

Factors Influencing the Emergence of Antimicrobial Drug Resistance in Clinical Dental Practice



Resham Hafeez¹

BDS, MCPS

Hina Mahmood²

BDS, MDS

Fahad Raza³

BDS

Wajeeha Jabeen⁴

BDS, MCPS

Pakiza Raza Hyder⁵

BDS, M.Phil

OBJECTIVE: To investigate the perception of general dentists regarding the over-prescription of antibiotics leading to Antimicrobial drug resistance in their clinical practice.

METHODOLOGY: A cross-sectional study encompassing a personalized Likert scale questionnaire on factors influencing anti-microbial resistance in dental general practices was conducted on 196 practitioners. The questionnaire inquired about different factors which tend to affect the over-prescription of antibiotics and influence anti-microbial resistance. It was piloted on 30 participants before dissemination.

RESULTS: Factors showing the highest level of agreement were "lack of patient awareness regarding use of antibiotics" (96.9%), "over-the-counter availability" (95.4%), and self-medication" (95.4%). General dental practitioners were overprescribing in their clinical setup due to improper guidelines (24.4%), for their patient's satisfaction (21.2%), and lack of knowledge (19.2%). 33.5% of them stated that patients reporting to them were self-medicating and 27.2% found that their patients had a lack of awareness.

CONCLUSIONS: This study concluded that all the factors were responsible for the Antimicrobial Drug Resistance phenomenon in clinical dental practice. However, the majority of the dentists were over-prescribing antibiotics due to improper guidelines, lack of knowledge, and for the patient's satisfaction.

KEYWORDS: Antimicrobial Drug Resistance; Awareness; Antibiotics; Dental General Practices; Over-the-Counter Drugs.

HOW TO CITE: Hafeez R, Mahmood H, Raza F, Jabeen W, Hyder PR. Factors influencing the emergence of antimicrobial drug resistance in clinical dental practice. J Pak Dent Assoc 2023;32(2):60-65.

DOI: <https://doi.org/10.25301/JPDA.322.60>

Received: 21 December 2022, Accepted: 03 June 2023

INTRODUCTION

"I did not invent penicillin. Nature did that. I only discovered it by accident" Alexander Fleming. The invaluable discovery of penicillin in 1928 proved to be one of the most outstanding scientific discoveries in medicine, successfully treating various infections. Since then, hundreds of natural, semisynthetic, and synthetic antibiotics have been identified.¹

However, the prevalent and extensive use of antibiotics over the past 80 years has led to the emergence of microorganisms or superbugs which are tolerant to certain antibiotics, leading to failure in treating infectious diseases, including life-threatening conditions.² Globally, between 2000 and 2015, a 91% rise in the consumption of critically important antibiotics was documented and this trend has not ceased.³

Although Antimicrobial drug resistance (AMR) is a natural phenomenon that was first observed in the early 1940s⁴, nevertheless it has only intensified by the misuse of antimicrobials over the years. AMR has now been identified as one of the greatest threats to human life globally, and an even bigger menace for developing countries resulting in daunting treatment failures of basic infections, financial loss, prolonged treatment, and even death.^{5,6}

In dentistry, prescribing antibiotics is typically empirical, since culture and susceptibility tests are not routinely

1. Associate Professor, Department of Periodontology, Islamabad Medical and Dental College, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad.
2. Associate Professor and Head of Department Periodontology, Islamabad Medical and Dental College, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad.
3. Post Graduate Trainee MSC, Department of Periodontology, Islamabad Medical and Dental College, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad.
4. Associate Professor and Head of Department Periodontology, Islamabad Medical and Dental College, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad.
5. Professor, Department of Periodontology, Margalla Institute of Health Sciences, University of Health Sciences, Lahore.

Corresponding author: "Dr. Resham Hafeez" <dr.reshamhafeez@gmail.com>

conducted, therefore broad-spectrum antibiotics are widely prescribed.⁷ Even though, undergraduate dental students are taught, that most oral infections may be treated operatively or surgically. Nevertheless, dentists worldwide are prescribing millions worth of antibiotics every year. The literature suggests a significant contributing factor in the selection of resistance may be the unnecessary use of antibiotics in dentistry.⁸

