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Original Article

Assessment of the Prescription Patterns and Use of Antibiotics in ENT Outdoor Patients During Smog at DHQ Sahiwal

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ABSTRACT

Background: Upper respiratory tract symptoms commonly increase during smog-season months and may clinically overlap with viral, allergic, irritant, and bacterial ENT conditions, creating diagnostic uncertainty and potentially encouraging empirical antibiotic use. Objective: To assess antibiotic prescribing patterns, WHO AWaRe classification, empirical therapy, adjuvant medicine use, polypharmacy, and prescriber-level adherence among ENT outpatients during the smog season at DHQ Hospital Sahiwal. Methods: This cross-sectional observational prescription audit reviewed 450 ENT outpatient prescriptions collected from October 2025 to January 2026. Data were extracted using a structured form and analysed in SPSS version 27. Antibiotic use was assessed through prescribing indicators and WHO AWaRe classification. Associations were examined using Chi-square, Mann–Whitney U, Jonckheere–Terpstra, and Spearman correlation tests where applicable. Results: Antibiotics were prescribed in 442 of 450 encounters (98.2%), with 437 prescriptions (97.1%) containing one antibiotic and 5 (1.1%) containing two. Watch-group antibiotics were used in 399 prescriptions (88.7%), while Access-group antibiotics were used in 43 (9.6%). All treatment was empirical, culture testing was not documented, and infection type was not specified. Macrolides were most frequent (53.1%), followed by cephalosporins (32.9%). Low adherence was observed in 402 prescriptions (89.3%) and improved significantly with prescriber seniority ($p = 0.026$). Polypharmacy was present in 119 prescriptions (26.4%). Conclusion: ENT outpatient antibiotic prescribing during smog-season months was predominantly empirical, Watch-group oriented, and poorly aligned with rational prescribing expectations, indicating a need for targeted antimicrobial stewardship and diagnostic guidance. Keywords: Antibiotic prescribing patterns; Smog season; WHO AWaRe classification; Upper respiratory tract infections; Rational drug use; ENT outpatients

INTRODUCTION

Air pollution has become a major global public health concern, particularly in low- and middle-income countries where rapid urbanisation, industrial expansion, traffic emissions, biomass burning, and weak environmental regulation have contributed to sustained deterioration in ambient air quality. The global burden attributable to environmental and behavioural risk factors remains substantial, and air pollution is consistently associated with avoidable morbidity and premature mortality across populations (1). Ambient air pollutants affect multiple organ systems, but their impact on respiratory health is especially important because the upper and lower airways are the first anatomical interface between inhaled pollutants and human tissue (2). Smog represents a visible and clinically relevant form of air pollution and commonly contains fine and coarse particulate matter, including PM2.5 and PM10, nitrogen oxides, sulfur dioxide, ozone, volatile organic compounds, and other irritant pollutants. Exposure to these pollutants can induce airway inflammation, mucosal irritation, cough, throat discomfort, nasal obstruction, rhinorrhoea, worsening of allergic rhinitis, asthma exacerbations, and increased healthcare utilisation for acute respiratory symptoms (3–6).

The clinical relevance of smog is particularly important in outpatient ear, nose, and throat practice because symptoms triggered by air pollution frequently overlap with those of viral upper respiratory tract infections, allergic rhinitis, acute pharyngitis, sinusitis, and other non-specific ENT complaints. This overlap creates diagnostic uncertainty, especially in high-volume outpatient departments where consultation time is limited and laboratory confirmation is not routinely available. Air pollution and pollen-related exposures may also intensify allergic airway symptoms and increase the likelihood of patients seeking medical care during high-pollution months (7,8). In such circumstances, symptoms such as sore throat, cough, nasal discharge, congestion, headache, and throat irritation may be interpreted clinically as infectious, even when the underlying cause is viral, allergic, irritant, or mixed rather than bacterial. This diagnostic ambiguity is important because most uncomplicated upper respiratory tract infections are self-limiting and do not routinely require antibiotic treatment.

Irrational antibiotic prescribing is a major driver of antimicrobial resistance, which remains one of the most serious threats to global public health (9). International antimicrobial-resistance strategies emphasise the need to reduce unnecessary antimicrobial exposure, improve diagnostic stewardship, and strengthen rational prescribing practices, particularly in primary care and outpatient settings where a large proportion of antibiotic use occurs (10). Evidence from Pakistan and other low- and middle-income settings suggests that antibiotics are frequently prescribed empirically for upper respiratory tract infections, often without microbiological confirmation and sometimes with broad-spectrum agents that have a higher resistance potential (11–13). This practice is clinically concerning because unnecessary antibiotic use increases the risk of antimicrobial resistance, adverse drug reactions, drug interactions, avoidable treatment costs, and distortion of future prescribing expectations among patients and clinicians.

