

Antibiotic use and misuse for dental conditions among respondents from Saudi Arabia, Jordan, and Egypt: a multinational cross-sectional survey of knowledge, attitudes, and practices

Lara M Sghaireen ¹, Amira Mira ^{2,3}, Ghazi M Sghaireen ⁴, Mohammad Khursheed Alam ^{5,6,7}, Mohammed G Sghaireen ^{8*}, Kiran Kumar Ganji ⁵, Merin Mathew ⁸, Santosh R. Patil ⁹, Mohammed Assayed Mousa ¹⁰

ABSTRACT

Background

Misuse of antibiotics for dental pain and infection contributes to antimicrobial resistance, yet directly comparable community-level evidence from Middle Eastern settings remains limited.

Objective

To describe antibiotic use and misuse for dental conditions, assess related knowledge and attitudes, and explore sociodemographic associations among respondents from Saudi Arabia, Jordan, and Egypt.

Methods

A multinational cross-sectional online survey used a structured 21-item English-Arabic questionnaire covering demographics, dental problems, antibiotic-related behaviours, knowledge, attitudes, and information sources. Of 636 submitted questionnaires, 635 complete responses were analysed; behaviour-related items were completed by 516 respondents who reported a dental problem. Age was categorised as 18–25, 26–35, 36–45, and >45 years and summarised descriptively, but it was not included in inferential analyses because age-by-outcome cross-tabulations were unavailable. Categorical data were summarised using frequencies and percentages. Demographic associations were explored using Pearson chi-square tests, with Benjamini-Hochberg false-discovery-rate correction across 40 tests. The relationship between knowledge and misuse scores was assessed using Spearman rank correlation. Analyses were unadjusted.

Results

Among 516 respondents reporting a dental problem, 328 (63.6%) reported antibiotic use. Self-medication without professional advice was reported by 264 (51.2%), stopping after symptom improvement by 310 (60.1%), use of leftover antibiotics by 266 (51.6%), and sharing by 236 (45.7%). Only 32.8% recognised that antibiotics do not directly relieve dental pain and 38.1% recognised that antibiotics are not always necessary for dental infections; 69.0% understood that misuse promotes antimicrobial resistance and 72.1% understood that not completing a prescribed course reduces effectiveness. After false-discovery-rate correction, education and occupation remained associated with overall knowledge and each knowledge item. Nationality remained associated with the overall knowledge score and all misuse measures. Education remained associated with all misuse measures, while occupation was associated with early discontinuation, leftover use, sharing, and the overall misuse score. Knowledge correlated weakly and inversely with misuse (Spearman $\rho = -0.173$, $p < 0.001$).

Conclusion

Antibiotic use and potentially harmful antibiotic-related behaviours were frequent in this convenience sample. Misconceptions about the role of antibiotics in dental pain were prominent. Public education should be combined with dental stewardship, pharmacy engagement, prescription-only dispensing, and improved access to definitive dental care.

Keywords

Antibiotic resistance; self-medication; dental care; medication adherence; antimicrobial stewardship

INTRODUCTION

Antimicrobial resistance (AMR) is a major global health threat. A systematic analysis estimated that bacterial AMR was directly responsible for 1.27 million deaths and associated with 4.95 million deaths in 2019 ¹. Although resistance arises through microbial evolution, antimicrobial exposure, inappropriate prescribing, weak infection control, and unregulated access

1. Clinical Pharmacy Student, College of Dentistry & Pharmacy, Buraydah Colleges, Buraydah, Kingdom of Saudi Arabia. Email: lara1349939@gmail.com
2. Associate Professor, Department of Pharmacognosy & Pharmaceutical Chemistry, College of Dentistry & Pharmacy, Buraydah Colleges, Buraydah, Kingdom of Saudi Arabia. amira_mera2006@mans.edu.eg
3. Professor, Department of Pharmacognosy, Faculty of Pharmacy, Mansoura University, Mansoura, Egypt.
4. Internship medical doctor, Al Rajhi Medical College, Al Bukayriyah, Saudi Arabia. Ghazimohad17@gmail.com
5. Preventive Dentistry Department, College of Dentistry, Juf University, Sakaka 72345, Saudi Arabia. mksalam@ju.edu.sa [MKA]; dr.kiran.ganji@jodent.org [KKG]
6. Department of Dental Research Cell, Saveetha Institute of Medical and Technical Sciences, Saveetha Dental College and Hospitals, Chennai 600077, India
7. Department of Public Health, Faculty of Allied Health Sciences, Daffodil International University, Dhaka 1207, Bangladesh.
8. Department of Prosthetic Dentistry, College of Dentistry, Juf University, Sakaka 72345, Aljuf, Saudi Arabia. dr.mohammed.sghaireen@jodent.org [MGS]; dr.merin.mathew@jodent.org [MM]
9. Department of Oral Medicine and Radiology, Chhattisgarh Dental College and Research Institute, Rajnandgaon, Chhattisgarh, India. drpsantosh@gmail.com
10. Assistant Professor, Prosthodontic department, Faculty of Dentistry, King Salman International University, Al-Tur, Egypt. dr.mohammed.assayed@gmail.com

Correspondence

Professor. Prof. Dr. Mohammed G Sghaireen.
dr.mohammed.

accelerate its selection and spread ^{2,3}. Dentistry is an important stewardship setting because dental pain and infection are common, frequently urgent, and often managed in community care.

