

The path of least resistance in oral surgery

Abstract

Statement of the problem: Antibiotic resistance is an imminent threat to worldwide public health. Dental professionals must demonstrate judicious use of antibiotics and educate their patients about the risks associated with their overuse.

Purpose of the paper: To encourage the dental profession to prescribe responsibly in order to optimise the use of antibiotics in oral surgery. Antibiotic stewardship programmes are recommended to help reduce the emergence of infections that are multidrug-resistant. Clinical practice audits are encouraged to help dentists ensure conservative prescribing patterns.

Conclusions: The dental profession has a duty of care to prescribe antibiotics in adherence with current best practice oral surgery guidelines. The dental profession must show leadership in slowing antibiotic resistance by pledging to safeguard their appropriate use.

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Introduction

The World Health Organisation has identified antibiotic resistance as a major threat to worldwide public health.¹ Every year there are an estimated 25,000 deaths in Europe due to antibiotic resistance.² This is primarily caused by inappropriate prescribing habits, which lead to the over-use of antibiotics. The dental profession is globally responsible for between 7 and 11% of all antibiotic prescriptions.³ Indiscriminate prescribing practices among dentists, particularly in the field of oral surgery, need to be targeted. Inappropriate prescribing of antibiotics leads to selection and dominance of resistant microorganisms. The exchange of genetic material can also increase resistance, resulting in resistant genes spreading between populations of bacteria.⁴ As a consequence, antibiotics are becoming less effective and contribute to many infections, which are increasingly difficult to treat. The dental profession must demonstrate leadership in helping to reduce the impact of antibiotic resistance.

The human microbiome

The human microbiome consists of the microbes, along with their genes and genomes, that live in and on the human body. These resident microbes are important to our health as they play a significant role in maintaining our immune systems, contributing to digestion and acting as a first line of defence against pathogens. Researchers now believe that many diseases may be the result of disturbed microbiomes. The current understanding indicates that the human body is made up of 10 times more microbial cells than human cells. It is thought that there may be millions more microbial genes than human genes in this human and microbiome system, and it is the ways in which these microbial genes interact with the human host that describe their ultimate role in health.⁵ At the same time as we are beginning to appreciate the microbiome, scientists are growing concerned about things that we are doing that may disturb this delicate system. Antibiotic resistance develops when bacteria are exposed to