The WHO AWaRe classification provides a practical stewardship framework by categorising antibiotics into Access, Watch, and Reserve groups according to their role in empirical therapy and resistance potential. Access antibiotics are generally preferred for common infections when antibiotics are clinically indicated, while Watch antibiotics require more cautious use because of their broader spectrum and higher potential contribution to resistance. In outpatient URTI care, excessive reliance on Watch-group antibiotics, empirical prescribing without evidence of bacterial infection, and routine use of antibiotics for non-specific respiratory complaints indicate gaps in rational prescribing and antimicrobial stewardship. Prescription audits using WHO core prescribing indicators and AWaRe classification are therefore useful for identifying prescribing patterns, monitoring deviations from rational-use principles, and guiding targeted interventions in hospital outpatient departments.

Although the independent effects of air pollution on respiratory symptoms and the role of antibiotic misuse in antimicrobial resistance are well established, limited local evidence is available on antibiotic prescribing patterns for ENT and URTI-related outpatient presentations during high-smog months in Pakistan. This gap is important because smog-season respiratory complaints may increase clinical uncertainty and may contribute to empirical antibiotic use, but available prescription-level data from public-sector ENT outpatient settings remain scarce. Sahiwal, like several urban and semi-urban regions of Punjab, experiences poor air quality during winter smog months, making it a relevant setting for examining real-world prescribing behaviour during a period of high respiratory-symptom burden.

Therefore, this study was conducted to assess prescription patterns and antibiotic use among ENT outpatients presenting with URTI-related complaints during the smog season at Government Haji Abdul Qayyum DHQ Hospital, Sahiwal. Specifically, the study aimed to determine the frequency of antibiotic prescribing, distribution of prescribed antibiotics according to WHO AWaRe classification, extent of empirical therapy and diagnostic testing, use of adjuvant medicines, occurrence of polypharmacy, and association of prescribing adherence with prescriber seniority. The study also evaluated whether antibiotic prescribing patterns varied across the smog-season months. The primary research question was whether antibiotic prescribing for ENT outpatient URTI-related presentations during the smog season was consistent with rational prescribing principles and WHO AWaRe-based stewardship expectations.

MATERIALS AND METHODS

This study was designed as a cross-sectional observational hospital-based prescription audit to evaluate antibiotic prescribing patterns among patients attending the Ear, Nose, and Throat outpatient department during the winter smog season. The design was selected because the objective was to assess real-world prescribing behaviour at the point of routine outpatient care rather than to test an intervention or establish a causal relationship between smog exposure and antibiotic use. The study was conducted in the ENT Outpatient Department of Government Haji Abdul Qayyum District Headquarter Hospital, Sahiwal, Punjab, Pakistan, a public-sector referral facility that serves both urban and rural populations. Data were collected from October 2025 to January 2026, corresponding to the peak smog season in Punjab, when ambient air quality in the region is commonly reported in unhealthy to hazardous categories. Smog-season context was documented descriptively using publicly available air-quality information from sources such as IQAir, AccuWeather, and Plume Labs; however, patient-level pollutant exposure was not treated as an individual exposure variable.

The study population comprised ENT outpatient prescriptions issued during the study period for patients presenting with upper respiratory tract infection-related or ENT-related complaints that may clinically overlap with smog-associated respiratory irritation. Patients of either gender and all age groups were eligible if they attended the ENT outpatient department during the study period and had a recorded clinical diagnosis or complaint such as non-specific upper respiratory tract infection, cough, sore throat, rhinitis, pharyngitis, tonsillitis, sinusitis, otitis media, or related upper-airway symptoms. Prescriptions were excluded if the patient was diagnosed with lower respiratory tract infection, tuberculosis, chronic infectious disease, chronic respiratory illness requiring long-term therapy, major chronic systemic illness likely to alter prescribing patterns, or documented drug addiction. Outdoor emergency cases, inpatient prescriptions, and prescriptions with insufficient information for antibiotic classification or prescribing-indicator assessment were not included in the analysis.

A total of 450 eligible prescriptions were reviewed according to the predefined inclusion and exclusion criteria. The sample size was calculated using OpenEpi software at a 95% confidence level and was finalised as 450 prescriptions to provide adequate precision for estimating antibiotic prescribing frequency and related prescribing indicators. Eligible prescriptions were selected using purposive sampling from patients attending the ENT outpatient department during the data-collection period. Recruitment and data collection were performed after obtaining permission from the hospital administration. Patient participation and prescription review were undertaken after consent, and confidentiality was maintained by recording study data without patient-identifying information.

Data were collected using a structured data collection form developed for this prescription audit. The form captured patient demographic characteristics, including age, gender, residence, and month of visit; clinical information, including recorded diagnosis or presenting ENT condition; prescriber-related information, including prescriber category; antibiotic-related variables, including antibiotic name, class, dosage form, route of administration, number of antibiotics prescribed, duration of therapy, and fixed-dose combination use; and non-antibiotic prescription details, including adjuvant medicines and total number of drugs per prescription. Additional variables included whether laboratory testing was recommended, whether culture or sensitivity testing was documented, whether the infection type was specified as bacterial, viral, allergic, or non-specific, whether treatment was empirical, and whether medicines were selected from the Essential Drugs List of Pakistan.

