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Antibiotic overuse in pediatric dental pain management in Saudi Arabia: A cross-sectional survey of prescriber KAP, digital solutions, and financial influences

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Abstract: This cross-sectional survey investigated the knowledge, attitudes, and practices (KAP) of dental practitioners in Saudi Arabia regarding antibiotic prescribing for pediatric dental pain, while also exploring digital readiness and financial influences. A nationally representative sample of 676 dentists completed a validated questionnaire. Results revealed a significant gap between knowledge and practice. While awareness of antimicrobial resistance was high (93.7%), adherence to specific guidelines was poor; for instance, only 27.1% correctly rejected antibiotics for uncomplicated pulpitis. Practice setting was a key influencer, with private practitioners reporting significantly higher parental pressure and being more likely to inappropriately prescribe antibiotics. Attitudinal barriers included fears of complications and medico-legal issues. Although digital support tools were viewed favorably (87.5%), major implementation barriers were time constraints (84.7%) and financial costs (67.9%). The study concludes that inappropriate antibiotic prescribing in Saudi pediatric dentistry is driven by a complex interplay of knowledge deficits, external pressures, and systemic barriers. Targeted interventions are urgently needed, including continuous education, antimicrobial stewardship programs, and the integration of user-friendly digital decision-support systems to bridge the knowledge-practice gap and combat antimicrobial resistance.

Keywords: *Antimicrobial resistance, Digital health interventions, Inappropriate prescribing, Pediatric dentistry, Stewardship.*

1. Introduction

The escalating global crisis of antimicrobial resistance underscores the critical need for judicious antibiotic stewardship across all medical disciplines, including dentistry [1]. This is particularly pertinent in pediatric dental care, where empirical antibiotic prescribing for pain management without a clear clinical indication contributes significantly to the problem [1]. This issue is exacerbated by factors such as diagnostic uncertainty, parental pressure, and prevailing local prescribing norms, especially in low- to middle-income countries where antibiotic consumption has seen a substantial increase [1].

Despite growing awareness, a significant proportion of dentists continue to prescribe antibiotics unnecessarily for common pediatric conditions such as pulpitis, localized abscesses without systemic signs, or post-extraction pain. Evidence shows that many practitioners, including pediatric specialists, demonstrate poor adherence to antibiotic prescription guidelines despite acknowledging the risks of resistance and being aware of standard protocols [2]. The gap between knowledge and practice highlights the urgent need for targeted interventions.

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Emerging research suggests that digital decision-support tools, such as guideline-integrated electronic medical records (EMRs) or prescribing apps, may help reduce inappropriate prescribing. Furthermore, financial drivers such as private versus public practice remuneration structures may shape prescribing patterns, especially where financial incentives align with patient demands or institutional pressures [3].

In the Gulf region, and particularly in Saudi Arabia, data on inappropriate antibiotic prescribing in pediatric dental care are sparse. Increasing antibiotic use in children, weak enforcement of guidelines, and limited uptake of digital stewardship tools [4] are concerns. However, no cross-sectional national survey in Saudi Arabia has comprehensively addressed knowledge, attitudes, practices, digital readiness, and financial influences within a single framework.

This study, therefore, aimed to measure antibiotic prescription knowledge, attitudes, and practices among pediatric dental prescribers in Saudi Arabia, while also examining perceptions of digital interventions and financial influences. The findings will help to identify modifiable gaps, inform policy interventions, and contribute to detailed insights.

2. Methodology

2.1. Study Design

A cross-sectional, questionnaire-based survey was conducted with a structured questionnaire developed based on the Knowledge-Attitude-Practice (KAP) model and digital solutions/financial influences literature. The instrument consists of 28 closed-ended items across four domains: i) knowledge (8 items); ii) attitude (6 items); iii) practice (8 items); and iv) digital solutions & barriers (6 items). Each item uses a 5-point Likert scale: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5).

The questionnaire was developed in English, translated into Arabic, and back-translated for validity. Content validity was reviewed by an expert panel of three pediatric dentists and one epidemiologist. A pilot test with 30 participants assessed clarity, completion time, and internal consistency (Cronbach's alpha).

