Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

Journal of University Studies for Inclusive Research
Vol.16, Issue 24 (2023), 12426- 12440
USRIJ Pvt. Ltd

Antibiotic Stewardship in Dentistry Examine Strategies to Optimize Antibiotic Use in Dental Practice, Considering the Rise of Antibiotic Resistance and the Impact on Patient Outcomes

Bader M. Alsahabi , Abdullah H. Almatrafi, Mohammed A. Jubran, Fayez H. Alsahabi, Abdullah I. Alghannam, Majid A. Albahooth

1. Senior Pharmacist, Ministry Of Health. KSA
2. Senior Pharmacist, Ministry Of Health. KSA
3. Dental Assistant, Ministry Of Health. KSA
4. Pharmacist, Ministry Of Health. KSA
5. Pharmacist, Ministry Of Health. KSA
6. Dental Assistant, Ministry Of Health. KSA

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

Abstract

The present systematic review searches for antibiotic stewardship in dentistry as the burden of antimicrobial resistance mounts. Various studies, studies show that dentists abuse drugs too commonly. A study of 345 dentists found 65.8% were female and 34.2% were male. 15.7% prescribed unnecessary antibiotics > once/week, and 33.9% felt pressured by patients. Gender differences were observed in patient pressure ($P < 0.001$) and confidence in antibiotic prescribing ($P < 0.001$) (Al-Khatib and AlMohammad, 2022). and their actions contribute greatly to global concerns with resistance. Given that oral diseases are multi-dimensional, there is always a tendency to give antibiotic prescriptions precautionaryly, aggravating the resistance issues. This study highlights the tremendous contribution of dentistry to global antibiotic stewardship initiatives and the need to integrate dental practices into broader antibiotic resistance reduction plans. Educational interventions have shown a potential to change the attitudes of private practice dentists; however, standardized guidelines will be imperative in ensuring universal and optimal prescription patterns of antibiotic

Keywords: *Antibiotic stewardship, Dentistry, Antibiotic resistance, Oral diseases, Antibiotic*

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

1. Introduction

The contemporary healthcare strategy involves enhancing patients' well-being through antimicrobial substances (Siddique et al., 2021). Nevertheless, implementing antibiotic stewardship interventions has predominantly occurred within primary care and hospital environments (Majumder et al., 2022). Consequently, the dental field has not been exempt from the issue of irresponsible antibiotic prescription and consumption. The apprehension surrounding the escalating frequency of antimicrobial prescriptions has recently intensified, emphasizing the need to assess and enhance stewardship practices in dental settings.

Dentistry is integral in the general health system, handling lesions on the oral mucous membranes and teeth, which may eventually lead to systemic diseases (Gross et al. 2019). There are concerns among the general health community about the excess utilisation of antibiotics in dentistry because much of it is uncertain, coupled with heightened expectations and changes in clinical practices (Gross et al., 2019). There is a need for a systematic review, given the increasing prevalence of antimicrobial resistance that continues to compromise patient outcomes.

1.1 Antibiotic Resistance

World Health Organization (WHO) warned that antibiotic resistance is one of the greatest threats to global public health (Siddique et al., 2021). The development of resistant strains results from over and misprescribing antibiotics from different health care settings, which is a major cause for bacteria that a resistant strain and hence makes once effective antibiotics powerless against the infection caused by these organisms (Siddique et al., 2021). Though the main responsible for this issue are included mainly in general medication and agriculture, the dental sector is not a free bystander to the general actions of resisting antibiotics (Tolksdorf et al., 2022).

An important part of human health is the oral microbiome, i.e., the complex community of bacteria in the mouth. Although dentists should not abuse antibiotics, they can cause resistant bacteria to emerge by interfering with this balance. In this regard, it becomes

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

difficult for dental practitioners who have to fight infections while, on the other hand, preventing antibiotics resistance

1.2 Antibiotic Use in Dentistry

Improvements in dentistry that involve better treatment techniques and diagnosing modalities mainly target dental diseases. Most acute dental infection cases include periapical abscess, specific dental surgeries and sometimes prophylactic antibiotics. It involves making distinctions between situations where the use of antibiotics is justified and others where alternatives would suffice (Buonavoglia et al., 2021).