Antibiotic prescribing was assessed at both prescription-encounter and antibiotic-item levels where applicable. An antibiotic-prescribing encounter was defined as any prescription containing at least one antibiotic. The number of antibiotic items per prescription was calculated by counting each antibiotic separately, including prescriptions containing two antibiotics. Empirical therapy was defined as antibiotic treatment prescribed without documented microbiological confirmation of bacterial infection. Culture testing was considered present only when culture or sensitivity testing was specifically documented or requested. The WHO AWaRe framework was used to classify antibiotics into Access, Watch, or Reserve categories, and prescriptions without antibiotics were recorded separately rather than being treated as an AWaRe category. Prescribing adherence was assessed by comparing antibiotic use with the recorded diagnosis, empirical nature of treatment, evidence of diagnostic confirmation, and AWaRe-based rational-use principles. Adherence was categorised as high adherence, adherence, or low adherence according to whether the antibiotic choice and indication were compatible with rational prescribing expectations for the documented ENT/URTI diagnosis. Polypharmacy was defined as the prescription of five or more medicines in a single encounter.

Steps were taken to reduce measurement bias and improve consistency during data extraction. A structured form was used for all prescriptions, variables were predefined before analysis, antibiotic names were standardised by class, and AWaRe categories were assigned using the WHO AWaRe classification. Diagnosis was recorded as written on the prescription or outpatient documentation and was not reclassified into bacterial, viral, or allergic categories unless explicitly stated. This approach reduced interpretive misclassification but also preserved the real-world nature of the prescription audit. Potential confounding by patient demographics and prescriber level was addressed descriptively and through subgroup analysis where relevant. Because the study was based on prescription-level data, clinical severity, symptom duration, prior antibiotic use, and patient expectation could not be incorporated into the statistical model.

Data were entered and analysed using IBM SPSS Statistics version 27. Descriptive statistics were used to summarise demographic characteristics, monthly distribution of visits, antibiotic prescribing frequency, AWaRe classification, route and duration of therapy, laboratory and culture testing, adjuvant medicine use, number of medicines per prescription, and polypharmacy. Categorical variables were reported as frequencies and percentages, while continuous or count variables, such as number of antibiotics and total number of drugs per prescription, were summarised using means where appropriate. The association between month of visit and antibiotic prescribing status was assessed using the Chi-square test of independence, with exact testing considered where expected cell counts were small. Differences in the total number of medicines per prescription by patient gender were assessed using the Mann–Whitney U test because the variable represented a non-normally distributed count measure. The Jonckheere–Terpstra test was used to evaluate ordered trends between prescriber seniority and adherence category, and Spearman's rank correlation was used to estimate the direction and magnitude of the ordinal association. Statistical significance was set at $p < 0.05$.

Data integrity was maintained through structured data entry, review of prescription forms for completeness, standardisation of antibiotic class names, and verification of frequency totals before analysis. Missing or undocumented items were treated as not documented and were not inferred from clinical assumptions. Ethical approval and administrative permission were obtained before data collection, and consent to participate was obtained from patients. The study used anonymised prescription-level data, involved no experimental intervention, and maintained confidentiality throughout data collection, entry, analysis, and reporting.

RESULTS

A total of 450 ENT outpatient prescriptions meeting the eligibility criteria were reviewed during the smog-season study period from October 2025 to January 2026. The largest proportion of prescriptions was issued for patients aged 21–40 years, accounting for 172 prescriptions (38.2%), followed by patients aged 41–60 years with 144 prescriptions (32.0%). Patients aged 11–20 years accounted for 57 prescriptions (12.7%), those older than 60 years accounted for 55 prescriptions (12.2%), and children aged 1–10 years accounted for 22 prescriptions (4.9%). Female patients represented 275 prescriptions (61.1%), while male patients represented 175 prescriptions (38.9%). With respect to monthly distribution, the highest number of prescriptions was recorded in January, with 188 visits (41.8%), followed by December with 163 visits (36.2%), November with 80 visits (17.8%), and October with 19 visits (4.2%). Antibiotic prescribing did not vary significantly by month of visit during the smog season (p = 0.444), indicating that the overall antibiotic prescribing pattern remained statistically consistent across the four study months.

Table 1. Distribution of Prescriptions According to Demographic Characteristics and Month of Visit

Characteristic	Category	n (%)
Age group, years	1–10	22 (4.9)
	11–20	57 (12.7)
	21–40	172 (38.2)
	41–60	144 (32.0)
	>60	55 (12.2)
Gender	Male	175 (38.9)
	Female	275 (61.1)
Month of visit during smog season	October, unhealthy AQI category	19 (4.2)
	November, unhealthy to very unhealthy AQI category	80 (17.8)
	December, very unhealthy to hazardous AQI category	163 (36.2)
	January, very unhealthy to hazardous AQI category	188 (41.8)
Association tested	Month of visit and antibiotic prescribing status	p = 0.444

AQI, Air Quality Index. Percentages were calculated using the total sample denominator of 450 prescriptions. The p-value refers to the association between month of visit and whether an antibiotic was prescribed.