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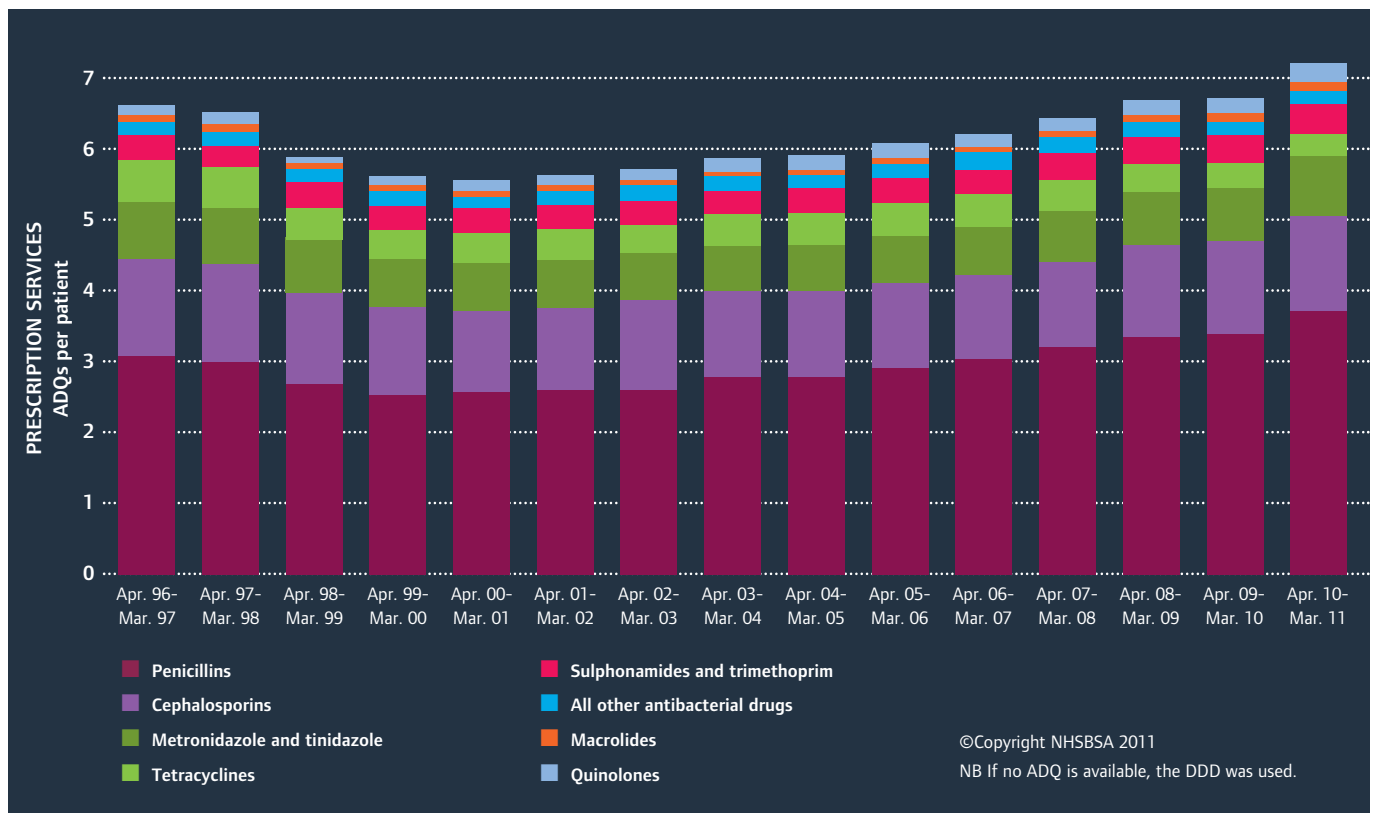


FIGURE 1: Trends in usage of antibacterials in general practice in England.⁷¹

sub-lethal doses of an antibiotic that, instead of killing them, allows them to develop genetic resistance against the antibiotic. Antibiotics can also kill beneficial bacteria in our microbiomes. There is thought to be a relationship between the theorised disturbance in the human microbiome through antibiotic use and the unexpected rise in autoimmune diseases and allergies, particularly in Western countries (Figure 1). Autoimmunity is the failure of our own immune system to distinguish 'self' from 'non-self'. This failure can lead to an immune response being mounted against our own cells and tissues. Examples of autoimmune diseases include rheumatoid arthritis, lupus, diabetes and coeliac disease. Current thinking is that antibiotics cause the loss of normal microbiome constituents, removing the necessary triggers for normal immune system development. As a result, an underdeveloped immune system might possibly encourage autoimmune diseases to develop.⁶

Healthcare-associated infections

The number of infections emerging due to multi-drug resistant organisms is rising sharply and the timeline for the development of new antibiotics is limited. A study comparing short-term (three days) with longer-term (five days) prophylaxis following excision of head and neck lesions found a significantly lower number of patients had wounds infected by methicillin-resistant *Streptococcus aureus* (MRSA) in the shorter term group.⁷ Antibiotic resistance adversely affects patient outcomes and increases the length of their hospital stays. In addition, there are tremendous healthcare expenses involved in developing new drug therapies to treat such patients. Administration of antibiotics also predisposes patients to infection with

Clostridium difficile, which causes antibiotic-associated colitis.⁸ Some 5% of healthy adults carry low concentrations of *C. difficile* in their colon asymptotically.⁹ The overuse of antibiotics by dentists can upset the harmony of bacteria in the gut. *C. difficile* infection occurs when these bacteria multiply and produce toxins, resulting in symptoms such as diarrhoea and fever. Patients who have been treated with broad-spectrum antibiotics are at the greatest risk.¹⁰

There were 1,696 new cases of *C. difficile* infection documented in Ireland throughout 2010. The majority of these patients completely recovered; however, on rare occasions this infection proved fatal.¹¹ More conservative antibiotic prescribing is imperative to reduce the number of emerging healthcare-associated infections.

