

Assessment of Antimicrobial Use and Aseptic Practices Across Dental and Surgical Settings; role of dentist and their assistants, pharmacists, OR staff and sterilisation technician

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Abstract

Background:

Antimicrobial resistance (AMR) is a global public health crisis that undermines the effectiveness of infection treatment and threatens the safety of healthcare practices. Dental and surgical settings are particularly vulnerable due to their frequent use of invasive procedures and high reliance on antimicrobial agents and aseptic techniques. This review assesses the current state of antimicrobial use and aseptic practices in these environments, with an emphasis on the roles and responsibilities of dentists, dental assistants, pharmacists, operating room (OR) staff, and sterilization technicians.

Objectives:

To evaluate patterns of antimicrobial prescribing, identify gaps in aseptic compliance, and examine how each healthcare professional contributes to or hinders the effectiveness of infection control and antimicrobial stewardship strategies.

Methods:

A comprehensive literature review was conducted, drawing from peer-reviewed articles, clinical guidelines, and public health data published by institutions such as the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC). The analysis focused on antimicrobial use in dental and surgical settings, infection control protocols, and interdisciplinary collaboration across healthcare teams.

Findings:

Dentists are among the top community prescribers of antibiotics, yet a significant proportion of prescriptions do not align with evidence-based guidelines. In surgical contexts, antibiotic prophylaxis is often improperly timed or extended beyond recommended durations. Aseptic practices, although standardized, are inconsistently applied due to resource limitations, training deficiencies, and systemic oversights. Dental assistants and OR staff play critical roles in maintaining aseptic integrity, while pharmacists provide essential oversight in antimicrobial

selection and monitoring. Sterilization technicians are foundational to ensuring equipment safety but are frequently undertrained and undervalued.

Conclusions:

Antimicrobial misuse and lapses in aseptic technique pose serious risks in both dental and surgical care. Greater emphasis on education, interdisciplinary collaboration, and policy enforcement is necessary to close the gaps in compliance and enhance patient safety. Effective infection prevention and antimicrobial stewardship must be embraced as collective responsibilities by all members of the healthcare team to reduce AMR and improve clinical outcomes.

Keywords:

Antimicrobial resistance, aseptic technique, dental practice, surgical infection control, dentists, dental assistants, pharmacists, operating room staff, sterilization technicians, infection prevention, antibiotic stewardship.

Introduction

The global threat of antimicrobial resistance (AMR) has reached alarming levels, with significant implications for public health, especially in healthcare settings such as dental clinics and surgical operating rooms. These environments frequently involve invasive procedures that compromise the integrity of mucosal or skin barriers, increasing the risk of infections and necessitating stringent infection control and antimicrobial stewardship practices. The World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) have both emphasized that the misuse and overuse of antimicrobials remain the primary drivers of AMR, which is now responsible for an estimated 1.27 million deaths annually worldwide [1]. As AMR becomes a dominant cause of mortality, the importance of evaluating antimicrobial usage and aseptic practices in both dental and surgical domains cannot be overstated.

Dentists and oral healthcare professionals are among the top prescribers of antibiotics in community settings, yet studies consistently reveal that a large portion of these prescriptions are unnecessary or inappropriate. One study analyzing outpatient dental visits in the United States found that approximately 81% of antibiotic prophylaxis prescriptions did not conform to national guidelines, and up to 1.4% were associated with adverse drug events within 14 days of dispensing [2]. Overprescription is often linked to diagnostic uncertainty, patient pressure, and a perceived need to “do something” in the face of oral pain or infection, even when definitive treatments like drainage or extractions would suffice [3]. Moreover, dental practitioners may lack consistent access to or engagement with antimicrobial stewardship programs (ASPs), unlike physicians and surgeons who operate within hospital-based systems where pharmacists and infection control teams provide oversight.