Antibiotic prescribing was highly frequent across the reviewed prescriptions. Of the 450 prescriptions, 442 (98.2%) contained at least one antibiotic, while only 8 prescriptions (1.8%) contained no antibiotic. At prescription-encounter level, 437 prescriptions (97.1%) included one antibiotic and 5 prescriptions (1.1%) included two antibiotics. The total number of antibiotic items was therefore 447 across 450 prescriptions, giving a mean of 0.99 antibiotic items per prescription. According to WHO AWaRe classification at prescription level, 399 prescriptions (88.7%) included Watch-group antibiotics and 43 prescriptions (9.6%) included Access-group antibiotics, while 8 prescriptions (1.8%) did not include any antibiotic. No Reserve-group antibiotic was documented. All prescribed antibiotics were given through the oral route and all prescriptions recorded a treatment duration of 1–5 days. Laboratory testing, mainly complete blood count, was recommended in 96 prescriptions (21.3%). Culture or sensitivity testing was not documented in any prescription, and bacterial, viral, allergic, or other infection type was not specified in any prescription. Treatment was therefore classified as empirical in all 450 prescriptions (100.0%). All medicines were documented as being selected from the Essential Drugs List of Pakistan.

Table 2. Antibiotic Prescribing Indicators and Prescription-Level Characteristics

Prescription indicator	Category	n (%) or value
Total prescriptions reviewed	—	450 (100.0)
Prescriptions containing at least one antibiotic	Yes	442 (98.2)
	No	8 (1.8)
Number of antibiotics per prescription encounter	Zero	8 (1.8)
	One	437 (97.1)
	Two	5 (1.1)
Total antibiotic items prescribed	—	447
Mean antibiotic items per prescription	—	0.99
WHO AWaRe prescription-level classification	Access group	43 (9.6)

Prescription indicator	Category	n (%) or value
	Watch group	399 (88.7)
	Reserve group	0 (0.0)
	No antibiotic prescribed	8 (1.8)
Route of antibiotic administration	Oral	442/442 (100.0)
Antibiotic treatment duration	1–5 days	442/442 (100.0)
Laboratory test recommended	Yes, mainly CBC	96 (21.3)
	No	354 (78.7)
Culture/sensitivity test documented	Yes	0 (0.0)
	No	450 (100.0)
Infection type specified	Yes	0 (0.0)
	No	450 (100.0)
Empirical therapy	Yes	450 (100.0)
Medicines selected from Essential Drugs List of Pakistan	Yes	450 (100.0)

AWaRe, Access, Watch, Reserve; CBC, complete blood count. AWaRe classification was reported at prescription level; prescriptions without antibiotics were kept separate and were not treated as an AWaRe category.

Prescriber distribution showed that most prescriptions were issued by senior medical officers, who accounted for 325 prescriptions (72.2%), followed by medical officers with 101 prescriptions (22.4%) and specialists with 24 prescriptions (5.3%). Macrolides were the most frequently prescribed antibiotic class overall, accounting for 239 prescriptions (53.1%), followed by cephalosporins in 148 prescriptions (32.9%). Amoxicillin-clavulanate combination therapy was prescribed in 27 prescriptions (6.0%), while penicillins were prescribed in 20 prescriptions (4.4%). Fluoroquinolones were rarely used, appearing in only 2 prescriptions (0.4%). Dual antibiotic therapy was uncommon and included macrolide-cephalosporin combinations in 3 prescriptions (0.7%) and macrolide-other combinations in 2 prescriptions (0.4%). Eight prescriptions (1.8%) contained no antibiotic. Most macrolide and cephalosporin prescriptions were issued by senior medical officers, reflecting their dominant contribution to total prescribing volume.

Table 3. Antibiotic Class Prescribed According to Prescriber Category

Antibiotic class/category	Total prescriptions, n (%)	Medical officer, n (%)	Senior medical officer, n (%)	Specialist, n (%)
Fluoroquinolones	2 (0.4)	0 (0.0)	2 (100.0)	0 (0.0)
Macrolides	239 (53.1)	81 (33.9)	154 (64.4)	4 (1.7)
Cephalosporins	148 (32.9)	4 (2.7)	144 (97.3)	0 (0.0)
Penicillins	20 (4.4)	9 (45.0)	9 (45.0)	2 (10.0)
Amoxicillin-clavulanate combination	27 (6.0)	6 (22.2)	3 (11.1)	18 (66.7)
Other antibiotic	1 (0.2)	0 (0.0)	1 (100.0)	0 (0.0)
Macrolide plus cephalosporin	3 (0.7)	0 (0.0)	3 (100.0)	0 (0.0)
Macrolide plus other antibiotic	2 (0.4)	1 (50.0)	1 (50.0)	0 (0.0)
No antibiotic prescribed	8 (1.8)	0 (0.0)	8 (100.0)	0 (0.0)
Total prescriptions by prescriber category	450 (100.0)	101 (22.4)	325 (72.2)	24 (5.3)

Percentages in prescriber columns are calculated across each antibiotic class/category and indicate the distribution of that antibiotic class by prescriber category.