Antibiotic stewardship

Antimicrobial stewardship is an organisational approach to promoting and monitoring conservative use of antimicrobials to maintain their ongoing effectiveness.¹²

The objective of antimicrobial stewardship is to improve antibiotic prescribing patterns. Antibiotic resistance poses a threat to the elderly, to children, and to patients with weakened immune systems. However, an increase in infections that are more difficult to treat not only affects vulnerable patients but also the wider community. Bacterial resistance can complicate the treatment of even mild infections.

Educating the dental profession and the public in the judicious use of antibiotics as part of an antimicrobial stewardship programme is imperative in

safeguarding this vital medicine. Unfortunately, patients have come to expect antibiotics for ‘toothache’, which is an inflammatory condition and best managed with local measures in combination with analgesics. Good communication and reassurance by the dental profession must enforce antibiotic stewardship. However, an unscheduled emergency often presents a profoundly difficult situation for the dentist. As a profession, we are increasingly vulnerable to regulatory criticism if we cannot justify our care to our patients in circumstances of acute pain.

Doron and Davidson stressed three important aims with antimicrobial stewardship:¹³

- ▶ optimise treatment for patients;
- ▶ prevent inappropriate prescribing; and,
- ▶ reduce the development of resistance in the individual patient and therefore the wider community.

The dental profession must show leadership in slowing the development of antimicrobial resistance by demonstrating more judicious prescribing in both private and hospital settings.

Indications for therapeutic antibiotic treatment in oral surgery¹⁴

Therapeutic antibiotic treatment is the use of substances that reduce the growth or reproduction of bacteria, including eradication therapy.¹⁵ In the field of oral surgery, clinical situations that require antibiotic therapy include:

- ▶ management of acute/chronic infections;
- ▶ management of active infective disease; and,
- ▶ immediate treatment if there is a delay due to unco-operative behaviour requiring referral to specialist services (this may happen if a dentist is unable to establish drainage and the patient requires sedation/general anaesthesia).¹⁶

Therapeutic antibiotics are also indicated where body temperature is elevated and where signs or symptoms of systemic spread, such as lymphadenopathy and trismus, exist. Facial cellulitis with or without dysphagia also requires immediate antibiotic treatment to prevent the spread of infection through lymph and blood circulation, which could culminate in septicaemia.¹⁷ Most dental infections can be successfully resolved by removal of the source. However, there is still a worrying tendency among dentists to favour an antibiotic prescription over immediate dental treatment.¹⁸

In managing dento-alveolar infections in children and immunocompromised patients early treatment is imperative. Local infections can spread very quickly, culminating in life-threatening consequences such as Ludwig’s angina.¹⁹

Acute dento-alveolar infections

Antibiotics are only indicated as an adjunct to local treatment where the patient’s temperature is increased and there is evidence of systemic spread and local lymph gland involvement.²⁰ If the infection has resolved three days post drainage or removal of the cause, and the temperature has returned to normal, then antibiotics can be stopped.²¹

Chronic dento-alveolar infections¹⁴

These usually present as a well-localised abscess, sometimes with a sinus, but rarely require antibiotics unless:

- ▶ grossly spreading, or if there is an acute flare-up of infection; or,
- ▶ increased temperature or malaise is present.

Pericoronitis

For patients presenting with localised pain and swelling involving the pericoronal tissues, and in the absence of regional and systemic symptoms, it is recommended that only local measures are used. These include debridement of plaque and food debris, drainage of pus, irrigation with sterile saline, chlorhexidine or hydrogen peroxide, and elimination of occlusal trauma.