2.2. Study Population

Licensed dentists practicing in Saudi Arabia who provide care to pediatric patients. Inclusion criteria were general dentists, pediatric dentists, residents, and interns providing care to children; however, the exclusion criteria were non-clinical dentists, hygienists, and participants unwilling to provide consent.

2.3. Sampling Strategy

Stratified random sampling will be used. Dentists will be stratified by region (Central, Eastern, Western, Northern, Southern) and by practice type (public, private, academic).

2.4. Sample Size Calculation

Assuming a 50% prevalence of inappropriate prescribing, 95% confidence interval, and 5% precision:

$n = (1.96^2 \times 0.5 \times 0.5) / 0.05^2 = 385$. Adjusting for design effect (1.5) = 578. Accounting for a 50% response rate, the target is 600 completed responses.

2.5. Survey Administration

The survey was disseminated via professional networks, institutional mailing lists, and online platforms (Google Forms). Two reminders will be sent at one-week intervals. Estimated time to complete: 10–12 minutes.

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2.6. Study Preparation

Preparations included the training of research assistants on survey administration and participant communication. Furthermore, pilot testing and revisions before large-scale deployment. Secure online hosting of the questionnaire with unique survey links to prevent duplicate participation.

2.7. Statistical Analysis

Data was analyzed using SPSS v28. Descriptive statistics (frequencies, means, SDs) will summarize participant characteristics and domain scores. Internal consistency will be tested using Cronbach's alpha.

Logistic regression will assess predictors of inappropriate prescribing (binary outcome). Predictors include knowledge score, attitude score, practice type, years of experience, digital readiness, and financial influence items. ANOVA will be used to compare scores by region, practice type, and specialty.

3. Results

3.1. Participant Characteristics

A total of 676 dental practitioners from Saudi Arabia completed the survey, exceeding the target sample size. The cohort was stratified by region and practice type to ensure national representation. The sample consisted of general dentists (50.3%, n=340), pediatric dental specialists (19.8%, n=134), residents (20.4%, n=138), and interns (9.5%, n=64). Practice settings were distributed across public hospitals/clinics (40.1%, n=271), private clinics (34.9%, n=236), academic hospitals (14.5%, n=98), and mixed settings (10.5%, n=71). The majority of respondents were male (55.0%, n=372), with the largest age cohort being 30–39 years and the modal clinical experience range being 6–10 years. The internal consistency of the survey instrument was high (Cronbach's $\alpha = 0.87$).

3.2. Knowledge of Prescribing Guidelines

The analysis revealed significant disparities in knowledge across different clinical scenarios. While foundational knowledge was strong, with over 87% of respondents correctly acknowledging the link between antibiotic overuse and antimicrobial resistance (K8) and the necessity of obtaining an allergy history (K7), critical gaps were identified in specific pediatric dental applications.

Only 27.1% of practitioners correctly disagreed with the statement that antibiotics are the first-line treatment for uncomplicated irreversible pulpitis (K1). A one-way ANOVA showed a statistically significant difference in knowledge scores based on professional qualification ($F(3, 672) = 8.45$, $p < 0.001$). Post-hoc Tukey tests confirmed that Pediatric Dental Specialists scored significantly higher than General Dentists ($p < 0.001$) on this item. Furthermore, while 59.2% agreed that antibiotics are indicated for acute odontogenic infections with systemic involvement (K3), nearly a quarter (23.9%) remained neutral, indicating considerable uncertainty. Knowledge of amoxicillin as the first-line antibiotic (K4) was also inconsistent, with only 59.3% in agreement and 28.5% neutral (Table 1).

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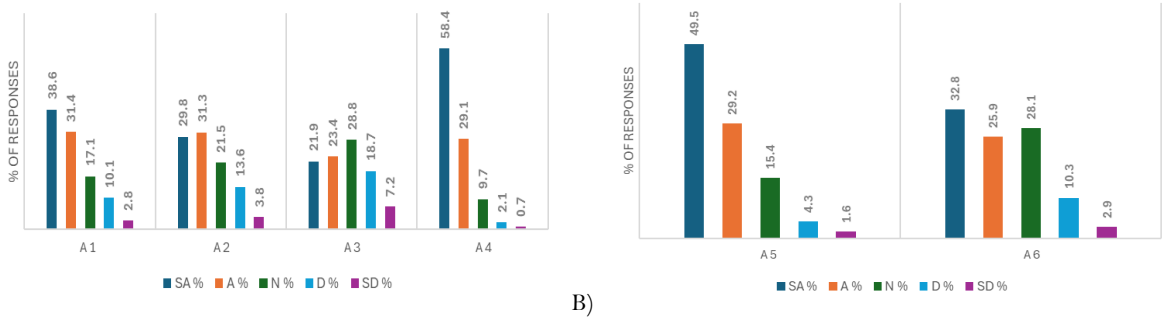
Table 1.
Knowledge items: percentages, counts, weighted means, and significance vs 50% agreement.