Dental professionals account for a meaningful proportion of outpatient antibiotic prescribing, and a substantial share of dental prescriptions is inconsistent with evidence-based indications ⁴⁻⁹. In immunocompetent adults, most pulpal and localised periapical pain should be managed through definitive dental treatment and appropriate analgesia. Systemic antibiotics are generally reserved for spreading infection, systemic involvement, or selected high-risk circumstances ^{10,11}. Prophylactic antibiotics are similarly restricted to clearly defined indications, including selected patients at highest risk of infective endocarditis ¹². Antibiotics therefore do not substitute for elimination of the source of odontogenic infection ¹³.

Antibiotic misuse also occurs at the patient level. Individuals may obtain antibiotics without a prescription, reuse leftovers, stop treatment when symptoms improve, share medicines, or use antibiotics as a substitute for dental care. These behaviours may expose individuals to adverse effects and microbiome disruption while increasing antimicrobial selection pressure. Pain, cost, limited access to dental services, previous experience, expectations, pharmacy practices, health literacy, and trust in healthcare professionals may all influence these decisions.

Evidence from Saudi Arabia, Jordan, and Egypt has largely come from single-country studies or selected professional groups. Directly comparable information on community knowledge, attitudes, and antibiotic-related behaviours across respondents connected with these three settings remains limited. This study therefore described antibiotic use and misuse for dental conditions, assessed knowledge and attitudes, and explored associations with gender, nationality, educational level, and occupation. Because the analyses were cross-sectional and unadjusted, they were considered exploratory rather than causal or independently predictive.

MATERIALS AND METHODS

Study design and reporting

This multinational questionnaire-based cross-sectional study was conducted online among respondents from

Saudi Arabia, Jordan, and Egypt. Reporting was revised with reference to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations ¹⁴.

Study period, setting, and recruitment

Data collection was conducted from July 7, 2026, to July 29, 2026. A convenience sample was recruited through invitations distributed by WhatsApp and email. Approximately 2,000 invitations were circulated. A total of 636 questionnaires were submitted, of which one incomplete response was excluded, leaving 635 complete questionnaires for analysis. The approximate invitation yield was 31.8%; this should not be interpreted as a population response rate because successful delivery, duplicate exposure to invitations, and eligibility among all invitees could not be verified.

Eligibility criteria

Eligible participants were adults aged 18 years or older who were located in or responding from Saudi Arabia, Jordan, or Egypt, could read English or Arabic, provided electronic informed consent, and completed the questionnaire satisfactorily.

Age was categorised as 18–25, 26–35, 36–45, and >45 years. Age was summarised descriptively and was not included in inferential analyses because the available analytic output did not contain the required age-by-outcome cross-tabulations.

Sample size

The minimum sample size for estimating a single overall proportion was calculated using a 95% confidence level, a 5% absolute margin of error, and an expected proportion of 50%, which provides the most conservative estimate. The resulting minimum was 384 participants. The final sample exceeded this target.

Questionnaire

Data were collected using a structured, self-administered questionnaire developed after a literature review. The instrument contained 21 questions organised into six sections: demographic characteristics, experience of dental problems, antibiotic-related behaviours, knowledge about antibiotics, attitudes toward antibiotic use, and sources of information. English and Arabic versions were provided.

Instrument-development records reported a content validity index of 0.93 and Cronbach's alpha of 0.87. However, the supplied manuscript did not document

the number or expertise of content-validity assessors, translation and back-translation procedures, pilot-testing sample, or the scale to which the alpha coefficient applied. These coefficients are therefore reported descriptively and are not interpreted as complete evidence of construct validity or reliability across the questionnaire's distinct domains.

Variables and operational definitions

The descriptive outcomes were antibiotic use for the most recent dental condition; the reported source of antibiotic advice or access for that episode; self-medication without a medical or dental prescription or recommendation; stopping antibiotics after symptom improvement; use of leftover antibiotics; sharing antibiotics; perceived reasons for antibiotic use; information sources; correct knowledge responses; and responses to three attitude statements. Demographic variables were age, gender, nationality, education, and occupation. Age was used descriptively only. Nationality was analysed as reported and was not treated as equivalent to country of residence or country of antibiotic acquisition.

The source/advice item and the broader self-medication item represented different constructs. The source/advice item described the pathway reported in relation to the most recent dental problem and was asked of all 516 respondents with a dental problem; it was not treated as confirmation that antibiotics were consumed. The four behaviour items were also asked of these 516 respondents. Because an explicit recall period was not documented in the supplied questionnaire record, these findings are presented as reported behaviours within the survey sample rather than episode-specific or population prevalence estimates.

Scoring

The knowledge score comprised four items coded as correct (1) or incorrect/uncertain (0), giving a total score from 0 to 4. Antibiotic misuse was represented by four behaviours—self-medication without professional prescription or advice, stopping after symptom improvement, using leftovers, and sharing antibiotics—coded as present (1) or absent (0), giving a total score from 0 to 4. Items related to attitudes were scored using a Likert-type scale of five values. Since the polarity of the original composite attitude score could not be ascertained, no composite attitude score was used in the modified analysis; results concerning attitudes are

reported at the level of individual items.