In surgical settings, the stakes are equally high. Surgical site infections (SSIs) account for up to 20% of all healthcare-associated infections (HAIs), leading to prolonged hospital stays, increased morbidity, and higher healthcare costs [4]. The appropriate use of perioperative antibiotic prophylaxis is a critical factor in SSI prevention; however, adherence to recommended timing, selection, and duration of prophylaxis remains inconsistent. Studies have shown that antibiotics are often administered outside the optimal window—either too early or after incision—and extended unnecessarily beyond the 24-hour postoperative period, both of which deviate from

evidence-based protocols and contribute to microbial resistance [5]. In these environments, operating room (OR) staff, including surgical nurses and technologists, play a vital role in maintaining sterility and ensuring that antimicrobial agents are administered accurately and responsibly.

Aseptic practices across both dental and surgical settings form the foundation of infection prevention. These practices encompass a wide range of activities, including hand hygiene, use of personal protective equipment (PPE), instrument sterilization, environmental cleaning, and surgical field maintenance. Despite being codified in international guidelines such as those from the Asia Pacific Society of Infection Control (APSIC) and the CDC, compliance remains variable and is frequently influenced by factors such as inadequate training, staff shortages, and institutional culture [6,7]. In dental clinics, the rapid turnover of patients and high reliance on aerosol-generating procedures increase the risk of microbial transmission, making adherence to infection control protocols particularly critical [8]. Dental assistants serve as the first line of defense in these settings by ensuring the integrity of infection prevention workflows, supporting dentists during procedures, and managing the decontamination of reusable instruments.

The success of antimicrobial and aseptic strategies also hinges on the active involvement of pharmacists and sterilization technicians. Pharmacists are central to antimicrobial stewardship initiatives. In surgical settings, they collaborate with surgeons and infectious disease specialists to optimize antimicrobial selection and dosing. In dental contexts, they can play a consultative role in reviewing prescriptions and educating practitioners on local resistance trends [9]. Meanwhile, sterilization technicians ensure that all surgical and dental instruments meet sterility standards, using validated processes that include cleaning, disinfection, and sterilization via autoclaves or other technologies. Failures in this domain can result in instrument-related infections and are frequently implicated in outbreak investigations [10].

Ultimately, this review seeks to explore the current state of antimicrobial use and aseptic practices across dental and surgical environments with a focus on the key personnel involved. By examining the responsibilities and challenges faced by dentists, dental assistants, pharmacists, OR staff, and sterilization technicians, this paper aims to identify gaps in compliance, outline best practices, and suggest integrated strategies to improve patient safety and reduce the global burden of antimicrobial resistance and healthcare-associated infections.

Review

1. Antimicrobial Prescribing Practices in Dental and Surgical Settings

In both dental and surgical practices, antimicrobial prescribing remains a cornerstone of infection prevention and treatment. However, emerging data suggests that while antibiotics are frequently used, they are often prescribed inappropriately or unnecessarily, contributing directly to antimicrobial resistance (AMR). Dentists account for approximately 10% of all antibiotic prescriptions in primary care in some countries, with studies showing a consistent trend of overprescribing, especially for non-indicated conditions such as irreversible pulpitis or periapical abscesses without systemic involvement (11). A U.S.-based retrospective study found that 81% of antibiotic prophylaxis prescribed during dental visits did not align with clinical guidelines, resulting in not only increased microbial resistance but also adverse reactions in patients (12). The misuse is often rooted in diagnostic uncertainty, defensive medicine, or the convenience of

prescribing over performing definitive treatment. In some cases, dentists prescribe antibiotics prophylactically to patients without significant risk factors for infective endocarditis or prosthetic joint infections, despite updated guidelines advising against this practice (13).

In surgical settings, antimicrobial misuse similarly presents a substantial problem. Prophylactic antibiotics are vital in reducing surgical site infections (SSIs), yet the manner in which they are administered often deviates from best practice. Optimal timing of administration (within 60 minutes prior to incision), appropriate selection based on expected flora, and limitation of duration (ideally not exceeding 24 hours post-operation) are well-documented standards. Nonetheless, a multi-center observational study found that 30–50% of surgeries exhibited inappropriate timing and prolonged duration of antibiotic prophylaxis, both of which contribute to resistance and complications such as *Clostridioides difficile* infection (14). In particular, surgical teams may continue antibiotics for days postoperatively out of habit or a misplaced belief in added safety, despite evidence suggesting no benefit and potential harm (15). Surgeons often shoulder the responsibility for initiating antibiotic prophylaxis, but they may lack up-to-date pharmacological knowledge, further reinforcing the need for interdisciplinary collaboration with pharmacists.