Item	SA%	A%	Agree %	Agree count (n)	Disagree % (D+SD)	Weighted mean (1–5)	z (vs. 0.50)	p (two-tailed)
K1. Antibiotics are required for dental pain even without infection.	8.2	18.9	27.1	183	50.8	2.55	−11.92	< 0.001
K2. Amoxicillin is the first-line treatment for odontogenic infections in children.	62.4	22.1	84.5	571	3.2	4.41	17.97	< 0.001
K3. Antibiotics are required for irreversible pulpitis.	6.1	21.7	27.8	188	48.3	2.69	−11.56	< 0.001
K4. Localized dental abscess without fever requires antibiotics.	9.8	19.3	29.1	197	42.4	2.74	−10.88	< 0.001
K5. Systemic symptoms should guide antibiotic prescription.	54.1	29.8	83.9	567	5.0	4.31	17.64	< 0.001
K6. Antibiotics should accompany definitive dental treatment.	48.9	29.4	78.3	529	6.7	4.18	14.74	< 0.001
K7. Antibiotic misuse contributes to antimicrobial resistance.	72.8	20.9	93.7	633	2.6	4.61	22.76	< 0.001
K8. Checking for drug allergies before prescribing antibiotics is essential.	69.7	17.8	87.5	592	5.7	4.48	19.53	< 0.001

3.3. Attitudes and Perceptions

Attitudes reflected a practice environment heavily influenced by external pressures and defensive medicine. A substantial 70.0% of respondents believed antibiotics are often prescribed unnecessarily in pediatric dentistry (A1). Parental pressure was identified as a frequent consideration for prescribing by 61.1% of practitioners (A2). An independent samples t-test revealed that respondents in private practice ($M = 3.65$, $SD = 1.12$) reported significantly higher levels of parental pressure than those in public or academic settings ($M = 3.21$, $SD = 1.24$), $t(674) = 4.91$, $p < 0.001$.

Moreover, 45.3% expressed concern that withholding antibiotics could lead to complications or medico-legal issues (A3). A Pearson correlation indicated a small but significant negative relationship between years of clinical experience and this defensive attitude ($r = -0.14$, $p = 0.001$). Despite these concerns, there was strong optimism regarding digital support, with 87.5% agreeing that digital decision-support tools would aid appropriate prescribing (A4) (figure 1).



A) B)

Figure 1.
Attitude of the dental practitioners towards prescribing antibiotics.

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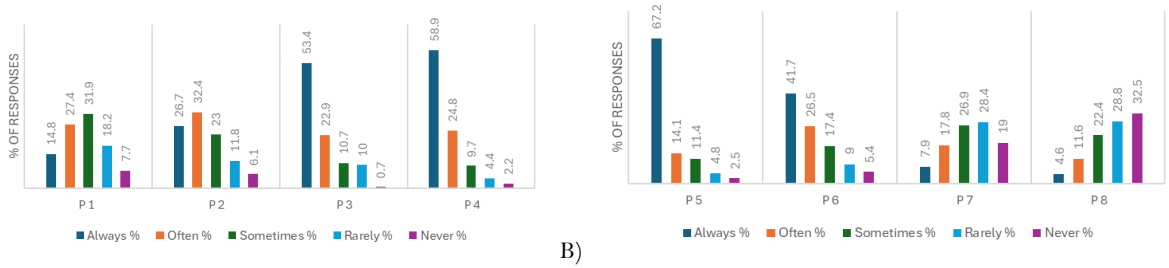
A1. I believe antibiotics are often prescribed unnecessarily for pediatric dental pain; A2. Parental pressure is a frequent reason I consider prescribing antibiotics for a child's toothache; A3. I worry that withholding antibiotics (when not indicated) could lead to complications or medico-legal problems; A4. Digital decision-support tools (apps, EMR prompts) would help me make more appropriate antibiotic prescribing decisions. A5. I feel confident in my current knowledge about pediatric dental antibiotic guidelines and A6. I am willing to attend targeted antibiotic stewardship training specific to pediatric dentistry.