Therefore, it does not come as a surprise that resistance is present in the oral flora.⁹ Evidence demonstrates that the presence of resistance in oral flora is a global problem. In Pakistan, bacterial resistance has been well documented in several studies conducted over a decade. An increasing trend of Gram-negative organisms' resistance was recognized with extended-spectrum beta-lactamases (ESBLs) being a major concern.¹⁰ Oral commensals associated with specific dental infections such as α -hemolytic streptococci and gram-negative anaerobes, such as members of the genus *Prevotella*, appeared in the majority of studies reviewed, show strains resistant to a range of antibiotics used commonly in dentistry.⁹

Several qualitative studies have revealed multi-layered aspects linked to non-rational and irresponsible antibiotic prescribing.³ Broadly, the factors responsible for injudicious prescribing practice stem from doctors' knowledge and perception, demographics of the patient, malpractice by pharmacies, misleading advertisements, economic benefits offered by pharmaceutical representatives, or the regulatory environment in the country.^{11,12,5,10}

Enforcing regulations, and addressing prescribing and dispensing practices have been principal points of strategies to decrease antimicrobial usage for many years.¹⁰ Although several small-scale studies have been conducted in Pakistan suggesting gaps in awareness of appropriate antibiotic use¹⁰, however, there is a lack of data on the current status of dental professionals' understanding of the factors that influence antimicrobial resistance in their clinical practice.¹³

METHODOLOGY

A cross-sectional study was conducted from January 2022 to March 2022 for a period of 3 months and approval was sought from Institutional Review Board (IRB) (Ref# IMDC/DS/IRB/217). Surveyed dental practitioners included registered consultants, demonstrators, and postgraduate residents. Non-practicing dentists and those with less than 1 year of experience were excluded from the study.

A personalized electronic Likert scale questionnaire was self-constructed on google forms, and content validity was assessed by five panelists including 2 medical

educationists and three senior dental consultants. After the panelists' assessment and responses were received, changes were made to the questionnaire. The items which were repetitive, ambiguous, or showed less relevance were excluded from the questionnaire. It was then piloted on 30 general dentists and Cronbach's alpha coefficient was calculated as 0.79.

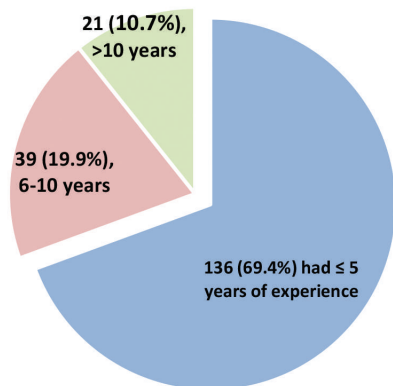
A sample size of 186 was calculated by taking 86% of the population proportion of dental practitioners who agreed that antimicrobial drug resistance is a global threat with absolute precision of 0.1 at a 95% confidence level.¹⁴ To compensate for any incomplete/incorrectly filled questionnaires the sample size was increased to 20% and the questionnaire was distributed to 223 dental practitioners via email and WhatsApp. The response rate was n=207. After excluding the incomplete responses, the final analysis was performed on 196 questionnaires. Informed consent was taken from each participant.

The first section of the questionnaire comprised of biodata including age, gender, designation, and years of experience. The second section encompassed major factors related to doctors, patients, pharmaceuticals, and law and legislature and was labeled as "domain". These domains included related to the knowledge and prescription of antibiotics by dental practitioners, patients' misuse of antibiotics, pharmaceutical endorsements/ incentives, insufficiencies in law, and over-the-counter (OTC) sales. At the end of each domain, the participants were inquired about the most contributing factor which affected the clinical practice of dentists via an open-ended question.

Data from complete questionnaires were entered in the statistical software SPSS v-22 and descriptive analysis was carried out. The quantitative variable such as age was reported as mean \pm standard deviation. The qualitative variables like the perception of antimicrobial resistance and the opinion of the dental practitioners about the most affecting factor in their clinical setup were reported as frequencies and percentages. Further, the extended bar chart, table, and infographics were used to report the findings.

RESULTS

The study included a total of 196 dental practitioners, out of which 66 (33.7%) were males and 130 (66.3%) were females. The age was distributed as mean \pm standard deviation=29.41 \pm 5.43, min=21, and max=52 years. The perception of the dental practitioners regarding the factors affecting the over-prescription of antibiotics was recorded on a 5-point Likert scale ranging from strongly agree to strongly disagree. The participant's clinical experience ranged from 1-10 years and its further distribution is shown in fig.1.