Data collection, consent, and missing information

The landing page of the survey provided details about the purpose of the study, voluntary participation, anonymity, and confidentiality. The submission of a completed questionnaire served as informed consent, and participants were instructed to complete the survey only once. Statistical imputation was not done. There was one participant who did not indicate their nationality, and nationality analysis was done on complete cases.

Ethical considerations

Ethical approval was not required, as the study employed an anonymous, survey-based design.

Statistical analysis

Data were analysed using IBM SPSS Statistics for Windows, version 31.0.2.0. Categorical variables were summarised as frequencies and percentages, and composite scores as means and standard deviations. Associations between gender, nationality, educational level, occupation, and the knowledge or antibiotic-misuse outcomes were explored using Pearson chi-square tests. Degrees of freedom are reported with each statistic. Because 40 demographic association tests were conducted, Benjamini-Hochberg false-discovery-rate adjustment was applied across these tests; both nominal p-values and adjusted q-values are reported. A two-sided q-value below 0.05 was considered statistically significant for these exploratory comparisons. The relationship between the knowledge and misuse scores was assessed using Spearman's rank correlation coefficient.

RESULTS

Participant characteristics

A total of 635 complete questionnaires were analysed. Of these, 220 respondents (34.6%) were aged 18–25 years, 192 (30.2%) were aged 26–35 years, 113 (17.8%) were aged 36–45 years, and 110 (17.3%) were older than 45 years. Women represented 53.5% of respondents, 46.6% had a bachelor's degree, 31.0% were students, and 29.1% reported a healthcare-related occupation. Saudi, Jordanian, Egyptian, and other nationalities accounted for 36.4%, 33.1%, 28.5%, and 1.9% of the sample, respectively; nationality was missing for one respondent (Table 1).

Dental problems and antibiotic-related behaviours

Overall, 516 respondents (81.3%) reported a dental problem. Toothache was the most frequently reported recent condition (48.1%), followed by gum infection (22.7%), dental abscess (17.2%), and post-extraction pain (9.9%). Among respondents with a dental problem, 328 (63.6%) reported using antibiotics for that condition.

For the separate item addressing the reported source of antibiotic advice or access, a dentist was the most common response (47.1%), followed by a pharmacist (12.4%); 9.3% selected a self-initiated pathway without professional consultation. In the broader behaviour item, 264 respondents (51.2%) reported self-medication without professional prescription or advice. Stopping antibiotics after symptom improvement was reported by 310 (60.1%), use of leftover antibiotics by 266 (51.6%), and sharing antibiotics by 236 (45.7%). Relief of pain (36.6%) and reduction of swelling (28.7%) were the most frequently reported perceived reasons for antibiotic use (Table 2).

Knowledge and attitudes

The mean knowledge score was 2.12 ± 1.14 out of 4. Correct responses were most frequent for the statements that not completing the prescribed course reduces effectiveness (72.1%) and that misuse contributes to AMR (69.0%). Only 32.8% correctly recognised that antibiotics do not directly relieve dental pain, and 38.1% recognised that antibiotics are not always necessary for dental infections (Figure 1).

Attitudes were mixed. Agreement or strong agreement with preferring antibiotics for quick relief was reported by 51.8% of respondents. In contrast, 76.7% agreed or strongly agreed that they trusted dentists' prescription decisions, and 51.5% agreed or strongly agreed that antibiotics are overused in dentistry (Figure 2).

Exploratory demographic associations

After false-discovery-rate correction, nationality remained associated with the overall knowledge score ($q=0.019$), but not with any individual knowledge item. Education and occupation remained associated with the overall knowledge score and all four knowledge items (all $q \leq 0.002$). Gender was not associated with knowledge outcomes (Table 3).

Nationality remained associated with self-medication, stopping after symptom improvement, leftover use,

sharing, and the overall misuse score (all $q \leq 0.032$). Education remained associated with all five misuse outcomes (all $q \leq 0.003$). Occupation was associated with stopping after symptom improvement, leftover use, sharing, and the overall misuse score (all $q \leq 0.010$), but not with self-medication. Gender was associated with sharing antibiotics ($q=0.007$); the nominal association with stopping after improvement did not remain significant after correction ($q=0.063$) (Table 4). Directional nationality-group comparisons are not presented because the supplied analysis did not contain the required cross-tabulated frequencies.

Correlation between knowledge and misuse

Knowledge correlated weakly and inversely with the misuse score (Spearman $\rho = -0.173$, $p < 0.001$), indicating that higher knowledge was associated with slightly fewer reported misuse behaviours. The effect was small and should not be interpreted causally (Table 5).

DISCUSSION

Principal findings

This multinational convenience survey identified frequent antibiotic use and potentially harmful antibiotic-related behaviours among respondents reporting dental problems. Nearly two thirds reported antibiotic use for the condition, approximately half reported self-medication, use of leftovers, or sharing, and three fifths reported stopping after symptom improvement. Knowledge of AMR and treatment completion was better than knowledge of clinical indications: most respondents did not recognise that antibiotics do not directly relieve dental pain or that many dental infections can be managed without systemic antibiotics. Higher knowledge was associated with fewer misuse behaviours, but the correlation was weak, suggesting that knowledge alone is unlikely to determine behaviour.