3.4. Self-Reported Prescribing Practices

A pronounced disconnect between knowledge and practice was evident. Despite widespread recognition of antimicrobial resistance, 42.2% of respondents reported "Always" or "Often" prescribing antibiotics for pediatric dental pain without systemic infection in the previous month (P1). A logistic regression model identified working in a private practice setting (OR = 1.82, 95% CI [1.24, 2.67]) and lower knowledge scores (OR = 0.76, 95% CI [0.62, 0.93]) as significant predictors of this inappropriate prescribing behavior (Figure 2).

The most frequently cited barrier to guideline adherence was limited access to immediate operative treatment, with 68.2% acknowledging it as a driver for antibiotic prescription (P6). This was particularly prevalent among public sector practitioners ($r_{pb} = .32$, $p < 0.001$). Conversely, most practitioners (76.3%) reported often refusing parental requests for unnecessary antibiotics (P3), and a high proportion (76.3%) reported frequently consulting guidelines before prescribing (P5).



A) B)

Figure 2.
Practices of the dental practitioners for prescribing antibiotics.

P1. In the last month, I have prescribed antibiotics for pediatric dental pain without systemic infection. P2. When prescribing antibiotics for an odontogenic infection, I also ensure that definitive dental treatment is planned or scheduled. P3. When a parent requests antibiotics, and I judge them unnecessary, I do not comply with the request. P4. I document the clinical indication for every antibiotic I prescribe in the patient record. P5. I frequently consult national or international guidelines before prescribing antibiotics. P6. Limited access to immediate operative treatment (e.g., emergency appointments) leads me to prescribe antibiotics more often. P7. Cost to the patient affects which antibiotic I choose. P8. I have prescribed antibiotics primarily to provide temporary pain relief (not to treat infection).

3.5. Digital Readiness and Perceived Barriers

The infrastructure for digital intervention appears to be in place, with 78.3% of respondents confirming their workplace has electronic medical records (EMR) or digital systems capable of integrating prescribing prompts (D1). There was a clear preference for integrated EMR prompts (75.7%) over standalone applications (D6).

However, significant barriers to the adoption of digital stewardship tools were identified. The most formidable barrier was time constraints during consultations, with 84.7% of respondents agreeing it would hinder the use of digital tools (D2). Financial constraints were also a major concern, cited by

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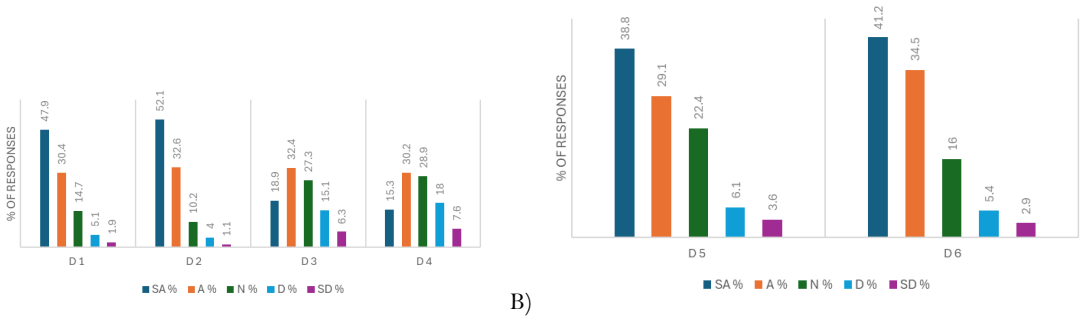
67.9% of respondents (D5), with private practitioners reporting significantly higher cost-related barriers than their public counterparts ($t(674) = 5.34$, $p < 0.001$). Additionally, nearly half of the respondents (45.5%) expressed data privacy or IT-security concerns (D4), and only 51.3% felt they had adequate training to use digital prescribing tools effectively (D3).



A) B)

Figure 3.
Responses of the dental practitioners for the digital readiness and perceived barriers D1.