This issue poses a particular challenge for the dental profession. However, in cases such as dental infections, they may be multifaceted and caused by factors like poor oral hygiene, low immunocompetence, and other conditions. In many cases, this multidimensional nature of these diseases is associated with a certain degree of clinical uncertainty, compelling physicians to go for safer options, i.e., prescription of antibiotic drugs. However, this approach is also very exemplary because it is part of the problem leading to more extensive difficulties associated with excessive use of antibiotics (Nagendra et al., 2023).

1.3 Rationale for a Systematic Review

These increases in antibiotics, and consequently increase the risk of resistance, emphasize the need for an extensive understanding of Antibiotic Stewardship in Dental practice (Tolksdorf et al., 2022). This systematic review aims to critically analyze the literature to establish antibiotic stewardship in dentistry at present. Integrating all available evidence, we aim to find out how best to improve the utilization of antibiotics for better oral health.

2. Methodology

2.1 Literature Search Strategy

Researchers performed an extensive literature search using our systematic review approach to locate pertinent evidence on the resistance of antibiotics. The search was made through several electronic resources like Pubmed, Embase, and web of science. Maximum sensitivity and specificity of the search were achieved by utilizing Boolean operators to combine

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

keywords and MeSH terms related to “antibiotic stewardship”, “dentistry,” and “antibiotic resistance.”

2.2 Inclusion and Exclusion Criteria

The studies considered for inclusion had to meet specific criteria. Original research articles, RCT studies, systematic reviews, meta-analyses, and observational studies conducted in a dental setting. Dentistry studies should be conducted for antibiotic utilization, antibiotic stewardship, and their impacts on patient outcomes. Studies dealing with dentistry, non-English studies, and studies without necessary information on antibiotic stewardship in dental practice were excluded.

2.3 Study Selection

The first screening comprised the two independent reviewers who based their decision on the inclusion and exclusion criteria. Potentially eligible studies were assessed in full text, and inconsistencies between the reviewers were resolved by consensus meetings or consulting a third reviewer. We documented the screening procedures in the included studies using a Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart. The screening procedures for the included studies were carefully documented according to a rigorous protocol, utilizing a personalized system known as the "Systematic Documentation for Evaluation of Studies" (SDES).

2.4 Data Extraction

A predetermined information extraction form was constructed to record important data from the included studies. Two independent reviewers undertook data extraction, and they collected details on study design, participant characteristics, the nature of antibiotic use intervention/exposure, outcomes, and relevant findings. Such inconsistencies were settled through discussion or referring it to another reviewer.

2.5 Quality Assessment

Appropriate tools were adapted for the analysis based on the study design used in the included studies. Researchers utilized graded using the GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) for RCTs. Quality assessment was done via a

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

comprehensive and extensive approach. Two independent reviewers evaluated the selected studies based on the Cochrane Risk of Bias tool for randomized controlled trials and the Newcastle-Ottawa Scale for observational studies. Quality disagreements were discussed at consensus meetings or consulted by a third appraiser. A standard protocol was developed, followed by the documentation of the specific criteria and the established scoring system for this study.

2.6 Data Synthesis

The synthesis method used was narrative, where the results of the involved studies were analyzed and summarized. The extracted data were systematically organized and interpreted to answer the study's questions, hypotheses, and objectives.

2.7 Subgroup Analysis

Subgroup studies were conducted based on study design, area, nature of dental anti-bacterial therapy, and other factors to clarify heterogenicity and variations. It permitted a deeper comprehension of how antibiotic stewardship practice varied among settings.

2.8 Assessment of Publication Bias

A publication bias was analyzed using funnel plots and Egger's test. This step considered the possibility of publication bias in systematic reviews, thereby improving the validity of synthesized evidence.

2.9 Sensitivity Analysis

The robustness of the findings was assessed through the systematic exclusion of trials with a high risk of bias and those inconsistent with the overall pattern. This step aimed to increase the trustworthiness and external validity of the outcomes.

2.10 Ethical Considerations

Considering that such a study was based on secondary research and the involvement of available literature, getting ethical approval was unnecessary. Nevertheless, ethical standards were observed in the entire research, making it possible to ensure appropriate and honest study.