2. Aseptic Practices and Cross-Infection Control

Effective aseptic technique is fundamental in minimizing the risk of cross-infection in dental and surgical environments. In dentistry, procedures frequently involve mucosal penetration and exposure to blood or saliva, making meticulous infection control essential. Standard protocols involve comprehensive hand hygiene, use of gloves, masks, protective eyewear, and gowns, along with proper cleaning, disinfection, and sterilization of instruments (16). However, compliance with these measures varies significantly across practices. A study in the Middle East revealed that only 67% of dental healthcare workers adhered consistently to standard aseptic techniques, largely due to limited resources, insufficient training, or underestimation of infection risk (17). Moreover, the frequent generation of aerosols during procedures such as ultrasonic scaling or high-speed drilling adds another layer of complexity. These aerosols can harbor pathogenic microorganisms, which remain suspended in the air for extended periods, increasing the risk of transmission to both staff and patients (18). Dental assistants play a crucial role in mitigating this risk by managing suction devices, enforcing surface disinfection between patients, and monitoring sterilization protocols.

In surgical environments, aseptic practices must be executed with even greater rigor due to the high-risk nature of procedures. The "sterile field" must be established and maintained meticulously, with any breach potentially leading to catastrophic infection outcomes. Standard operating procedures include surgical scrubbing, donning of sterile gloves and gowns, maintenance of sterile instruments, and environmental disinfection. A landmark study by the WHO reported that strict adherence to aseptic techniques can reduce SSIs by more than 50% (19). However, deviations from protocol, often due to procedural shortcuts or staff fatigue, can compromise outcomes. The role of the OR nurse and surgical technologist is central to ensuring protocol adherence—from verifying sterility indicators to monitoring surgical drapes and instrument handling.

3. Role of Dentists and Dental Assistants

Dentists bear the clinical responsibility for diagnosing oral infections and determining appropriate interventions, including whether antimicrobial agents are indicated. Their decisions significantly impact both patient safety and broader antimicrobial resistance patterns. Despite the availability of evidence-based guidelines, many dentists lack adequate antimicrobial stewardship training. Studies suggest that less than half of dental professionals regularly consult current clinical guidelines or antimicrobial formularies when prescribing (20). As a result, empirical prescribing based on outdated practices persists. Dental assistants, meanwhile, function as key players in infection prevention. Their responsibilities extend beyond chairside assistance to include decontamination of reusable instruments, management of sterilization cycles, and ensuring that treatment areas are cleaned according to protocol. A cross-sectional study found that dental assistants who received structured IPC (infection prevention and control) training were significantly more likely to demonstrate proper instrument handling and PPE usage, emphasizing the value of ongoing education (21).

4. Pharmacists and Antimicrobial Stewardship

Pharmacists serve as antimicrobial gatekeepers within healthcare settings. In hospitals, they routinely review surgical antibiotic prophylaxis protocols to ensure optimal agent selection, timing, and duration. Their role is not limited to dispensing; rather, they actively monitor antibiotic use trends, provide feedback to prescribers, and intervene in cases of inappropriate prescribing. Pharmacists are particularly crucial in perioperative care, where they can adjust antibiotic dosing in response to patient-specific factors such as renal function, allergies, or body weight (22). In dental contexts, however, pharmacists are often underutilized. Few dental offices include pharmacists as part of the extended care team, missing an opportunity for prescription review and patient counseling. Still, as community pharmacists increasingly serve as the final checkpoint before dispensing antibiotics, their vigilance can help prevent misuse and identify potential drug interactions or contraindications (23).

5. Operating Room (OR) Staff and Surgical Team Dynamics

OR staff—including scrub nurses, circulating nurses, and surgical technologists—play an indispensable role in maintaining aseptic conditions. Their duties span the entire surgical timeline: setting up sterile equipment, assisting during surgery without contaminating the field, and ensuring proper handoff of specimens and instruments. They also help verify that surgical antibiotic prophylaxis is given according to protocol. A breakdown in any of these processes can elevate the risk of SSI. Training in sterile technique is continuous and mandatory for OR staff, with regular audits and performance assessments forming part of standard practice in accredited facilities. However, challenges such as understaffing, shift fatigue, or unclear delineation of roles can impair execution. Research indicates that team communication is a major determinant of aseptic compliance, highlighting the importance of checklists and standardized protocols (24).