Comparison with previous evidence

The high level of reported antibiotic use is consistent with evidence that antibiotics are frequently used more broadly than clinical guidance recommends. Reviews and prescribing studies from India, Europe, South Africa, Australia, and primary dental care have documented substantial inappropriate therapeutic or prophylactic prescribing and important variation by professional and practice context^{4,5,15-20}. These findings support a broad interpretation in which clinical

uncertainty, limited time, patient expectations, difficulty accessing definitive procedures, and prescribing norms interact to sustain antibiotic use.

The findings also support multilevel stewardship rather than education alone. Policy analysis suggests that dentistry may have insufficient representation within national AMR documents, followed by an intervention strategy developed through co-production involving a chair-side guidance document, an online training course, and patient information^{21,22}. Some attitudes towards antibiotic stewardship can be enhanced by training, but knowledge and practices will be not affected equally²³. Another key professional group is community pharmacists, since they regularly deal with patients suffering from pain in the mouth or face region, though deficiencies in red flags identification and referral have been observed²⁴. According to a systematic review, high prevalence of self-treatment for oral health problems has been estimated; moreover, antibiotics have been among the most common drugs besides analgesics²⁵. Pediatrics dentistry raises additional issues associated with body weight, side effects, parental expectations and infection source elimination²⁶.

Pain-related misconceptions and regional context

Pain was an important motivating factor in the current survey, where toothache was the most frequently observed dental problem, pain relief was the most commonly identified reason for using antibiotics, and only 32.8% knew that antibiotics cannot alleviate dental pain directly. Pain and inflammation misconceptions were also documented among Saudi dental-clinic patients²⁷. Other Saudi studies have described reuse of previous prescriptions, storage of leftovers, and knowledge-practice gaps²⁸⁻³¹. Jordanian studies have reported non-prescription purchase, leftover use, persistent misconceptions, and stewardship gaps among members of the public and prescribers³²⁻³⁷. Egyptian pharmacy and community studies have likewise documented self-medication, pharmacist-mediated dispensing, and associations between health literacy and antibiotic knowledge³⁸⁻⁴¹. Surveys of dental students across countries have identified ongoing training needs and gaps in confidence^{42,43}, while public data from Kuwait similarly link education and knowledge with antibiotic practices⁴⁴. The present findings are compatible with this regional literature, but nationality should not be

interpreted as a proxy for residence, healthcare-system exposure, or place of antibiotic acquisition.

Interpretation of sociodemographic associations

Education and occupation showed the most consistent relationships with knowledge, and education remained associated with all misuse outcomes after false-discovery-rate correction. These are unadjusted associations and may reflect overlapping differences in health literacy, access to care, professional exposure, socioeconomic circumstances, and age. Nationality was associated with the overall knowledge score and each misuse measure, but the direction and independence of these associations cannot be determined without cross-tabulated frequencies and multivariable modelling. The small inverse knowledge-misuse correlation reinforces the likelihood that convenience, previous experience, access barriers, symptom severity, and social norms may override knowledge.

Implications for antimicrobial stewardship

Dentists were the most frequently reported source of advice or access and the leading information source. Trust in dentists therefore provides an opportunity to explain why operative care is required, distinguish analgesia from antimicrobial treatment, and provide safety-net instructions when antibiotics are not indicated. The pharmacists may support prescription-only dispensing, recognize the development of infection or systemic symptoms and make possible urgent referrals. Public information needs to explicitly point out that antibiotics are not analgesics, cannot take the place of the treatment by the dentist, must not be kept or shared, and need to be taken according to the instructions. Information campaigns are probably less effective than audits and feedback, accessible dental care, explanation to patients, and consistent prescribing practices.

Strengths and limitations

The strengths of the study are a relatively large sample size, respondents from three different Middle Eastern settings, bilingual interviewing, separating knowledge from behaviors, and using clear denominators for each section. Modifications to the analysis include the separation of the episode source/advice question from the self-medication question, excluding the confusing

attitude analysis, fixing inconsistencies with the p-values, and false-discovery-rate adjustment.

Several limitations are important. Convenience recruitment through electronic platforms may have overrepresented younger, educated, healthcare-connected, and digitally engaged respondents and does not support population-representative prevalence estimates. All behaviours were self-reported and vulnerable to recall and social-desirability bias. The survey record supplied for revision did not document an explicit recall period for the behaviour items, exact antibiotic agents, doses, durations, clinical diagnoses, access to dental services, or timing of use. The source/advice item was administered to all respondents with a dental problem and was not equivalent to confirmed antibiotic consumption. Nationality was not equivalent to country of residence or country of antibiotic acquisition. The available analyses were unadjusted and could not account for confounding among education, occupation, nationality, and other characteristics. Small demographic categories may have produced sparse contingency-table cells; exact expected-cell diagnostics were not available in the supplied output. Instrument-development reporting was incomplete, and the attitude composite could not be interpreted because its coding direction was undocumented. Age was summarised descriptively and was not included in inferential analyses because the required age-by-outcome cross-tabulations were unavailable. Cross-sectional findings cannot establish causality.