Adherence to WHO AWaRe-based rational prescribing expectations varied by prescriber seniority. Overall, low adherence was observed in 402 prescriptions (89.3%), adherence in 40 prescriptions (8.9%), and high adherence in 8 prescriptions (1.8%). Among medical officers, 87 of 101 prescriptions (86.1%) showed low adherence, while 14 prescriptions (13.9%) were adherent and none were classified as highly adherent. Among senior medical officers, 306 of 325 prescriptions (94.2%) showed low adherence, 11 prescriptions (3.4%) were adherent, and 8 prescriptions (2.5%) were highly adherent. Among specialists, low adherence was observed in 9 of 24 prescriptions (37.5%), while 15 prescriptions (62.5%) were adherent and none were classified as highly adherent. The Jonckheere–Terpstra test showed a statistically significant ordered trend between prescriber seniority and adherence category ($Z = -2.219$, $p = 0.026$), and Spearman's rank correlation showed a small ordinal association ($\rho = -0.105$), indicating better adherence among higher clinical ranks despite the overall high burden of low adherence.

Table 4. Prescriber Seniority and WHO AWaRe-Based Adherence Category

Prescriber category	Total prescriptions, n	High adherence, n (%)	Adherent, n (%)	Low adherence, n (%)
Medical officer	101	0 (0.0)	14 (13.9)	87 (86.1)
Senior medical officer	325	8 (2.5)	11 (3.4)	306 (94.2)
Specialist	24	0 (0.0)	15 (62.5)	9 (37.5)
Overall	450	8 (1.8)	40 (8.9)	402 (89.3)

Adherence categories were based on the compatibility of antibiotic indication and choice with the documented diagnosis and AWaRe-based rational prescribing expectations. Percentages are calculated within each prescriber category.

The recorded diagnoses were dominated by non-specific upper respiratory tract infections, which accounted for 201 prescriptions (44.7%). Cough was recorded in 62 prescriptions (13.8%), while sore throat and rhinitis were each recorded in 45 prescriptions (10.0%). Tonsillitis accounted for 29 prescriptions (6.4%), pharyngitis for 25 prescriptions (5.6%), sinusitis for 24 prescriptions (5.3%), and otitis media for 19 prescriptions (4.2%). Across diagnosis categories, azithromycin was the most frequently documented antibiotic, particularly in non-specific URTIs, cough, rhinitis, pharyngitis, otitis media, and sinusitis. Cefixime was the second most common antibiotic and was frequently used in non-specific URTIs, sore throat, tonsillitis, and sinusitis. Amoxicillin-clavulanate was used most often in non-specific URTIs, while ciprofloxacin and ceftriaxone were rarely documented.

Table 5. Recorded Diagnosis and Antibiotic Type Documented in Prescriptions

Recorded diagnosis	Total diagnosis count, n (%)	Ciprofloxacin, n	Azithromycin, n	Clarithromycin, n	Ceftriaxone, n	Cefixime, n	Amoxicillin, n	Amoxicillin-clavulanate, n	Other/dual antibiotic category, n
Non-specific URTI	201 (44.7)	1	102	0	1	68	9	19	4
Cough	62 (13.8)	0	35	0	0	21	0	4	0
Sore throat	45 (10.0)	1	18	0	1	22	3	0	0
Rhinitis	45 (10.0)	0	35	0	0	7	1	2	0
Pharyngitis	25 (5.6)	0	21	0	0	2	2	0	0
Tonsillitis	29 (6.4)	0	9	0	0	14	4	1	1
Otitis media	19 (4.2)	0	12	1	0	5	1	0	1
Sinusitis	24 (5.3)	0	11	0	0	10	1	1	0
Total diagnosis count	450 (100.0)	2	243	1	2	149	21	27	6

URTI, upper respiratory tract infection. Diagnosis percentages were calculated using 450 prescriptions as the denominator. The antibiotic counts in this table reflect the diagnosis-antibiotic distribution documented in the source data; because five prescriptions included dual antibiotic therapy, antibiotic-item counts may exceed antibiotic-prescription encounter counts. Diagnosis-specific antibiotic subtotals should be verified against the raw dataset before final statistical submission because the diagnosis-level antibiotic counts show minor differences from the broader antibiotic-class totals.

Almost all prescriptions contained additional medicines besides antibiotics. Additional non-antibiotic medicines were prescribed in 449 prescriptions (99.8%), while only 1 prescription (0.2%) contained no additional medicine. NSAIDs were the most frequently prescribed adjuvant medicines and were included in 440 prescriptions (97.8%). Montelukast was prescribed in 348 prescriptions (77.3%), antihistamines in 216 prescriptions (48.0%), gastric acid inhibitors in 166 prescriptions (36.9%), and anti-cough preparations in 152 prescriptions (33.8%). Nasal decongestants, nutritional supplements, and other medicines were rarely documented. The mean number of medicines per prescription was 4.06. Most prescriptions contained four medicines, observed in 228 prescriptions (50.7%), followed by five medicines in 99 prescriptions (22.0%) and three medicines in 92 prescriptions (20.4%). Polypharmacy, defined as five or more medicines per prescription, was observed in 119 prescriptions (26.4%). The source analysis reported no statistically significant difference in the total number of medicines per prescription by patient gender using the Mann–Whitney U test.