In addition to local pain and swelling, if the patient is experiencing regional or systemic signs and symptoms, antimicrobial therapy is indicated. It is important to emphasise that this is an adjunct rather than a first-line treatment. Systemic symptoms include pyrexia, tachycardia and hypotension. The antibiotic of choice is metronidazole 400mg three times a day for five days or phenoxymethylpenicillin 500mg four times a day for five days. The two antimicrobials can be used in combination for severe infections. For patients who are allergic to penicillin, erythromycin 500mg four times a day for five days is suitable.²²

Antibiotic prophylaxis in oral surgery

Prophylactic antibiotic treatment is the use of antibiotics before, during or after a diagnostic, therapeutic or surgical procedure to prevent infectious complications.²³ If antibiotic prophylaxis is administered too late or too early it reduces the effectiveness of the antibiotic and may increase the risk of a surgical site infection.²⁴ It has been shown that administration of prophylaxis more than three hours after the start of the procedure dramatically reduces its efficacy.²⁵

Historically, antibiotics were prescribed to prevent bacteraemias and metastatic infections resulting from dental procedures. The British Society of Antimicrobial Chemotherapy (BSAC) and the National Institute for Health and Clinical Excellence (NICE) have reviewed the evidence for bacteraemias in relation to cardiac patients. They concluded that the chance of developing a bacteraemia is greater from chewing and toothbrushing than from dental treatments.²⁶ It was found that even if antibiotic prophylaxis was 100% effective, it might only help to prevent a very small number of infective endocarditis cases.²⁷

The NICE guidelines state that there is no requirement to prescribe antibiotics for patients with acquired or congenital endocardial disease.²⁸ Likewise, for patients with total joint replacements, the BSAC found no evidence to support antibiotic prophylaxis when dental treatment is required.²⁹

However, amid the backdrop of universally conflicting arguments, NICE has recently announced that it is to immediately review its 2008 guidelines following new research published at a meeting of the American Heart Association in Chicago in November 2014. The new research suggests that the number of people developing infective endocarditis in the UK has increased following the publication of the NICE guidelines.³⁰ This raises the concern that despite a lack of supporting evidence for antibiotic prophylaxis, perhaps the total abolition of cover may have been a step too far? The need for more randomised prospective research is clear.

Risks of antibiotic prophylaxis

Side effects of antibiotics include diarrhoea, allergy, gastrointestinal upset and a potentially fatal anaphylactic reaction. However, the incidence of fatal anaphylactic reactions was found to be extremely low where a single dose of oral amoxicillin is concerned. Over a 50-year period, the AHA is unaware of any cases of fatal anaphylaxis resulting from the administration of penicillin

recommended in their guidelines.²⁷ To date, there is only one documented case of a fatal anaphylaxis in the GlaxoSmithKline Global records.³¹

Prophylactic antibiotic use in third molar surgery

Current research states that 12 people would need to receive antibiotic prophylaxis to prevent one infection.³² Antibiotics are frequently prescribed in a prophylactic way in cases where surgery is complex, and in patients suffering from systemic conditions causing immunodeficiency such as HIV, diabetes and cancer.³³ It is likely that antibiotics are more advantageous in immunocompromised patients, as infections in this group are more frequent and difficult to resolve.

However, there is no evidence that antibiotics prevent fever, swelling or problems with restricted mouth opening in patients who have had their wisdom teeth extracted. Therefore, the administration of antibiotics in healthy people to eliminate the risk of infections may cause more harm than benefit to both the individual patient and the wider population. The use of antibiotics was found to lead to at least one mild adverse effect for every 21 people treated.³² In oral surgery there appears to be very little clinical gain from prescribing postoperative antibiotics alone. There is no evidence to advise the use of antibiotics after surgical extraction of impacted teeth/roots to reduce infection postoperatively. The evidence clearly indicates that there is no decrease in postoperative infection, pain, swelling or wound healing.³⁴ It appears that medically compromised patients benefit the most from antibiotic therapy.