CONCLUSION

Antibiotic use and potentially harmful antibiotic-related behaviours were frequent among respondents with dental problems in this multinational convenience sample. Self-medication, stopping after improvement, use of leftovers, sharing, and the belief that antibiotics provide rapid relief for dental pain were prominent. Knowledge was associated with fewer misuse behaviours, but the relationship was weak. These findings support coordinated dental antimicrobial stewardship, pharmacy engagement, prescription-only dispensing, patient communication, and improved access to definitive dental care. Generalisation to national populations or causal interpretation is not warranted.

Tables and figures

Table 1. Demographic characteristics of respondents (N=635)

Variable	Category	n	%
Age (years)	18-25	220	34.6
	26-35	192	30.2
	36-45	113	17.8
	>45	110	17.3
Gender	Male	291	45.8
	Female	340	53.5
	Prefer not to disclose	4	0.6
Nationality	Saudi	231	36.4
	Jordanian	210	33.1
	Egyptian	181	28.5
	Other	12	1.9
	Not reported	1	0.2
Education level	High school or less	133	20.9
	Diploma	92	14.5
	Bachelor's degree	296	46.6
	Postgraduate	114	18.0
Occupation	Student	197	31.0
	Healthcare-related	185	29.1
	Non-healthcare-related	129	20.3
	Unemployed	124	19.5

Note: Percentages are based on N=635. One respondent did not report nationality.

Table 2. Dental problems, antibiotic use, and reported antibiotic-related behaviours

Variable	Category	n	%
History of dental problem (N=635)	Yes	516	81.3
	No	119	18.7
Most recent dental condition (n=516)	Toothache	248	48.1
	Gum infection	117	22.7
	Dental abscess	89	17.2
	Post-extraction pain	51	9.9
	Other	11	2.1
Used antibiotics for the condition (n=516)	Yes	328	63.6

Variable	Category	n	%
Reported source of advice/access (n=516)	No	188	36.4
	Dentist	243	47.1
	Pharmacist	64	12.4
	Self-initiated/no professional source	48	9.3
	Physician	36	7.0
	Friend/relative	19	3.7
	Other/no specific source	106	20.5
Self-medication without professional advice (n=516)	Yes	264	51.2
	No	252	48.8
Stopped after symptoms improved (n=516)	Yes	310	60.1
	No	206	39.9
Used leftover antibiotics (n=516)	Yes	266	51.6
	No	250	48.4
Shared antibiotics with others (n=516)	Yes	236	45.7
	No	280	54.3
Main perceived reason for antibiotic use (n=516)	Relieve pain	189	36.6
	Reduce swelling	148	28.7
	Believed all infections require antibiotics	120	23.3
	Advised by someone	27	5.2
	Other	32	6.2
Main information source (N=635)	Dentist	226	35.6
	Doctor	154	24.3
	Pharmacist	121	19.1
	Internet/social media	71	11.2
	Self-educated	33	5.2
	Family/friends	30	4.7

Table 3. Exploratory associations between demographic variables and knowledge outcomes

Knowledge outcome	Gender	Nationality	Education	Occupation
Overall knowledge score	5.37 (8); p=0.717; q=0.755	25.72 (12); p=0.012; q=0.019	79.79 (12); p=<0.001; q=<0.001	103.26 (12); p=<0.001; q=<0.001
Antibiotics do not directly relieve dental pain	4.15 (2); p=0.126; q=0.157	5.93 (3); p=0.115; q=0.148	16.13 (3); p=0.001; q=0.002	36.78 (3); p=<0.001; q=<0.001
Antibiotics are not always necessary	0.93 (2); p=0.628; q=0.679	1.14 (3); p=0.767; q=0.777	27.74 (3); p=<0.001; q=<0.001	22.79 (3); p=<0.001; q=<0.001
Misuse contributes to AMR	4.89 (2); p=0.087; q=0.116	1.10 (3); p=0.777; q=0.777	24.58 (3); p=<0.001; q=<0.001	71.55 (3); p=<0.001; q=<0.001
Not completing the course reduces effectiveness	5.33 (2); p=0.070; q=0.096	2.62 (3); p=0.454; q=0.519	22.61 (3); p=<0.001; q=<0.001	17.77 (3); p=<0.001; q=0.001

Note: Values are Pearson χ^2 (df); nominal *p*-value; Benjamini-Hochberg adjusted *q*-value. A *q*-value <0.05 was considered statistically significant.