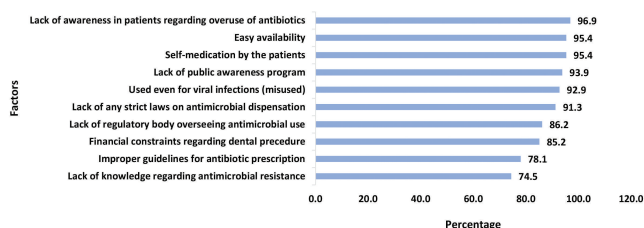
Figure 1: The distribution of participants' experience (n=196)

The level of agreement of the participants for factors affecting the over-prescription of antibiotics in all domains (Doctor, Patient, pharmaceutical, law, and legislature) is shown in table 1.

Table 1: The level of agreement of the participants affecting over-prescription of antibiotics (n=196)

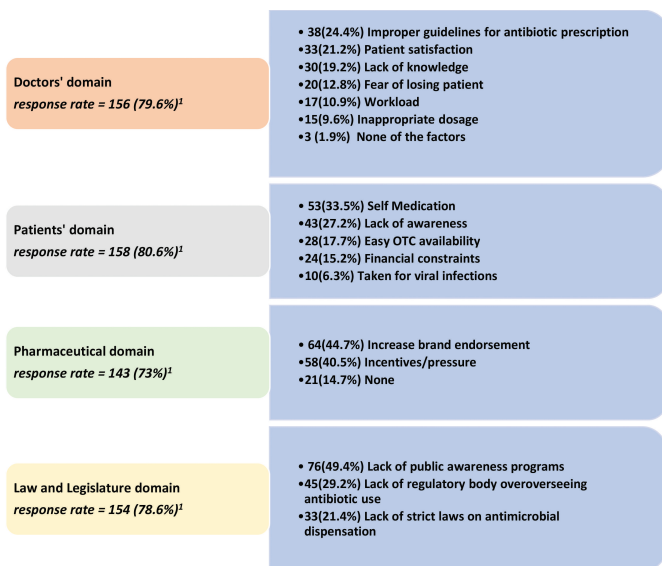
Factors	Level of agreement				
	Strongly agreed	Agreed	Neutral	Disagreed	Strongly disagreed
	N (%)	N (%)	N (%)	N (%)	N (%)
Doctors' factors					
Improper guidelines for an antibiotic prescription	52 (26.5%)	101 (51.5%)	27 (13.8%)	14 (7.1%)	2 (1%)
Prescription of inappropriate dosage	38 (19.4%)	80 (40.8%)	42 (2.4%)	31 (15.8%)	5 (2.6%)
Lack of knowledge regarding antimicrobial resistance	54 (27.6%)	92 (46.9%)	29 (14.8%)	16 (8.2%)	5 (2.6%)
Fear of losing the patient	42 (21.4%)	83 (42.3%)	41 (20.9%)	24 (12.2%)	6 (3.1%)
For the psychological satisfaction of patients	48 (24.5%)	96 (49%)	26 (13.3%)	17 (8.7%)	9 (4.6%)
Workload	19 (9.7%)	64 (32.7%)	43 (21.9%)	61 (31.1%)	9 (4.6%)
Patient factors					
Self-medication	139 (70.9%)	48 (24.5%)	6 (3.1%)	3 (1.5%)	0
Lack of awareness regarding the overuse of antibiotics	122 (62.2%)	68 (34.7%)	4 (2%)	2 (1%)	0
Easy availability	111 (56.6%)	76 (38.8%)	7 (3.6%)	2 (1%)	0
Taken even for viral infections	102 (52%)	80 (40.8%)	10 (5.1%)	3 (1.5%)	1 (0.5%)
Financial constraints	79 (40.3%)	88 (44.9%)	24 (12.2%)	5 (2.6%)	0
Pharmaceutical representatives					
Pressure/incentive from pharmaceutical companies	18 (9.2%)	70 (35.7%)	68 (34.7%)	34 (17.3%)	6 (3.1%)
Increased brand endorsement	20 (10.2%)	89 (45.4%)	58 (29.6%)	26 (13.3%)	3 (1.5%)
Law and legislature					
Lack of regulatory body	90 (45.9%)	79 (40.3%)	21 (10.7%)	6 (3.1%)	0
Lack of any strict laws on the antimicrobial dispensation	87 (44.4%)	92 (46.9%)	15 (7.7%)	2 (1%)	0
Lack of public awareness program	105 (53.6%)	79 (40.3%)	11 (5.6%)	1 (0.5%)	0