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

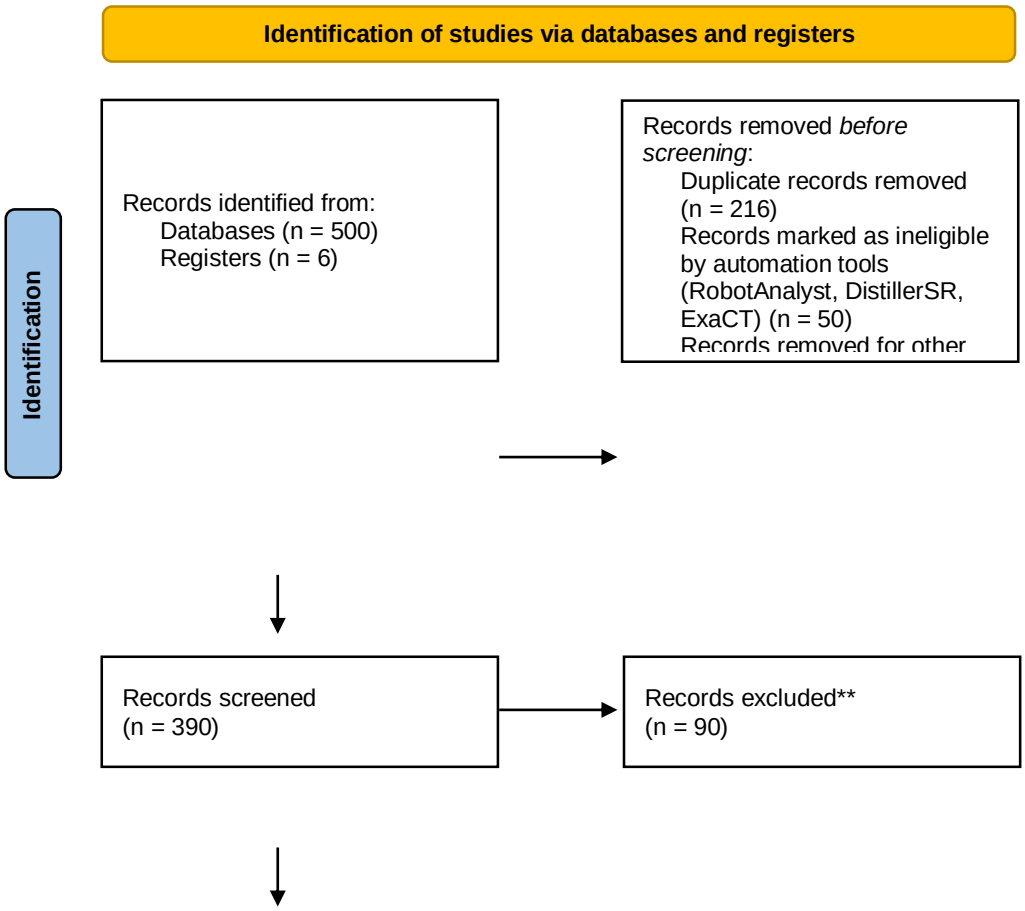
2.11 Protocol Registration

An attempt was made to be transparent by registering the systematic review protocol on a well-known platform such as PROSPERO. After any deviation from the registered protocol had been documented and justified, there was a final review.