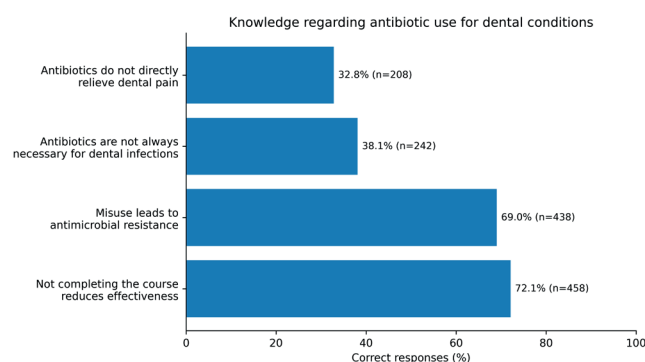
Table 4. Exploratory associations between demographic variables and antibiotic-misuse outcomes

Misuse outcome	Gender	Nationality	Education	Occupation
Self-medication	3.09 (2); p=0.213; q=0.251	51.92 (3); p=<0.001; q=<0.001	19.28 (3); p=<0.001; q=<0.001	2.18 (3); p=0.536; q=0.595
Stopped after symptoms improved	6.32 (2); p=0.042; q=0.063	9.76 (3); p=0.021; q=0.032	37.29 (3); p=<0.001; q=<0.001	17.77 (3); p=<0.001; q=0.001
Used leftover antibiotics	3.58 (2); p=0.167; q=0.202	66.28 (3); p=<0.001; q=<0.001	15.38 (3); p=0.002; q=0.003	12.50 (3); p=0.006; q=0.010
Shared antibiotics	11.01 (2); p=0.004; q=0.007	19.28 (3); p=<0.001; q=<0.001	21.96 (3); p=<0.001; q=<0.001	14.66 (3); p=0.002; q=0.004
Overall misuse score	14.66 (8); p=0.066; q=0.094	89.48 (12); p=<0.001; q=<0.001	46.14 (12); p=<0.001; q=<0.001	37.04 (12); p=<0.001; q=<0.001

Note: Values are Pearson χ^2 (df); nominal *p*-value; Benjamini-Hochberg adjusted *q*-value. These analyses

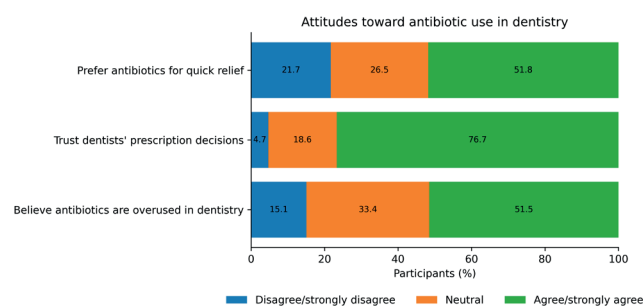
used respondents reporting a dental problem ($n=516$), with complete-case handling of missing nationality.

Table 5. Correlation between knowledge and antibiotic misuse



Variables	Spearman ρ	p-value
Knowledge score vs misuse score	-0.173	<0.001

Figure 1. Knowledge regarding antibiotic use among



respondents. Bars show the percentage and number providing the correct response ($N=635$). The mean knowledge score was 2.12 ± 1.14 out of 4.

Figure 2. Attitudes toward antibiotic use among respondents. Original five-point Likert responses were collapsed into disagree/strongly disagree, neutral, and agree/strongly agree for display.

REFERENCES

1. Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *Lancet*. 2022;399(10325):629-655. doi:10.1016/S0140-6736(21)02724-0.
2. Holmes AH, Moore LSP, Sundsfjord A, Steinbakk M, Regmi S, Karkey A, et al. Understanding the mechanisms and drivers of antimicrobial resistance. *Lancet*. 2016;387(10014):176-187. doi:10.1016/S0140-6736(15)00473-0.
3. Goossens H, Ferech M, Vander Stichele R, Elseviers M; ESAC Project Group. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet*. 2005;365(9459):579-587. doi:10.1016/S0140-6736(05)17907-0.
4. Bhuvanaragha A, King R, Larvin H, Aggarwal VR. Antibiotic use and misuse in dentistry in India-a systematic review. *Antibiotics (Basel)*. 2021;10(12):1459. doi:10.3390/antibiotics10121459.
5. Contaldo M, D'Ambrosio F, Ferraro GA, Di Stasio D, Di Palo MP, Serpico R, et al. Antibiotics in dentistry: a narrative review of the evidence beyond the myth. *Int J Environ Res Public Health*. 2023;20(11):6025. doi:10.3390/ijerph20116025.
6. Hicks LA, Bartoces MG, Roberts RM, Suda KJ, Hunkler RJ, Taylor TH Jr, et al. US outpatient antibiotic prescribing variation according to geography, patient population, and provider specialty in 2011. *Clin Infect Dis*. 2015;60(9):1308-1316. doi:10.1093/cid/civ076.
7. Thornhill MH, Dayer MJ, Durkin MJ, Lockhart PB, Baddour LM. Oral antibiotic prescribing by NHS dentists in England 2010-2017. *Br Dent J*. 2019;227(12):1044-1050. doi:10.1038/s41415-019-1002-3.
8. Suda KJ, Calip GS, Zhou J, Rowan S, Gross AE, Hershow RC, et al. Assessment of the appropriateness of antibiotic prescriptions for infection prophylaxis before dental procedures, 2011 to 2015. *JAMA Netw Open*. 2019;2(5):e193909. doi:10.1001/jamanetworkopen.2019.3909.
9. Cope AL, Francis NA, Wood F, Chestnutt IG. Antibiotic prescribing in UK general dental practice: a cross-sectional study. *Community Dent Oral Epidemiol*. 2016;44(2):145-153. doi:10.1111/cdoe.12199.
10. Lockhart PB, Tampi MP, Abt E, Aminoshariae A, Durkin MJ, Fouad AF, et al. Evidence-based clinical practice guideline on antibiotic use for the urgent management of pulpal- and periapical-related dental pain and intraoral swelling. *J Am Dent Assoc*. 2019;150(11):906-921.e12. doi:10.1016/j.adaj.2019.08.020.
11. Agnihotry A, Thompson W, Fedorowicz Z, van Zuuren EJ, Sprakel J. Antibiotic use for irreversible pulpitis. *Cochrane Database Syst Rev*. 2019;5(5):CD004969. doi:10.1002/14651858.CD004969.pub5.