Immunocompromised patients

There is no definitive evidence that the routine use of prophylactic antibiotics is advisable in patients with the following conditions:³⁵ leukaemia, immunosuppressive drugs following organ transplantation, lymphoma, anti-cancer chemotherapy, poorly controlled diabetes and HIV. Treatment should be carried out after correspondence with the patient's specialist.

Bisphosphonate-related osteonecrosis of the jaw

The scientific evidence does not support the routine administration of antibiotics in this patient cohort when undergoing dental procedures.³⁶

Radiotherapy

Patients with a history of radiotherapy for head and neck cancer are at a very high risk of developing osteoradionecrosis (ORN) following even straightforward extractions or biopsies.³⁷ There is controversy around identifying the most suitable antimicrobial regime. A recent survey of oral and maxillofacial consultants in the UK showed wide variation in practice. Most were in favour of preoperative antimicrobial use for the surgical removal of lower posterior teeth, and 89% advised a postoperative antibiotic course. Much of the controversy surrounds the microbial involvement in the pathogenesis of ORN, which is still unclear.³⁸

If a tooth is of hopeless prognosis, then advice on management should be attained from a maxillofacial surgeon. The risk of osteonecrosis of the jaw is high in this patient cohort and increases with time. Poor blood flow and tissue penetration in the irradiated site make the use of antimicrobials debatable.³⁹

Management of dry socket

Dry socket is a post-extraction complication, which follows the breakdown of the blood clot and occurs as a result of bacterial invasion. Its incidence is in the

region of 4%.⁴⁰ The aetiology of dry socket is related to systemic factors, localised infection and surgical trauma. Antibiotics are only recommended in the presence of spreading infection.³²

Studies have proven that approximately 38 healthy people would need to be treated with prophylactic antibiotics to prevent a single case of dry socket.³²

Surgical endodontics

A recent systematic review highlighted that prescribing prophylactic antibiotics to prevent systemic disease is not always in the patient's best interests.²⁸ Similarly, prophylactic administration to prevent postoperative infection has not been shown to be advantageous.⁴¹ Antibiotics should only be prescribed where signs of systemic involvement exist, with lymphadenopathy and pyrexia, along with appropriate surgical drainage if required.⁴² The RCS Surgical Endodontic Guidelines recommend preoperative and postoperative chlorhexidine mouthwashes as being the best method of preventing infections.⁴³

Therefore, the only indications for antibiotic therapy in surgical endodontics include infections with:

- ▶ gross local spread;
- ▶ systemic involvement; and,
- ▶ where treatment must be delayed or in cases where drainage is impossible and periradicular surgery is needed.

Current evidence highlights that postoperatively antibiotics do not decrease swelling, percussion pain or the amount of analgesics needed to alleviate symptoms.^{44,45}

Dental implant placement

There is very limited evidence to support the use of routine prophylactic antimicrobials in implant therapy. Where good asepsis is absent, it has been proven that antimicrobials are ineffective.⁴⁶ A meta-analysis, however, recommends the following protocol to reduce the failure of implants:

- ▶ amoxicillin 2g one hour preoperatively; or,
- ▶ in patients allergic to penicillin, clindamycin 600mg one hour preoperatively.

Prophylactic antibiotics given orally one hour preoperatively seem to reduce early dental implant failure; however, no differences in postoperative infections have been observed by some authors.⁴⁷ It is, however, considered good practice to recommend antibiotics where immediate implants are placed into extraction sockets.⁴⁸ The use of prophylactic antibiotics is indicated for patients at risk of endocarditis, those with immunodeficiencies, those with metabolic diseases, patients who have been irradiated in the head and neck, and when extensive and prolonged surgery is expected.⁴⁹ Prophylaxis should not be extended beyond the first three postoperative days since it does not appear to result in additional protection.⁵⁰