For the overall evaluation of the agreement level of the participants, the responses strongly agreed and agreed were merged into one category "agreed". Similarly, strongly disagreed and disagreed were merged into "disagreed". The factors in each domain, based on the participants' response i.e., agreed are listed in descending order (Figure 2). The factors showing the highest percentage of agreement were

Figure 2: Overall top ten factors affecting over-prescription of antibiotics based on participants' responses (strongly agree/agree)**Figure 3:** The contributing factor in the clinical setup of the participants with respect to the experience

"lack of patient awareness regarding use of antibiotics" n=190 (96.9%), "Over the counter availability" and "self-medication" n=187 (95.4%).

Further, the participants were inquired about the most contributory factor in their clinical setup, and their opinions were stratified within each domain. The percentage distribution is shown in figure 3.



In the doctors' domain, improper guidelines for antibiotic prescription n=38/196 (19.4%) followed by patient satisfaction n=33/196 (16.8%), and lack of knowledge n=30/196 (15%) tops the list of factors. However, in the patient's domain, most participants agreed that self-medication n=53/196 (27%) and lack of awareness n=43/196 (21.9%) were influencing

factors. In the pharmaceutical domain, increase brand endorsement $n=64/196(32.7\%)$ and incentive/pressure from pharmaceutical companies $n=58/196(29.6\%)$ were considered important factors in over-prescription. Lastly, in the law and legislature domain, the majority of the participants believed that the lack of public awareness programs in the country $n=76/196(38.8\%)$ is mostly responsible for over-prescription of antibiotics.

DISCUSSION

Change in the era from focal infection to periodontal medicine has inclined dentists towards prescribing antibiotics in oral infections lately. Chairside management of most of these lesions usually renders antibiotic intervention unnecessary and it is pivotal for general dentists to understand the dynamics and impact of antibiotic resistance. To initiate a change, it is important to first know the perception of the practicing dentists about factors responsible for antibiotic misuse as well as identify which factors are most contributory to their clinical practice. This survey provides insight into general dentists' understanding of the over-prescription of antibiotics with a specific focus on the factors contributing to antibiotic resistance in their clinical practice.

The perception of the general dentists in this survey leading to AMR is multifactorial. The most agreed-upon factors leading to AMR were a lack of patient awareness regarding the overuse of antibiotics, OTC availability, and self-medication.

Data from developing and underdeveloped countries highlight poor management of community-based programs and implementation of national drug policies regarding OTC medication.¹⁷

In the present study, most of the general dental practitioners agreed, that overall factors leading to AMR were patient-related, of which the highest agreement was seen for lack of patients' awareness and self-medication. Extensive literature has reinforced that these two are significant factors in the escalation of the AMR phenomenon.^{15,16}

Lack of dentists knowledge regarding AMR and improper guidelines for antibiotic prescription was agreed upon by 74-78% of dentists, which is consistent with studies done in multiple cities across the country.^{18,19} According to a recent survey, it was concluded that the increasing AMR crisis is a result of antibiotic-seeking behavior owing to the financial constraints of patients. Although the sale of un-prescribed antibiotics is prohibited by the national drug policy of Pakistan, on the contrary, every individual in the country has convenient access to antibiotics that are sold as OTC medicines.¹⁷

A few studies originating from the UK have found 'Patient's influence' as one of the main factors resulting in the overuse of antibiotics. In an umbrella review, W.Thompson et al concluded that antibiotic-seeking behaviors, patient's attitude and knowledge towards antibiotics, and will to accept operative dental procedure influences over-prescription.¹⁶

The participants were also inquired about the leading factors influencing the over-prescription of antibiotics in their private clinics. The majority of the clinicians were drawn towards prescribing antibiotics due to improper antibiotic guidelines, their lack of knowledge, and patients' satisfaction. Only 3% ($n= 3/156$) of the practitioners claimed that none of the factors influence their prescription practice.