12. Wilson WR, Gewitz M, Lockhart PB, Bolger AF, DeSimone DC, Kazi DS, et al. Prevention of viridans group streptococcal infective endocarditis: a scientific statement from the American Heart Association. *Circulation*. 2021;143(20):e963-e978. doi:10.1161/CIR.0000000000000969.
13. Buonavoglia A, Leone P, Solimando AG, Fasano R, Malerba E, Prete M, et al. Antibiotics or no antibiotics, that is the question: an update on efficient and effective use of antibiotics in dental practice. *Antibiotics (Basel)*. 2021;10(5):550. doi:10.3390/antibiotics10050550.
14. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet*. 2007;370(9596):1453-1457. doi:10.1016/S0140-6736(07)61602-X.
15. Erfan O, Khan M, Taka G. Necessity of antibiotic usage after simple tooth extraction in patient with healthy systemic condition in Herat, Afghanistan. *Open Dent J*. 2023;17:e187421062305170. doi:10.2174/18742106-v17-230621-2022-170.
16. Manciocchi E, Xhajanka E, D'Addazio G, Tafuri G, Santilli M, Rexhepi I, et al. Antibiotic prescribing patterns among dentists in Italy and Albania: a comparative questionnaire analysis. *Heliyon*. 2024;10(13):e33575. doi:10.1016/j.heliyon.2024.e33575.
17. Pillay L, Rikhotso RE. Antibiotic prescribing pattern of oral health practitioners before and during the COVID-19 pandemic at Wits Oral Health Centre. *Br J Oral Maxillofac Surg*. 2024;62(7):619-625. doi:10.1016/j.bjoms.2024.05.005.
18. Teoh L, Stewart K, Marino RJ, McCullough MJ. A survey of prescribing practices by general dentists in Australia. *BMC Oral Health*. 2019;19:193. doi:10.1186/s12903-019-0882-6.
19. Thompson W, Tonkin-Crine S, Pavitt SH, McEachan RRC, Douglas GVA, Aggarwal VR, et al. Factors associated with antibiotic prescribing for adults with acute conditions: an umbrella review across primary care and a systematic review focusing on primary dental care. *J Antimicrob Chemother*. 2019;74(8):2139-2152. doi:10.1093/jac/dkz152.
20. Wasan H, Mathur A, Mutneja E, Mathur VP, Gupta YK. Influence of qualification and practice settings of dental practitioners on antimicrobial prescribing in Delhi and National Capital Region, India. *J Nat Sci Biol Med*. 2017;8(2):229-234. doi:10.4103/0976-9668.210015.
21. Bhuvaraghan A, King R, Walley J, Thiruvengkatachari B, Aggarwal VR. Dental antibiotic policies, stewardship, and implementation in India: a policy document analysis. *Community Dent Oral Epidemiol*. 2024;52(6):844-860. doi:10.1111/cdoe.12989.
22. Bhuvaraghan A, Walley J, King R, Aggarwal VR. Co-producing an intervention to reduce inappropriate antibiotic prescribing among dental practitioners in India. *Antibiotics (Basel)*. 2025;14(10):984. doi:10.3390/antibiotics14100984.
23. Ramanarayanan V, Prabhu A, Sundareswaran A, Boban D. Effectiveness of a training program on the knowledge and awareness of antimicrobial resistance and stewardship among dental house-surgeons. *Public Health Toxicol*. 2024;4(2):9. doi:10.18332/pht/189989.
24. Jones A, Sturrock A, Elliott E, Gussy M, Maidment I, Nelson D, et al. Community pharmacists' perceptions on managing people with oral health problems-a prioritisation survey. *J Oral Rehabil*. 2024;51(5):851-860. doi:10.1111/joor.13657.
25. Katebi K, Eslami H, Jabbari S. Prevalence and causes of self-medication for oral health problems: a systematic review and meta-analysis. *BMC Oral Health*. 2024;24:1115. doi:10.1186/s12903-024-04900-8.
26. Balakrishnan P, Srinivasan D, Chandaran Selvaraj RS, Mariyappa Subramani S. Antimicrobials: wise use in pediatric dentistry-a detailed literature review. *Hacettepe Univ J Fac Pharm*. 2025;45(2):188-199. doi:10.52794/hujpharm.1486873.
27. Alharbi SR, Alzamil L, Alkudmani ZS, Alhani A, Faqih L, Aldawood E. Knowledge and misconceptions about antibiotic use and resistance among dental clinic visitors in Saudi Arabia-a cross-sectional study. *Healthcare (Basel)*. 2025;13(16):1971. doi:10.3390/healthcare13161971.
28. Alghadeer S, Aljuaydi K, Babelghaith S, Alhammad A, Alarifi MN. Self-medication with antibiotics in Saudi Arabia. *Saudi Pharm J*. 2018;26(5):719-724. doi:10.1016/j.jsps.2018.02.018.
29. Al-Mehmadi B, Alsubaie S, Al-Morikhi O, Alqahtani F, Almutairi W, Al-Mutairi M, et al. Knowledge and attitude of self-medication with leftover antibiotics in Saudi Arabia: a cross-sectional study. *F1000Res*. 2023;12:304. doi:10.12688/f1000research.130364.2.
30. Shatla M, Althobaiti FS, Almqaiti A. Public knowledge, attitudes, and practices towards antibiotic use and antimicrobial resistance in the western region of Saudi Arabia. *Cureus*. 2022;14(11):e31857. doi:10.7759/cureus.31857.
31. Al-Shibani N, Hamed A, Labban N, Al-Kattan R, Al-Otaibi H, Alfadda S. Knowledge, attitude and practice of antibiotic use and misuse among adults in Riyadh, Saudi Arabia. *Saudi Med J*. 2017;38(10):1038-1044. doi:10.15537/smj.2017.10.19887.