Perioperative antibiotic prophylaxis is advised when intraoral bone grafting is necessary prior to dental implant placement, even though there are no studies with high-level evidence to support this. It appears that the risk of infection with implants is less when preoperative and postoperative antibiotics are prescribed.^{51,52,53}

Maxillofacial fractures

Prophylactic antibiotics in the treatment of compound mandibular fractures have been shown to reduce the incidence of postoperative infection to 6%

compared with 50% in patients not receiving prophylactic antibiotics.⁵⁴ Currently, there is no data supporting the use of postoperative antibiotics.⁵⁵ The efficacy of prophylactic antibiotics in the management of craniofacial fractures remains highly controversial. A systematic review advises perioperative antibiotics in all facial thirds and preoperative antibiotics in comminuted mandibular fractures. Postoperative antibiotics were not recommended in any facial third.⁵⁶

Auditing current practice

It is clear that more short period antibiotic audits, which are held at regular intervals with stakeholder feedback, are needed. These help to ascertain the number of prescriptions written, their appropriateness, and also to highlight areas of prescribing knowledge lacking in the dental practice. Within clinical practice, audits have been shown to positively encourage appropriate prescribing patterns.⁵⁷ However, it must also be understood that prescriptions are an indirect measure of antibiotic consumption and do not precisely reflect the rate of emerging resistance, which is multifactorial.⁵⁸

The General Dental Council (GDC) in the UK has outlined responsible prescribing standards for dentists. These state that a drug should only be prescribed when appropriate. In recent years the GDC has reprimanded an increasing number of dentists regarding inappropriate antibiotic prescribing. These malpractices included giving a prescription without seeing the patient, not checking for allergies and failing to initiate drainage as the first line of treatment.⁵⁹

Dental prescribing by practitioners outside the dental profession

In the case of out-of-hours emergencies, patients often consult their GP before their dentist. GPs are more likely to prescribe antibiotics than dentists for acute dental problems.⁶⁰ Therefore, where oral infections are concerned, antibiotic prescribing is not exclusive to dentists. Other healthcare professionals also contribute to the threat of antibiotic resistance.

The Infectious Diseases Society of America recommends the use of specific antibiotic order forms to prevent inappropriate prolongation of antibiotic prophylaxis. These have been shown to reduce inappropriate prescribing from 64% to 21%.⁶¹

Use of microbiology laboratories by the dental profession

Diagnostic microbiology laboratories are an excellent resource for helping dentists with therapeutic decisions. Yet within the profession bacteriological sampling mostly occurs when empirical therapy has proven unsuccessful.⁶² Evidence of inappropriate prescribing within the dental profession indicates that the facility is grossly underused.⁶³ Diagnostic microbiology laboratories could also assist more in resistance surveillance and in the development of local policies and guidelines.⁶⁴

Are we taking the problem seriously enough in dentistry?

Every year on November 18, European Antibiotic Awareness Day aims to increase knowledge among patients and healthcare professionals about antibiotic resistance.⁶⁵ The Thunderclap Initiative also coincides with this date to harness social media networks to help spread the message that 'infection needs drainage before considering antibiotics'.⁶⁶

It is critically important that the dental profession enforces antibiotic stewardship programmes.⁶⁷ Currently in Ireland, there are no national legislative

or regulatory mandates optimising the use of antibiotics through stewardship programmes. There is also no national surveillance system to determine the extent of resistance and to monitor the use of antibiotics.⁶⁸

With regard to patient compliance, the dental profession could show leadership by encouraging patients to return uncompleted antibiotic courses to them. Currently, government ministers have no official policy on this. More controlled disposal of antibiotics could prevent their release into the environment, where they may have deleterious effects on environmental microbes by selecting for more resistance. Perhaps in the future the Irish Dental Association could find a mechanism of destroying these unwanted antibiotics.

Antibiotic resistance is a real and imminent threat to the health and well-being of our nation and indeed the global community. Action is urgently needed to slow resistance by pledging to cut antibiotic overuse. As a profession we have a duty of care to follow the 'path of least resistance' in protecting this life-saving medicine.

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