Table 6. Distribution of Adjuvant Medicines, Number of Drugs per Prescription, and Polypharmacy

Prescription characteristic	Category	n (%)
Additional medicines prescribed besides antibiotics	Yes	449 (99.8)
	No	1 (0.2)
Adjuvant medicine category	Nasal decongestants	1 (0.2)
	NSAIDs	440 (97.8)

Prescription characteristic	Category	n (%)
	Antihistamines	216 (48.0)
	Gastric acid inhibitors	166 (36.9)
	Nutritional supplements	3 (0.7)
	Anti-cough preparations	152 (33.8)
	Montelukast	348 (77.3)
	Others	1 (0.2)
Number of medicines per prescription	One	1 (0.2)
	Two	10 (2.2)
	Three	92 (20.4)
	Four	228 (50.7)
	Five	99 (22.0)
	Six	19 (4.2)
	Seven	1 (0.2)
Mean number of medicines per prescription		4.06
Polypharmacy	No	331 (73.6)
	Yes	119 (26.4)
Gender-based comparison of total medicines per prescription	Mann–Whitney U test	No significant difference reported

NSAIDs, non-steroidal anti-inflammatory drugs. Percentages were calculated using 450 prescriptions as the denominator. Polypharmacy was defined as five or more medicines per prescription.

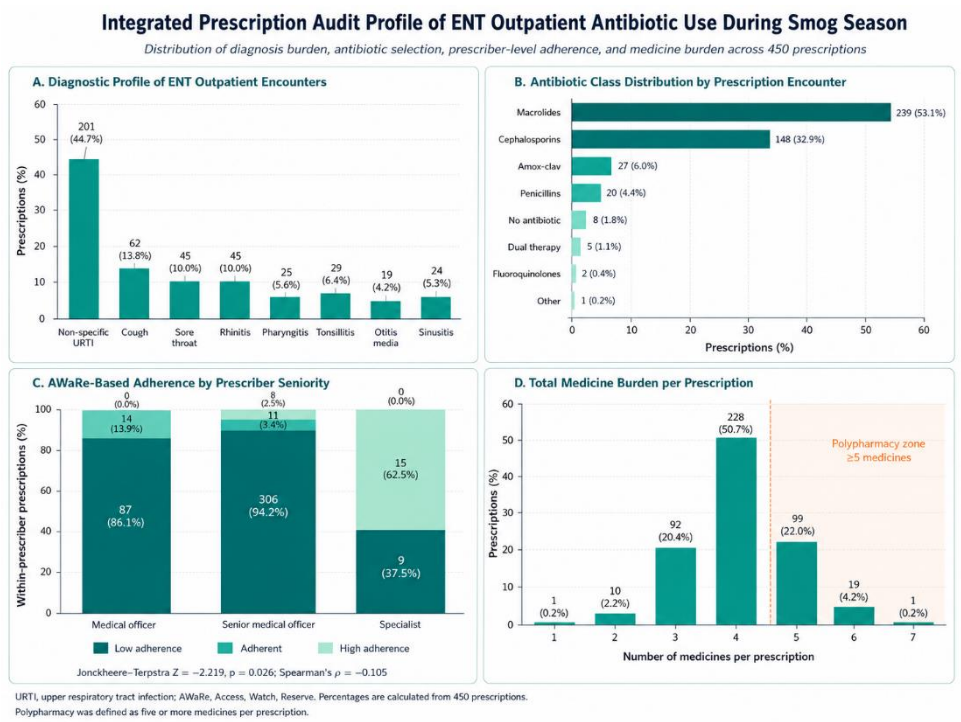

Figure 1. Integrated Prescription Audit Profile of ENT Outpatient Antibiotic Use During Smog Season.

The panelled figure demonstrates that the prescription burden was dominated by non-specific URTI diagnoses, representing 201 of 450 encounters (44.7%), followed by cough in 62 encounters (13.8%) and sore throat and rhinitis in 45 encounters each (10.0%). Antibiotic selection was heavily concentrated in broad-spectrum classes, with macrolides accounting for 239 prescriptions (53.1%) and cephalosporins for 148 prescriptions (32.9%), while Access-oriented penicillin use remained low at 20 prescriptions (4.4%) and only 8 encounters (1.8%) had no antibiotic. Prescriber-level adherence showed a clinically important gradient: low adherence was observed in 87 of 101 medical officer prescriptions (86.1%) and 306 of 325 senior medical officer prescriptions (94.2%), but decreased to 9 of 24 specialist prescriptions (37.5%), with a statistically significant ordered trend across prescriber categories (Jonckheere–Terpstra $Z = -2.219$, $p = 0.026$; Spearman's $\rho = -0.105$). Medicine burden was also high, with four medicines prescribed in 228 encounters (50.7%) and polypharmacy, defined as five or more medicines, present in

119 prescriptions (26.4%), indicating that antibiotic overuse occurred alongside substantial adjuvant medication exposure.