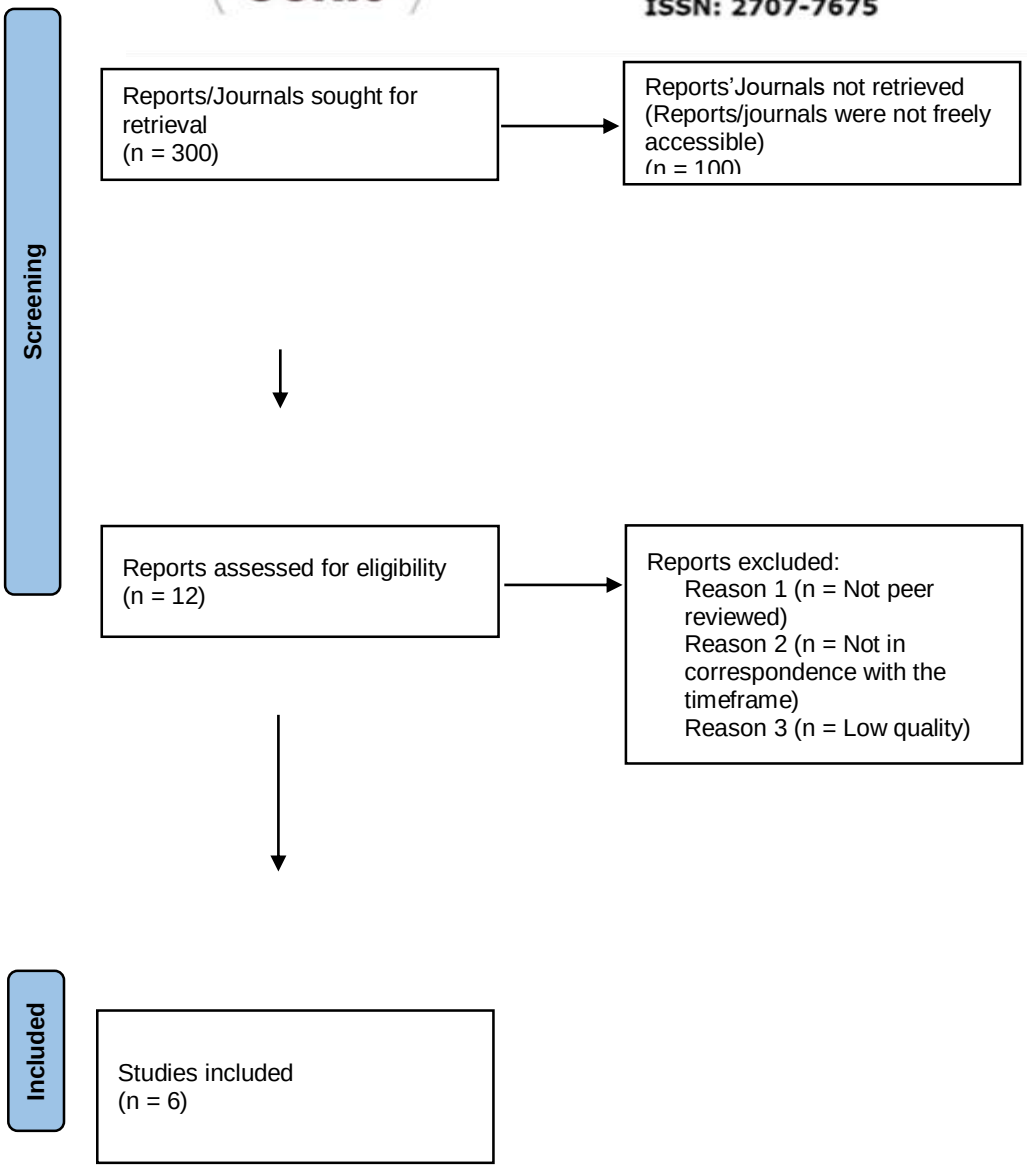
2.12 Reporting Standards

This systematic review follows PRISMA recommendations for a thorough and detailed methodological report and presentation of its findings. PRISMA checklist is systemically applied to improve the transparency and repeatability of the review process.

Figure 1: PRISMA Chat



Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675



3. Results

A systematic review by Teoh et al. (2020) measured outcomes in studies on antibiotic stewardship across primary health care involving an umbrella review in medicine and a systematic review in dentistry. In all, 2355 medical and 2704 dental studies were initially identified by systematically searching Ovid Medline, Ovid Embase, and the Web of Science. Upon screening and quality assessment, ten medical and five dental studies were part of this review. Researchers used the Critical Appraisal Skills Programme (CASP) for the umbrella

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

review and applied the Quality Assessment Tool for studies with diverse designs in a systematic dentistry review. This study noted that dental investigations concentrated on cutbacks of antibiotics instead of directly impacting antibiotic resistance. This made studies use antibiotic utilization as a proxy indicator for tackling antimicrobial (AMR) resistance instead of a change in profiles of antimicrobial resistance due to stewards' intervention, which was impracticable. Quantity, rates, percentages, and relative ratio antibiotic utilisations were among the most common criteria in general health care and dental practice. As for quantity measurements, DDD/1000 patients/day was commonly used. The umbrella review was concerned with primary medicine, where randomized control trials and ASP studies in general practice were considered; among the studied interventions included late antibiotic prescription, information leaflets, point-of-care testing, and computer-aided clinical decision support systems, among others. The measured outcomes were antibiotics use, adverse events, return consultation rate, patient satisfaction and other related parameters. A systematic review in dentistry is related to measuring outcomes in antibiotics stewardship programs in clinical management. It revealed outcomes, which were measured and compared with that of a medical setting. This review comprised interventions on optimal use of antibiotics in non-dental specialists. Dental study outcomes also included associations with antibiotic utilization and patient outcomes.