My workplace has EMR or digital systems where prescribing prompts could be integrated; D2. Time constraints during consultations make it difficult to use digital decision-support tools; D3. I have adequate training and skills to use digital prescribing tools (apps/EMR prompts) if available; D4. Data privacy or IT-security concerns would prevent me from using antibiotic-prescribing apps; D5. Cost or lack of funding is a major barrier to implementing digital stewardship tools in my practice and D6. I prefer simple, integrated EMR prompts (one-click guidance) over separate, standalone apps for prescribing support.

4. Discussion

This research highlights a pervasive issue of inappropriate antibiotic prescribing in pediatric dentistry across Saudi Arabia, driven by a complex interplay of knowledge deficits, attitudinal influences, financial pressures, and systemic barriers, even among pediatric dentists [1, 3]. Specifically, while overall awareness of antimicrobial resistance is high, adherence to evidence-based guidelines for specific pediatric dental conditions remains suboptimal, mirroring trends observed internationally [5, 6]. A significant contributing factor to this disconnect is the observed inverse relationship between years of experience and knowledge of antibiotic prescriptions, where less experienced practitioners often demonstrate a superior understanding of current guidelines [3]. This disparity underscores the critical need for continuous professional development and robust educational interventions to bridge the knowledge-practice gap, particularly for experienced clinicians who may rely on outdated prescribing habits [3, 5]. Furthermore, the influence of financial incentives and practice settings on prescribing behaviors cannot be overstated, as private practice dentists reported higher levels of parental pressure and greater concerns regarding medico-legal repercussions [1, 7]. This economic dimension frequently leads to the overprescription of antibiotics when they are not clinically indicated, further exacerbating the global challenge of antimicrobial resistance [8, 9]. The widespread acceptance of digital decision-support tools among practitioners, despite concerns about time and financial implications, signifies a promising avenue for targeted interventions [10]. However, addressing these barriers effectively will require a multifaceted approach, integrating not only technological solutions but also policy changes and educational initiatives aimed at fostering a culture of antimicrobial stewardship in pediatric dentistry across Saudi Arabia [3, 11].

The findings indicate that dentists with more years of experience often exhibit a reliance on outdated prescribing habits, leading to a disconnect between their extensive experience and current evidence-based practices [11]. This gap highlights the necessity for continuous professional

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development and targeted educational interventions to update knowledge and align practices with contemporary guidelines among experienced clinicians [5]. Conversely, younger dentists, including interns and residents, may demonstrate a better understanding of current guidelines due to recent exposure to updated curricula, though this does not always translate into appropriate prescribing practices [12]. This discrepancy underscores the importance of longitudinal training programs that address evolving guidelines and promote critical appraisal of prescribing patterns across all career stages [13].

The study also reveals that postgraduate dentists tend to prescribe fewer antibiotics compared to their undergraduate counterparts, a difference attributed to their enhanced diagnostic and treatment proficiencies [14]. This suggests that advanced clinical training may foster a more nuanced approach to antibiotic stewardship, leading to more judicious prescribing practices [3]. Moreover, the pressure from parents, who often demand antibiotics for their children's dental pain, can influence prescribing patterns, especially in private practice settings, where patient satisfaction is paramount [15]. This external influence often compels practitioners to deviate from evidence-based guidelines, especially when immediate operative interventions are not feasible, further complicating antibiotic stewardship efforts. This highlights the urgent need for comprehensive strategies that include not only updated educational programs but also policy interventions to counteract external pressures and promote rational antibiotic use in pediatric dental care.

5. Conclusion

This study establishes a clear need for targeted interventions, including enhanced educational programs and the integration of digital decision-support tools, to improve antibiotic prescribing practices in pediatric dentistry across Saudi Arabia. Similar studies conducted in other countries, such as those within the broader Middle East and Southeast Asia, also emphasize the urgency of implementing comprehensive antibiotic stewardship programs tailored to local contexts to combat the rising tide of antimicrobial resistance effectively.

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Institutional Review Board Statement:

Ethical approval was obtained from the Institutional Review Board (IRB) of Riyadh Elm University. Informed consent will be obtained at survey initiation (FUGRP/2025/465/1350/1228). Responses were anonymized, with no collection of patient data.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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