DISCUSSION

This cross-sectional prescription audit identified a very high frequency of antibiotic prescribing among ENT outpatients presenting with URTI-related and overlapping upper-airway complaints during the smog-season months at DHQ Hospital Sahiwal. Antibiotics were included in 442 of 450 prescriptions, corresponding to an encounter-level antibiotic prescribing rate of 98.2%, while only 8 prescriptions did not contain an antibiotic. This finding is clinically important because most uncomplicated upper respiratory tract infections are viral or self-limiting, and symptoms such as cough, sore throat, rhinorrhoea, nasal obstruction, and throat irritation may also arise from allergic or pollution-related airway inflammation rather than bacterial infection. The study was conducted during months in which air quality was described as unhealthy to hazardous, but the data should be interpreted as prescription-audit evidence from a high-smog period rather than proof of a direct causal association between smog exposure and antibiotic use. Nevertheless, the overlap between pollution-associated respiratory symptoms and infectious URTI presentations provides a plausible context in which diagnostic uncertainty may contribute to empirical prescribing in busy outpatient practice (3–8).

The predominance of empirical therapy was one of the central findings of this study. Culture or sensitivity testing was not documented in any prescription, infection type was not specified as bacterial, viral, allergic, or non-specific in any case, and all prescriptions were therefore classified as empirical. This pattern reflects a common outpatient challenge in resource-limited settings, where clinicians frequently depend on symptom-based diagnosis because microbiological testing is either unavailable, delayed, costly, or not routinely indicated for uncomplicated URTIs. However, empirical prescribing becomes problematic when it results in near-universal antibiotic use for conditions in which bacterial infection is not clinically established. Similar concerns have been raised in primary-care and outpatient studies from Pakistan and other low- and middle-income settings, where antibiotic prescribing for upper respiratory symptoms often occurs without confirmatory diagnostic evidence (11,13). The clinical implication is not that every ENT presentation requires culture testing, but that antibiotic prescribing should be guided by diagnostic probability, severity criteria, red-flag signs, local guidelines, and stewardship principles rather than routine prescription for all URTI-related complaints.

The antibiotic-class distribution further strengthens the stewardship concern. Macrolides were the most frequently prescribed class, accounting for 239 prescriptions (53.1%), followed by cephalosporins in 148 prescriptions (32.9%). In contrast, penicillins accounted for only 20 prescriptions (4.4%), and Access-group antibiotics represented only 43 prescriptions (9.6%). Watch-group antibiotics were used in 399 prescriptions (88.7%), substantially exceeding Access-group use and indicating a strong shift toward antibiotics with higher resistance potential. This pattern contrasts with stewardship recommendations that encourage preferential use of Access antibiotics when antibiotic therapy is clinically indicated for common infections, while limiting Watch antibiotics to situations where their broader spectrum is justified (19,22). The high use of macrolides and cephalosporins may reflect prescriber preference, perceived effectiveness, dosing convenience, local availability, patient expectations, or diagnostic uncertainty in differentiating bacterial infection from viral, allergic, or smog-related irritation. However, the frequent use of Watch antibiotics in largely empirical outpatient care is concerning because these agents are more closely linked with selection pressure and antimicrobial resistance.

The observed antibiotic prescribing rate was higher than that reported in many outpatient prescription studies. Earlier ENT outpatient studies from India and Nepal also documented frequent antibiotic use, but the present study showed a particularly high encounter-level antibiotic prescribing rate, suggesting a more intensive pattern of antimicrobial exposure in the study setting (15,16). The mean number of antibiotic items per prescription was 0.99 because most prescriptions contained one antibiotic and a small number contained two antibiotics. Although the mean antibiotic-item value appears numerically modest, it should not obscure the fact that almost every patient encounter resulted in antibiotic exposure. This distinction is important because encounter-level antibiotic prescribing rate is the more clinically meaningful indicator for assessing unnecessary exposure in URTI-related outpatient care.

The absence of significant monthly variation in antibiotic prescribing during the smog-season period suggests that prescribing behaviour remained consistently high across October, November, December, and January. The relationship between month of visit and antibiotic prescribing status was not statistically significant ($p = 0.444$), indicating that antibiotic use did not increase or decrease detectably across the observed smog months. This finding should be interpreted cautiously because the study did not include a non-smog comparison period and did not measure individual pollutant exposure. Therefore, the result does not rule out an influence of air pollution on patient attendance or symptom burden; rather, it indicates that within the observed high-smog period, antibiotic prescribing practice was already near-universal and did not differ significantly by month. This pattern may reflect a stable institutional or prescriber-level habit of empirical prescribing for ENT/URTI presentations rather than month-specific responsiveness to AQI variation.

Prescriber seniority showed a statistically significant ordered association with adherence category. Overall, low adherence was observed in 402 prescriptions (89.3%), while 40 prescriptions (8.9%) were classified as adherent and 8 prescriptions (1.8%) as highly adherent. Specialists showed better adherence than other prescriber categories, with 15 of 24 specialist prescriptions (62.5%) classified as adherent compared with 14 of 101 medical officer prescriptions (13.9%) and 11 of 325 senior medical officer prescriptions (3.4%). The Jonckheere–Terpstra test demonstrated a significant trend across prescriber seniority ($Z = -2.219$, $p = 0.026$), although Spearman's correlation indicated that the ordinal association was small ($\rho = -0.105$). This suggests that higher clinical rank may be associated with more rational antibiotic indication, but the overall prescribing environment still reflects substantial deviation from stewardship expectations. Similar findings from Quetta, Pakistan, have indicated variation in antibiotic prescribing behaviour across clinician categories, supporting the need for structured prescriber training and facility-level antibiotic stewardship interventions (11).