A study done in Lahore, one of the cosmopolitan cities, found that general physicians lacked the knowledge regarding basic epidemiology of AMR, anti-microbial stewardship, or any national or foreign guidelines while prescribing antibiotics.¹⁸

In this study, a high percentage of dentists felt that patients reporting to their clinics lacked awareness regarding the overuse of antibiotics and tend to self-medicate. A systematic review reported an overall prevalence of 42.64% for self-medication in the WHO Southeast Asian region. One of the main reasons for self-medication among communities was the belief, that they can successfully manage their illnesses. Other reasons reported were inadequate health facilities and economic instability in this region.²⁰ One important aspect leading to the self-medication of antibiotics is the misconceptions related to their use. David. A et al in a study observed that both patients and clinicians were under the perception that antibiotics can mitigate strong symptoms of a disease and pose a minimal health risk.²¹

In the Pharmaceutical domain, both brand endorsement and incentives from pharmaceutical companies were considered to influence the antibiotic prescription pattern of the majority of dentists. Chantal M Morel et al in a recent study identified that brand endorsements and incentives offered by pharmaceutical companies are one of the major obstacles in the rationale prescription of antibiotics.²² The alarming statistics in 2017 of AMR National action plan of Pakistan reveals, that majority of the pharmaceutical brand advertisements are misleading, and only nearly 15% of promotional brochures meet the WHO criteria. Furthermore, in this survey, the majority of the dentists were of the view that there is a lack of public awareness programs for antibiotic resistance and a lack of a regulatory body overseeing antibiotic use. Some dentists also believed that there is a lack of strict laws against antibiotic dispensation.

A survey in 2021 reports, that even though the sale of non-prescribed antibiotics in Pakistan is prohibited by the national drug policy (NDP), the incidence of dispensing of

non-prescribed antibiotics in community pharmacies of Pakistan is very high. This owes to insufficient knowledge of legislation, and a lack of awareness of regulations/ policies regarding OTC sales.¹⁷

LIMITATIONS AND FUTURE RECOMMENDATIONS

The study carried out had some limitations, as the data was collected only from general dentists of Islamabad and Rawalpindi. A country-wide study may give a holistic perception regarding the factors leading to AMR in dentistry. The study relied on self-reported practices, and participants may have provided more professionally desirable answers, resulting in an underestimation of the true picture. In the current era of digitalization, employing Artificial Intelligence to tackle AMR through predictive algorithms can substantially reduce antibiotic abuse and improve prescription practices. Similarly, an up-to-date guideline regarding the rational use of antibiotics in a mobile application may also be explored for dental professionals helping in judicious clinical decisions.

Awareness programs and antibiotic stewardship is the need of the hour. Making AMR part of a professional dental education curriculum, training dental practitioners in public & private setups, and encouraging the use of hospital antibiograms can aid in curtailing antibiotic resistance.

CONCLUSION

This study concluded that dentists agreed that all factors were responsible for escalating the AMR phenomenon. In their clinical practice, the majority of dentists were drawn towards prescribing antibiotics due to improper antibiotic guidelines, lack of knowledge, and patient satisfaction. They also reported that patients who come for dental treatment lack awareness regarding the overuse of antibiotics and tend to self-medicate. Dentists also accepted that both brand endorsement and incentives from pharmaceutical companies tend to influence their antibiotic prescription practice.

CONFLICT OF INTEREST

None declared

REFERENCES

1. Mohr KI. History of Antibiotics Research. *Curr Top Microbiol Immunol* [Internet]. 2016 Dec 1 [cited 2022 Feb 11];398:237-72. Available from: <https://pubmed.ncbi.nlm.nih.gov/27738915/>
2. WHO's first global report on antibiotic resistance reveals serious, worldwide threat to public health [Internet]. [cited 2022 Feb 16].

Available from: <https://www.who.int/southeastasia/news/detail/30-04-2014-who-s-first-global-report-on-antibiotic-resistance-reveals-serious-worldwide-threat-to-public-health>