32. Shehadeh M, Suaifan G, Darwish RM, Wazaify M, Zaru L, Alja'fari S. Knowledge, attitudes and behavior regarding antibiotics use and misuse among adults in the community of Jordan: a pilot study. *Saudi Pharm J*. 2012;20(2):125-133. doi:10.1016/j.jsps.2011.11.005.
33. Yusef D, Babaa AI, Bashaireh AZ, Al-Bawayeh HH, Al-Rijjal K, Nedal M, et al. Knowledge, practices and attitude toward antibiotics use and bacterial resistance in Jordan: a cross-sectional study. *Infect Dis Health*. 2018;23(1):33-40. doi:10.1016/j.idh.2017.11.001.
34. Abdelmalek S, ALEjielat R, Abu Rayyan W, Qinna N, Darwish D. Changes in public knowledge and perceptions about antibiotic use and resistance in Jordan: a cross-sectional eight-year comparative study. *BMC Public Health*. 2021;21:750. doi:10.1186/s12889-021-10723-x.
35. Karasneh RA, Al-Azzam SI, Ababneh M, Al-Azzeh O, Al-Batayneh OB, Muflih SM, et al. Prescribers' knowledge, attitudes and behaviors on antibiotics, antibiotic use and antibiotic resistance in Jordan. *Antibiotics (Basel)*. 2021;10(7):858. doi:10.3390/antibiotics10070858.
36. Al-Taani GM, Al-Azzam S, Karasneh RA, Ababneh M, Al-Batayneh OB, Khader YS, et al. Antibiotic use and resistance: information sources and application by dentists in Jordan. *J Infect Dev Ctries*. 2022;16(10):1607-1613. doi:10.3855/jidc.16540.
37. Abuhamdah SMA, Naser AY. Self-medication practice among the general public in Jordan: a cross-sectional study. *Front Public Health*. 2024;12:1433464. doi:10.3389/fpubh.2024.1433464.
38. Sabry NA, Farid SF, Dawoud DM. Antibiotic dispensing in Egyptian community pharmacies: an observational study. *Res Social Adm Pharm*. 2014;10(1):168-184. doi:10.1016/j.sapharm.2013.03.004.
39. El-Din MZ, Samy F, Mohamed A, Hamdy F, Yasser S, Ehab M. Egyptian community pharmacists' attitudes and practices towards antibiotic dispensing and antibiotic resistance: a cross-sectional survey in Greater Cairo. *Curr Med Res Opin*. 2019;35(6):939-946. doi:10.1080/030077995.2018.1544119.
40. Mostafa A, Abdelzaher A, Rashed S, AlKhawaga SI, Afifi SK, AbdelAlim S, et al. Is health literacy associated with antibiotic use, knowledge and awareness of antimicrobial resistance among non-medical university students in Egypt? A cross-sectional study. *BMJ Open*. 2021;11(3):e046453. doi:10.1136/bmjopen-2020-046453.
41. Ali HT, Barakat M, Abdelhalim AR, Al-Kurd IN, Muhammad MKE, Sharkawy MM, et al. Unravelling the dilemma of self-medication in Egypt: a cross-sectional survey on knowledge, attitude, and practice of the general Egyptian population. *BMC Public Health*. 2024;24:652. doi:10.1186/s12889-024-17913-3.
42. Bajalan A, Bui T, Salvadori G, Marques D, Schumacher A, Rosing CK, et al. Awareness regarding antimicrobial resistance and confidence to prescribe antibiotics in dentistry: a cross-continental student survey. *Antimicrob Resist Infect Control*. 2022;11:158. doi:10.1186/s13756-022-01192-x.
43. Cooper L, Sneddon J, Thompson W, Guise T, Robertson D, Smith A. Tackling antimicrobial resistance in practice: dental students' evaluation of university teaching supplemented by an online course. *JAC Antimicrob Resist*. 2022;4(2):dlac039. doi:10.1093/jacamr/dlac039.
44. Awad AI, Aboud EA. Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. *PLoS One*. 2015;10(2):e0117910. doi:10.1371/journal.pone.0117910.