The diagnostic distribution showed that non-specific URTIs represented the largest category, accounting for 201 prescriptions (44.7%), followed by cough, sore throat, rhinitis, pharyngitis, tonsillitis, otitis media, and sinusitis. The high proportion of non-specific URTI diagnoses is relevant because non-specific upper-airway symptoms are among the clinical presentations most likely to overlap with viral illness, allergic inflammation, irritant exposure, and smog-related respiratory effects. In the absence of documented bacterial classification, routine antibiotic use for these diagnoses may represent avoidable antimicrobial exposure. Air-pollution studies have shown that short-term exposure to ambient pollutants may increase healthcare utilisation for acute respiratory symptoms and may also influence antibiotic use indirectly by producing symptoms that resemble infection or by increasing vulnerability to secondary infection in selected cases (3,12). However, prescription-level data alone cannot distinguish these pathways, and future studies should include clinical criteria, symptom duration, severity markers, diagnostic scoring, microbiological testing where appropriate, and patient-level AQI exposure estimates.

The high burden of adjuvant prescribing also requires attention. Additional medicines were present in 449 prescriptions (99.8%), and the mean number of medicines per prescription was 4.06. NSAIDs were prescribed in 440 prescriptions (97.8%), montelukast in 348 prescriptions (77.3%), antihistamines in 216 prescriptions (48.0%), gastric acid inhibitors in 166 prescriptions (36.9%), and anti-cough preparations in 152 prescriptions (33.8%). Polypharmacy, defined as five or more medicines per prescription, was observed in 119 prescriptions (26.4%). This pattern suggests that antibiotic overprescribing occurred alongside substantial non-antibiotic medicine exposure. While symptomatic treatment may be appropriate for many ENT/URTI complaints, high medicine counts increase the risk of adverse effects, drug interactions, medication errors, unnecessary cost, and patient confusion. Routine use of gastric acid inhibitors and leukotriene receptor antagonists should be examined carefully against clinical indication, because adjuvant medicines may also contribute to irrational prescribing if used without clear diagnostic justification.

The strengths of this study include its focus on a clinically relevant outpatient setting during the smog season, use of prescription-level data from a public-sector hospital, assessment through WHO prescribing indicators and AWaRe classification, and evaluation of prescriber-level adherence patterns. These features provide practical insight into real-world prescribing behaviour in ENT outpatient care. The study also highlights an important intersection between environmental health, respiratory symptom burden, and antimicrobial stewardship, which remains underexplored in local Pakistani data.

Several limitations should be considered while interpreting the findings. First, this was a single-centre study, which limits generalisability to other hospitals, regions, and private-sector settings. Second, purposive sampling may have introduced selection bias, and the study did not include a non-smog comparison period. Third, patient-level exposure to PM2.5, PM10, nitrogen dioxide, or other pollutants was not measured, so the study cannot establish an exposure-response relationship between smog intensity and antibiotic prescribing. Fourth, diagnoses were extracted from prescriptions or outpatient documentation and were not independently verified using clinical examination criteria, laboratory confirmation, radiological evidence, or microbiological verification. Fifth, the study did not assess symptom severity, symptom duration, prior antibiotic use, patient expectations, prescriber workload, drug availability, or follow-up outcomes. These limitations mean that the study should be interpreted as a descriptive and inferential prescription audit.

Despite these limitations, the findings have important implications for antimicrobial stewardship. The near-universal use of antibiotics, predominance of Watch-group agents, absence of documented culture testing, limited specification of infection type, and high rate of low adherence indicate a need for targeted interventions in ENT outpatient practice. Practical measures may include implementation of standard treatment guidelines for common ENT and URTI presentations, prescriber education on AWaRe-based antibiotic selection, audit-and-feedback systems, clinical decision support for differentiating bacterial from viral or allergic conditions, patient counselling to reduce antibiotic expectations, and delayed-prescribing strategies where clinically appropriate. During smog season, outpatient clinicians may also benefit from structured algorithms that distinguish pollution-related irritation and allergic airway symptoms from bacterial infection, thereby reducing unnecessary antibiotic exposure while preserving appropriate care for patients with genuine bacterial disease.

CONCLUSION

This prescription audit showed a very high prevalence of empirical antibiotic prescribing among ENT outpatients presenting with URTI-related complaints during the smog-season months at DHQ Hospital Sahiwal. Antibiotics were prescribed in 98.2% of encounters, with marked predominance of Watch-group agents, especially macrolides and cephalosporins, while Access-group antibiotic use remained low. Culture or sensitivity testing was not documented, infection type was not specified, and most prescriptions showed low adherence to WHO AWaRe-based rational prescribing expectations. Antibiotic prescribing did not vary significantly by month of visit, suggesting that prescribing behaviour remained consistently high throughout the observed smog-season period. Although specialists demonstrated comparatively better adherence than other prescriber categories, the overall findings indicate a substantial need for antimicrobial stewardship, standard treatment guidelines, diagnostic support, and prescriber training in ENT outpatient practice, particularly during periods when pollution-related, viral, allergic, and bacterial respiratory symptoms may clinically overlap.

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