3. Böhmer F, Hornung A, Burmeister U, Köchling A, Altiner A, Lang H, et al. Factors, perceptions and beliefs associated with inappropriate antibiotic prescribing in German primary dental care: A qualitative study. *Antibiotics*. 2021;10.
4. Barber M, Rozwadowska-Dowzenko M. Infection by penicillin-resistant Staphylococci. *Lancet*. 1948 Oct 23;252(6530):641-4.
5. Bilal H, Khan MN, Rehman T, Hameed MF, Yang X. Antibiotic resistance in Pakistan: a systematic review of past decade. *BMC Infect Dis* [Internet]. 2021 Dec 1 [cited 2022 Feb 21];21:1-19. Available from: <https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-021-05906-1>
6. Sekyere JO, Asante J. Emerging mechanisms of antimicrobial resistance in bacteria and fungi: advances in the era of genomics. *Future Microbiol* [Internet]. 2018 [cited 2022 Feb 15];13:241-62. Available from: <https://pubmed.ncbi.nlm.nih.gov/29319341/>
7. Yu J, Nie E-M, Jiang R, Zhang C-Y, Li X. Analgesic and Antibiotic Prescription Pattern among Dentists in Guangzhou: A Cross-Sectional Study. 2020; Available from: <https://doi.org/10.1155/2020/6636575>
8. G R Barker AJQ. An investigation into antibiotic prescribing at a dental teaching hospital. *Br Dent J - Nat*. 2000;188(12).
9. Louise C. Sweeney1, Jayshree Dave1,2 PAC and JH. Antibiotic resistance in general dental practice-a cause for concern? 2004; Available from: <https://academic.oup.com/jac/article/53/4/567/782420>
10. National AMR Action Plan for Pakistan Antimicrobial Resistance National Action Plan Pakistan Ministry of National Health Services Regulations & Coordination Government of Pakistan. 2017;
11. Ping Wong LI, Alias HI, Amir Husin S, Brukan Ali Z, Sim B, Sri La Sri Ponnampalavanar S. Factors influencing inappropriate use of antibiotics: Findings from a nationwide survey of the general public in Malaysia. 2021. <https://doi.org/10.1371/journal.pone.0258698>
12. Nahar P, Unicomb L, Lucas PJ, Uddin MR, Islam MA, Nizame FA, et al. What contributes to inappropriate antibiotic dispensing among qualified and unqualified healthcare providers in Bangladesh? A qualitative study. *BMC Health Serv Res* [Internet]. 2020 Jul 15 [cited 2022 Feb 21];20:1-11. Available from: <https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-020-05512-y>
13. Maddy. Antibiotic prescribing and resistance: Views from low- and middle-income prescribing and dispensing professionals Report to the World Health Organization, researched and compiled by students and staff of the Antimicrobial Resistance Centre at the London Sc. [cited 2022 Feb 9]; Available from: <http://www.who.int/antimicrobial-resistance/LSHTM->
14. Anka Cori, Svjetlana Grgic, Sandra Kostic, Katarina Vukojevic,

Ruzica Zovko, Natasa Radica, et al. Attitudes of dental practitioners towards antimicrobial therapy in Croatia and Bosnia and Herzegovina | Enhanced Reader. Eur J Dent. 2020;

15. Anwen L, Cope1, Nick A. Francis2 FWIGC. Antibiotic prescribing in UK general dental practice: a cross-sectional study. 2015;

16. 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. Available from: <https://academic.oup.com/jac/article/74/8/2139/5475276>

17. Majid Aziz M, Haider F, Rasool MF, Hashmi FK, Bahsir S, Li P, et al. antibiotics Dispensing of Non-Prescribed Antibiotics from Community Pharmacies of Pakistan: A Cross-Sectional Survey of Pharmacy Staff's Opinion. 2021.
<https://doi.org/10.3390/antibiotics10050482>

18. Saleem Z, Hassali MA, Godman B, Hashmi FK, Saleem F. Antimicrobial prescribing and determinants of antimicrobial resistance: a qualitative study among physicians in Pakistan. Int J Clin Pharm. 2019;41:1348-58.
<https://doi.org/10.1007/s11096-019-00875-7>

19. Farzeen Tanwir SK. Antibiotic Prescription Habits of Dentists in Major Cities of Pakistan | Journal of the Pakistan Dental Association. J Pak Dent Assoc [Internet]. [cited 2022 Aug 16]; Available from: <http://archive.jpda.com.pk/volume-20-issue-3/antibiotic-prescription-habits-of-dentists-in-major-cities-of-pakistan/>

20. Nepal G, Bhatta S. Self-medication with Antibiotics in WHO Southeast Asian Region: A Systematic Review. 2018;

21. Broniatowski DA, Klein EY, May L, Martinez EM, Ware C, Reyna VF. Patients' and clinicians' perceptions of antibiotic prescribing for upper respiratory infections in the acute care setting HHS Public Access Background and rationale for study. Med Decis Mak. 2018;38:547-61.

22. Morel CM, Lindahl O, Harbarth S, Marlieke o, De Kraker EA, Edwards S, et al. Industry incentives and antibiotic resistance: an introduction to the antibiotic susceptibility bonus. J Antibiot (Tokyo) [Internet]. 2020;73:421-8.
<https://doi.org/10.1038/s41429-020-0300-y>