On the other hand, the constraints of DDD in gauging antibiotic usage in children were observed. One of the findings was on the non-use of clinical/patient outcome measures in dental research studies against medical studies that introduced adverse effect measures, for example. The paper stressed the inclusion of patient-related or clinical outcomes and antibiotic usage metrics to fit into the definition of antimicrobial stewardship. Quantity indicators were important for monitoring and tracking antibiotic use; however, it was necessary to ensure outcome measurements. This included the Infectious Diseases Society of America's recommendation for measures focused on their quality and amount.

The contribution of antibiotic drugs toward contemporary medicine ever since 1928, when penicillin was discovered, was highlighted in the study of Thompson et al. (2021). Antibiotics are at the heart of prevention and cure, which permits many operations and protects

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

patients against fatal illnesses. The fact that the strength of antibiotics reduces with the rising resistance to infections means that even routine operations such as small surgeries would be risky. The world implications of antibiotic resistance are also highlighted in this study (Thompson et al., 2021) Even though dentistry constitutes about a tenth of worldwide antibiotic prescriptions, it is characterized by difficulties in reducing antibiotic use (Thompson et al., 2021). WHO's Access-Watch-Reserve system for classifying antibiotics has been introduced to improve antibiotic stewardship programs. The research calls for strengthening antibiotic use by favoring them in the access category while utilizing stewardships to tackle those included in the watch category. This study emphasizes the need for explicit inclusion of dentistry in these plans due to its impact on antibiotic utilization. It promotes national solutions while considering each nation's unique circumstances of antimicrobial utilization and AMR.

The use and abuse of antibiotics lead to a new global pandemic, antimicrobial resistance (AMR), as indicated in Buonavoglia et al. (2021). Dentists are responsible for 10% of antibiotics prescribed for pain relief in oral cavities and postoperative conditions. The recent research focuses on lower dosages and fewer antibiotic prescriptions depending on proper diagnosis and better oral hygiene before dental treatment procedures (Buonavoglia et al., 2021). Common situations in dentistry are associated with reduced prescribing of antibiotics and increased treatment success. Mechanical removal of bacterial biofilms is the main measure in periodontology, and antibiotics are applied for severe ones. When choosing antibiotics for use alongside periodontal interventions, the risk of AMR should be considered carefully.

Given that there are no indication for systemic antibiotic prescriptions in general cases of dental extractions, a patient exposes themself to undue risk while gaining no significant advantage over a non-prescription option (Buonavoglia et al., 2021). Post-extraction pain and swelling are mainly due to surgical trauma, the age of the patient, and bacterial load. Recommended for use only on persistent infection symptoms in a limited number of cases. Short preoperative antibiotic regimes may lower failure risks in implantology, and controlling bacterial load with chlorhexidine is possible. Personalized medicine and tailored antibiotics administration is one of the possible directions for further studies on this topic. The correct management of

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

bacterial load removal of infectious foci, as trauma-based surgical methods, being more important than antibiotic administration as adjuncts, their ability to lower clinical symptoms is limited (Buonavoglia et al., 2021). This suggest an appropriate antibiotic strategy that reduces AMR and provides personalized care according to the patient's specificities.

Goff et al. (2022) reported that private practice dentists had reduced their antibiotic prescriptions significantly through a prospective cohort study that involved fifteen private practice dentists. A multilevel education involved 72 % of practicing dentists representing the American Dental Association. The study showed a decline of 308 prescriptions, even with an increase in surgical procedures numbering 306. Appropriate antibiotics used for prophylaxis and treatment increased from 19% to 87.9%, with prophylaxis increasing from 46.6% to 76.7%. It is important to point out that the use of the appropriate treatment antibiotics more than quadrupled from fifteen percent to ninety-two percent. Antibiotic use time was reduced remarkably with less clindamycin. These outcomes show how important infectious disease specialists are for promoting the optimal use of antibiotics in private dental practices.

A qualitative study was conducted by Atif et al. (2021) which explores the knowledge, perception, and attitudes of physicians towards antibiotic stewardship programs in three tertiary care public sector hospitals in the city of Bakawalpour and Rahimyar Khan review of 17 in-depth interviews yielded five main themes; doctor's perception towards antibiotics use and stewardship, prescribing antibiotics, resistance to antibiotics, poor antibiotics distribution strategies implemented by hospital management, and barriers to adopting a Misconception was noted about rational antibiotic usage, while ASP understanding was poor in the participants. Limited ASP activities were reported. This implies that there is a necessity for the design of laws, healthcare professional involvement, public education, and specifications to facilitate the successful realization of ASP and the challenges associated with irrational prescription practices and emerging bacterial infections.

