicated. Prolonged cough can create concern about bacterial infection, but duration of cough alone should not be used as justification for antibiotic therapy [1,9].

4.3 Pharyngitis

Most pediatric pharyngitis is viral. Antibiotics are appropriate when group A streptococcal infection is confirmed or otherwise meets accepted diagnostic criteria. The use of modified Centor/McIsaac criteria and appropriate rapid testing or culture can improve diagnostic stewardship. The Saudi physician-adherence study demonstrates that gaps in implementation remain an important contributor to inappropriate prescribing [3].

4.4 Acute bacterial sinusitis versus viral rhinosinusitis

Children with viral upper respiratory symptoms may develop prolonged nasal discharge or cough without bacterial sinusitis. Antibiotics should be reserved for children who meet established clinical criteria for acute bacterial sinusitis rather than being prescribed solely because symptoms have persisted for a short period or because the illness appears severe to caregivers [1,11].

4.5 Acute otitis media

Acute otitis media is a heterogeneous condition. Some children benefit from immediate antibiotic therapy, whereas selected uncomplicated cases can be managed with observation and analgesia. Applying established diagnostic and management criteria can therefore reduce unnecessary treatment while

maintaining appropriate therapy for children at higher risk of complications [1,12].

5. Consequences of Antibiotic Overuse

5.1 Antimicrobial resistance

Unnecessary antibiotic exposure contributes to selection pressure favoring resistant organisms. At the population level, this reduces the effectiveness of available antimicrobial agents and complicates treatment of future infections. Antimicrobial resistance is therefore both an individual patient-safety issue and a public-health concern [1,9].

5.2 Adverse drug effects

Antibiotics can cause adverse effects, including gastrointestinal symptoms, rash, and allergic reactions. Because uncomplicated viral URTIs generally resolve without antibiotics, exposing children to these risks without a corresponding expected benefit represents avoidable harm [1,9].

5.3 Microbiome disruption

Antibiotic exposure can alter the intestinal microbiome. The clinical significance of individual microbiome changes varies by drug, exposure pattern, age, and host factors; therefore, potential long-term associations should be interpreted cautiously. The immediate and well-established harms of unnecessary antibiotic exposure remain sufficient to support stewardship [9].

5.4 Healthcare utilization and cost

Inappropriate prescribing adds medication costs and may lead to additional healthcare encounters or investigations when adverse effects occur. At the system level, resistant infections can require more complex and costly therapy [9].

5.5 Reinforcement of future antibiotic expectations

Repeated antibiotic treatment for self-limiting illnesses can reinforce the belief that antibiotics are necessary for respiratory symptoms. This can increase future demand and perpetuate a cycle of unnecessary prescribing [2,8].

6. Strategies to Reduce Antibiotic Overuse

6.1 Antimicrobial stewardship programs

Effective outpatient stewardship should combine organizational commitment with practical prescribing interventions. The CDC framework identifies four core elements: commitment; action for policy and practice; tracking and reporting; and education and expertise [9].

6.2 Improve diagnostic accuracy

Diagnostic stewardship should focus on using appropriate clinical criteria and targeted testing. For suspected streptococcal pharyngitis, rapid antigen detection testing and/or culture should be used according to applicable pediatric guidelines. For sinusitis and otitis

media, adherence to established clinical diagnostic criteria can reduce treatment of uncomplicated viral illness [1,11,12].

6.3 Strengthen clinician–caregiver communication

Clinicians should explicitly explain why an antibiotic is not indicated, describe the expected natural history of the illness, recommend symptomatic treatment, and provide clear warning signs that require reassessment. Communication training is a recognized stewardship strategy [9].

6.4 Audit and feedback

Regular measurement of prescribing rates, comparison with peers or benchmarks, and individualized feedback can identify clinicians or settings with opportunities for improvement. Tracking and reporting are core elements of outpatient stewardship [9].

6.5 Local clinical guidelines and standardized pathways

Locally adapted guidelines can translate evidence into practical decisions at the point of care. Standardized pathways are particularly useful for common syndromes such as pharyngitis, sinusitis, otitis media, and nonspecific viral URI. In settings where adherence is low, educational programs should be accompanied by monitoring and feedback rather than education alone [3,9].

6.6 Delayed prescribing and safety-netting

Delayed prescribing can be considered for selected uncomplicated respiratory infections when immediate antibiotic treatment is not clearly indicated but a clinician believes a safety-net strategy is appropriate. It should not replace accurate diagnosis or guideline-based treatment of confirmed bacterial disease. Clear instructions about when reassessment is required are essential [9].

6.7 Use healthcare delivery data to identify opportunities

Differences in prescribing by setting or care modality can reveal system-level opportunities. The 2026 telemedicine study illustrates that antibiotic prescribing may vary substantially between in-person and telemedicine encounters without a corresponding difference in overall guideline concordance [6]. Local data should therefore be monitored before implementing interventions and used to assess their effect over time.

7. DISCUSSION

The evidence indicates that pediatric antibiotic overuse in URTIs is a multifactorial problem. A simple model in which prescribing is determined only by whether an infection is bacterial is insufficient. Clinical uncertainty, caregiver expectations, physician characteristics, workload, diagnostic resources, and

organizational culture interact at the point of prescribing. Consequently, interventions that focus exclusively on clinician knowledge are unlikely to address all important drivers [2,3,9].

An important distinction is that factors associated with antibiotic prescribing are not necessarily predictors of bacterial infection. For example, fever, tonsillar exudate, cervical lymphadenopathy, and a higher Centor score were associated with prescribing in the Saudi study, but the study authors found that many prescriptions were not justified [5]. This distinction is highly relevant to stewardship: a predictor of prescribing should not automatically be interpreted as a predictor of antibiotic need.

The evidence base also has limitations. Studies use different definitions of URTI, different age groups, different clinical settings, and different standards for defining inappropriate use. Some studies measure physician behavior rather than patient-level diagnostic appropriateness. Cross-sectional and observational studies can identify associations but cannot establish causation. Therefore, local baseline measurement is essential before drawing conclusions about the magnitude or causes of overuse in a particular institution.

For pediatric practice, the most promising approach is likely to combine evidence-based clinical pathways with behavioral and system-level interventions. These include rapid access to appropriate diagnostics, clear communication tools, audit and feedback, visible institutional commitment, and continuous measurement. Such an approach aligns with the broader principles of outpatient antimicrobial stewardship [9].

8. CONCLUSION

Antibiotic overuse in pediatric URTIs remains an important and preventable patient-safety and antimicrobial-resistance problem. Most uncomplicated pediatric URTIs are viral, yet unnecessary antibiotics continue to be prescribed in a substantial proportion of respiratory encounters. Evidence identifies diagnostic uncertainty, perceived caregiver expectations, clinician and practice characteristics, workload, limited diagnostic access, and organizational culture as important contributors.

Reducing overuse requires more than increasing awareness. Pediatric services should implement practical stewardship systems that support accurate diagnosis, guideline adherence, clinician–caregiver communication, audit and feedback, and organizational accountability. The objective should be appropriate antibiotic use rather than antibiotic reduction alone: children with bacterial infections should receive timely, effective treatment, while those with viral illnesses

should be protected from unnecessary antibiotic exposure.

A structured local stewardship program, supported by baseline prescribing data and repeated measurement, offers an appropriate framework for translating these findings into sustainable improvements in pediatric practice.

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