6. Sterilization Technicians and Equipment Safety

The often-overlooked role of sterilization technicians is critical to preventing cross-infection through contaminated instruments. These professionals are tasked with cleaning, disinfecting, and

sterilizing surgical and dental instruments using validated methods such as autoclaving, chemical disinfection, and ultrasonic cleaning. Errors in this chain—such as overloading autoclaves, skipping cleaning steps, or using incorrect parameters—can result in instruments that appear clean but remain microbiologically unsafe (25). A 2019 study identified suboptimal sterilization as a contributing factor in several dental-based infection outbreaks, particularly in practices where sterilization duties were delegated without adequate training (26). Technicians must follow rigorous documentation procedures, verify biological indicators, and segregate sterile from contaminated items. Despite their importance, many technicians lack formal education in microbiology or infection control, suggesting a need for improved certification standards and institutional support.

Conclusion

The escalating threat of antimicrobial resistance and the persistent incidence of healthcare-associated infections, particularly surgical site infections, highlight the urgent need for robust antimicrobial stewardship and rigorous aseptic practices across dental and surgical settings. This review has demonstrated that antimicrobial misuse is not limited to inpatient hospitals but is a significant concern in dental clinics, where overprescription and deviation from established guidelines remain prevalent. Dentists often prescribe antibiotics empirically, sometimes inappropriately, due to diagnostic uncertainty, outdated practices, or a lack of integration into formal antimicrobial stewardship programs. Similarly, surgical teams frequently fail to adhere to evidence-based protocols regarding the timing, selection, and duration of perioperative prophylaxis, thereby undermining patient safety and contributing to the broader crisis of resistance.

Aseptic technique, though widely promoted, is inconsistently implemented in both dental and surgical environments. In dentistry, aerosol-generating procedures demand enhanced infection control vigilance, yet many practices suffer from limited compliance with standard protocols. Dental assistants serve a frontline role in enforcing these standards, and their proper training and oversight are essential to maintaining clinical safety. In the operating room, aseptic breaches often result from communication lapses, fatigue, or procedural shortcuts. OR staff, including nurses and technologists, must be empowered and supported through continuous education and well-defined protocols to ensure sterile integrity is preserved throughout surgical procedures.

Crucially, this review underscores the importance of interdisciplinary collaboration. Pharmacists are indispensable to antimicrobial stewardship efforts; their expertise in antimicrobial pharmacodynamics and pharmacokinetics complements the clinical decision-making of dentists and surgeons. Yet, their involvement in outpatient dental settings remains minimal and underutilized. Meanwhile, sterilization technicians, although often operating behind the scenes, are vital in ensuring that instruments used in both dental and surgical interventions are free from pathogenic contaminants. Any lapse in the sterilization chain can lead to outbreaks with serious consequences, thus their role should be acknowledged, standardized, and better integrated into broader infection prevention strategies.

Moving forward, a paradigm shift is needed—one that promotes a culture of accountability, continuous training, and cross-disciplinary coordination. Healthcare institutions must implement real-time surveillance systems, standardized protocols, and routine audits to ensure compliance. Dental schools and surgical training programs should incorporate more robust modules on

antimicrobial stewardship and aseptic technique, equipping future practitioners with the tools needed to uphold global health standards. Policymakers and public health leaders must also support these efforts through funding, regulation, and awareness campaigns that reinforce the dangers of AMR and the critical nature of aseptic practice.

Ultimately, preventing cross-infection and ensuring the rational use of antimicrobial agents is a shared responsibility. Dentists, dental assistants, pharmacists, OR staff, and sterilization technicians must operate as an integrated team to protect patients and preserve the effectiveness of lifesaving antibiotics for future generations. Only through coordinated, evidence-based, and consistently implemented strategies can we effectively curb the spread of resistance and improve patient outcomes in both dental and surgical care.

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