The study by AlSarhan (2020) showed that he investigated 156 dentists, primarily periodontists (70.5%), on an understanding of preoperative prophylactic antibiotics prescriptions before dental implant surgery in Saudi Arabia. The result showed that 63.5 % of the participants

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

did not prescribe prophylactic antibiotics, highlighting differences in medical approaches within the dental practitioner community. Public practitioners preferred the development of guidelines related to antibiotic prescriptions, whereas private practitioners tended to prescribe preoperative antibiotics. Specifically, it showed that in cases of giving multidose antibiotics, a potential complication among private doctors is higher than among non-private doctors.

4. Discussion

Teoh et al. (2020) systematically reviewed antibiotic use strategies across medical and dental settings. The medical and dental studies' results involving antibiotics and patients' outcomes were also compared. Thompson et al. (2021) noted the impact of antibacterial resistance worldwide and demanded dentists' participation in fighting against resistant agents. They highlighted the challenges inherent in prescribing antibiotics in dentistry, which often leads to overprescription and misuse of antibiotics. This study stressed the requirement for dentistry to be an element in the global antibiotic management programs, pointing to its contribution to antibiotic use and patient safety. Buonavoglia et al. (2021) discovered the emerging threat of antimicrobial resistance and their role as prescribers of antibiotics.

Dental Antibiotic Stewardship Education Among Private Practice Dentists-An Improvement in Antibiotic Prescribing Practices: A Study by Goff et al. (2022) highlighted antibiotics prescriptions were reduced considerably while there was a significant rise in using them correctly by treating or as preventive measures. It was noted that infectious disease specialists' educational interventions greatly facilitate optimal prescribing of antibiotics in dentistry.

In this case, Atif et al. (2021) carried out a qualitative study on physicians' knowledge and practice towards antibiotic stewardship programs in Pakistani hospitals. Misconceptions involving rational antibiotic use and a lack of knowledge of antibiotic stewardship were noted in the study. The challenges of introducing an efficient antibiotics stewardship program are mainly due to a need for more relevant information provided by legislation, professionals involved, and public awareness (Atif et al., 2021). For instance, legislators and other stake holders like

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

professionals involved in the public awareness can make the courses for antibiotics mandatory for the dental professionals.

AlSarhan (2020) studied dentists in Saudi Arabia and their know-how in prescribing pre-operative antibiotics for dental implant surgery. The study demonstrated different patterns of antibiotic prescribing by private versus non-private providers. The study advised establishing strategic strategies and responsible procurement of antimicrobe agents to curb unnecessary use of antibiotics in line with global antibacterial resistance efforts.

Table 1: Key Findings and Recommendations from Selected Studies on Antibiotic Stewardship in Medical and Dental Settings

Study	Focus	Key Findings	Recommendations
Teoh et al. (2020)	Antibiotic Stewardship Programs in Medical and Dental Settings	Common outcomes in antibiotic use; emphasis on quantity indicators; need for outcome measurements beyond quantity	Emphasize antimicrobial stewardship definitions; incorporate outcome measurements
Thompson et al. (2021)	Global Implications of Antibiotic Resistance in Dentistry	Challenges in reducing antibiotic use in dentistry; excessive and misused prescriptions; dentistry's significant impact on antibiotic utilization	Include dentistry in global antibiotic stewardship plans; balance benefits vs. risks in dental prescribing
Buonavoglia et al. (2021)	Dentists' Role in Addressing Antimicrobial	Shift towards lower dosages and fewer antibiotic prescriptions;	Emphasize personalized medicine; reduce AMR while ensuring clinical

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

	Resistance	focus on accurate diagnosis and improved oral health; personalized medicine	success
Goff et al. (2022)	Impact of Dental Antibiotic Stewardship Education	Significant improvements in antibiotic prescribing practices; reduction in prescriptions; increase in appropriate antibiotic use	Implement educational interventions led by infectious diseases experts; optimize antibiotic prescribing
Atif et al. (2021)	Physicians' Knowledge and Practices in Antibiotic Stewardship Programs	Misconceptions about rational antibiotic usage; poor understanding of stewardship programs; limited activities	Implement legislative measures; involve healthcare professionals; public education for effective stewardship programs
AlSarhan (2020)	Dentists' Knowledge and Habits in Preoperative Antibiotic Prescription	Variations in antibiotic prescription practices; private vs. non-private practitioners	Implement strategic policies and stewardship programs; minimize unnecessary antibiotic utilization

5. Conclusion

This systematic review highlights the significance of customized antibiotic stewardship in dental care as an integral part of global healthcare systems. Some significant issues in the analysis comprised the overprescription of antibiotics and how it contribute to increasing

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

antimicrobial resistance. Oral diseases can be manifold, while some dental infections are complicated. As a result of this issue, dental practitioners usually apply prophylactic antibiotics, which may contribute to antibiotic resistance. The prescription of antibiotics more than necessary and for the prophylactic reasons has become the international issue. Antibiotic resistance is a major concern in dentistry, as dentists are often obliged to prescribe more antibiotics than they should. Moreover, the WHO's Access-Watch-Reserve system emphasizes the need to incorporate dental activities in the international antibiotics guidelines. As Goff et al. (2022) show, improving antibiotic prescribing habits might be a way forward through these education interventions. However, it underscores the need for standard guidelines and instructions on the highly diverse antibiotics practice within dental care providers. Therefore, this systematic review endorses a comprehensive approach through individualized antibiotics, adopting personalized medicine and reducing antibiotic overuse, which should curb antimicrobial resistance and improve antibiotic outcomes in dentistry.

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

References

AlSarhan, M. (2020). Knowledgeand prescription habits toward preoperative antibiotics in implant dentistry: A survey analysis in a subset of dentists in Saudi Arabia. *J Contemp Dent Pract*, 21(5), 568-574.

Atif, M.; Ihsan, B.; Malik, I.; Ahmad, N.; Saleem, Z.; Sehar, A.; & Babar, Z. (2021). Antibiotic stewardship program in Pakistan: A multicenter qualitative study exploring medical doctors' knowledge, perception and practices. *BMC infectious diseases*, 21(1), 1-11.

Buonavoglia, A.; Leone, P.; Solimando, A.; Fasano, R.; Malerba, E.; Prete, M.; & Racanelli, V. (2021). Antibiotics or no antibiotics that is the question: an update on efficient and effective use of antibiotics in dental practice. *Antibiotics*, 10(5), 550.

Goff, D. A.; Mangino, J.; Trolli, E.; Scheetz, R.; & Goff, D. (2022). Private Practice Dentists Improve Antibiotic Use After Dental Antibiotic Stewardship Education From Infectious Diseases Experts. In *Open Forum Infectious Diseases*, 9 (8), 361.

Gross, A.; Hanna, D.; Rowan, S; Bleasdale, S; & Suda, K. (2019). Successful implementation of an antibiotic stewardship program in an academic dental practice. *Open forum infectious diseases*, 6(3) 67

Majumder, M; Singh, K.; Hilaire, M; Rahman, S; & Haque, M. (2020). Tackling antimicrobial resistance by promoting antimicrobial stewardship in medical and allied health professional curricula. *Expert review of anti-infective therapy*, *18*(12), 1245-1258.

Siddique, S; Chhabra, K; Reche, A; Madhu, P; Kunghadkar, A; & Kalmegh, S. (2021). Antibiotic stewardship program in dentistry: Challenges and opportunities. *Journal of Family Medicine and Primary Care, 10* (11), 3951.

Teoh, L; Sloan, A; McCullough, M; & Thompson, W. (2020). Measuring antibiotic stewardship programmes and initiatives: an umbrella review in primary care medicine and a systematic review of dentistry. *Antibiotics*, *9*(9), 607

Thompson, W.; Williams, D.; Pulcini, C; Sanderson, S; Calfon, P; & Verma, M. (2021). Tackling antibiotic resistance: why dentistry matters. *international dental journal*

Tolksdorf, K; Freytag, A; Bleidorn, J; & Markwart, R. (2022). Antibiotic use by dentists in Germany: a review of prescriptions, pathogens, antimicrobial resistance and antibiotic stewardship strategies. *Community Dental Health*, *38*, 275-281.

Al-Khatib, A; and AlMohammad, R. (2022). Dentists' Habits of Antibiotic Prescribing May be Influenced by Patient Requests for Prescriptions. *International Journal of Dentistry*

Nagendra, L; Kapoor, N; & Bhattacharya, S. (2023). Metabolic Bone Disease in the Tropics.