Antimicrobial stewardship in dentistry

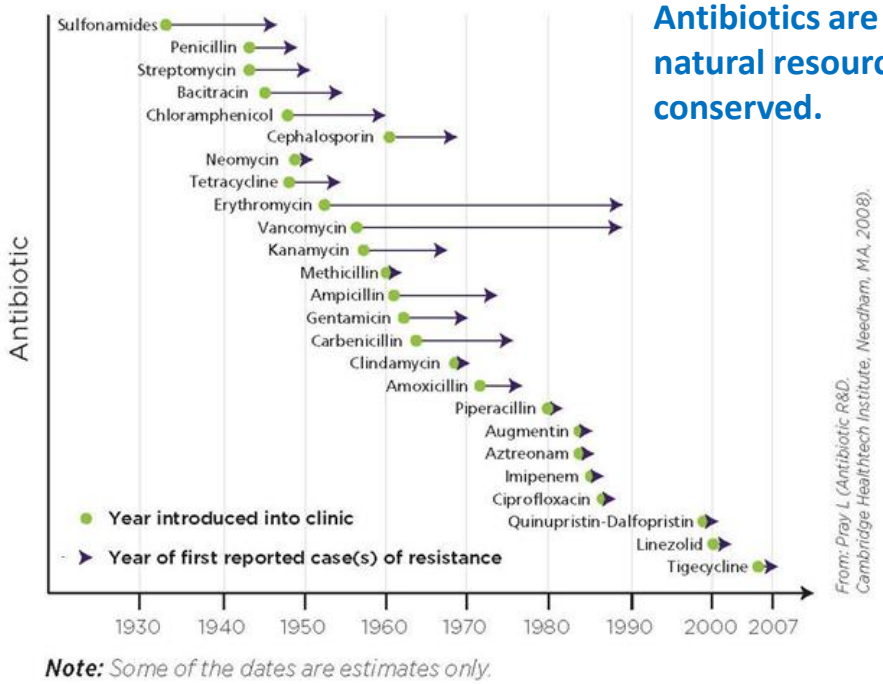
Emeritus Professor Laurence J. Walsh AO

Antimicrobial stewardship (AMS)

Coordinated interventions designed to improve the appropriate use of antimicrobials. Antimicrobial stewardship promotes the optimal use of antimicrobials through selecting the appropriate agent, dose, therapy duration and administration route.

Antimicrobial resistance (AMR)

Resistance of a microorganism to an antimicrobial drug that had previously been effective for treatment of infections by this organism. Resistant microorganisms including bacteria, fungi, viruses



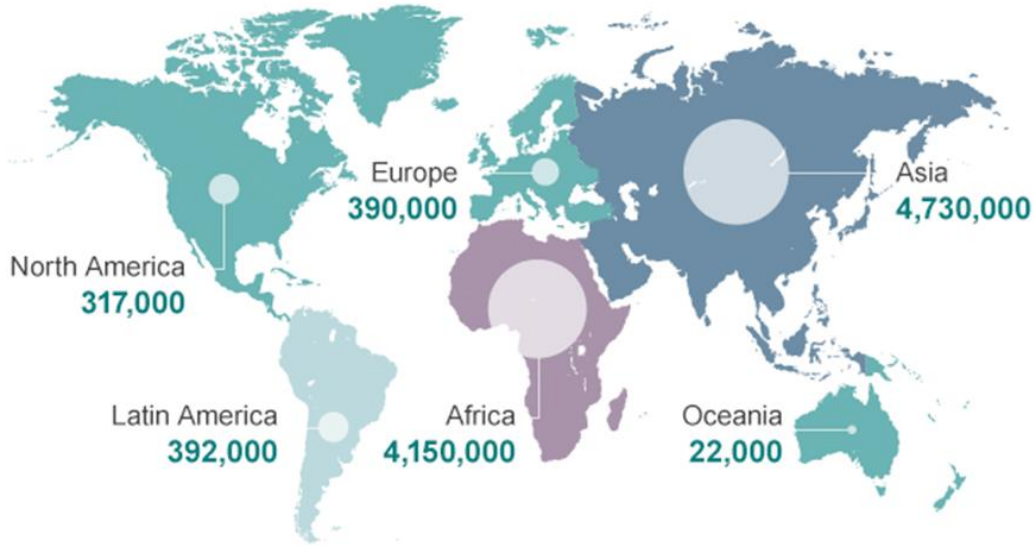
From: Pray L (Antibiotic R&D, Cambridge Healthtech Institute, Needham, MA, 2008).

Note: *Some of the dates are estimates only.*

Antibiotics are a precious and finite natural resource that should be conserved.

Alexander Fleming: penicillin

Deaths attributable to antimicrobial resistance every year by 2050



Source: Review on Antimicrobial Resistance 2014

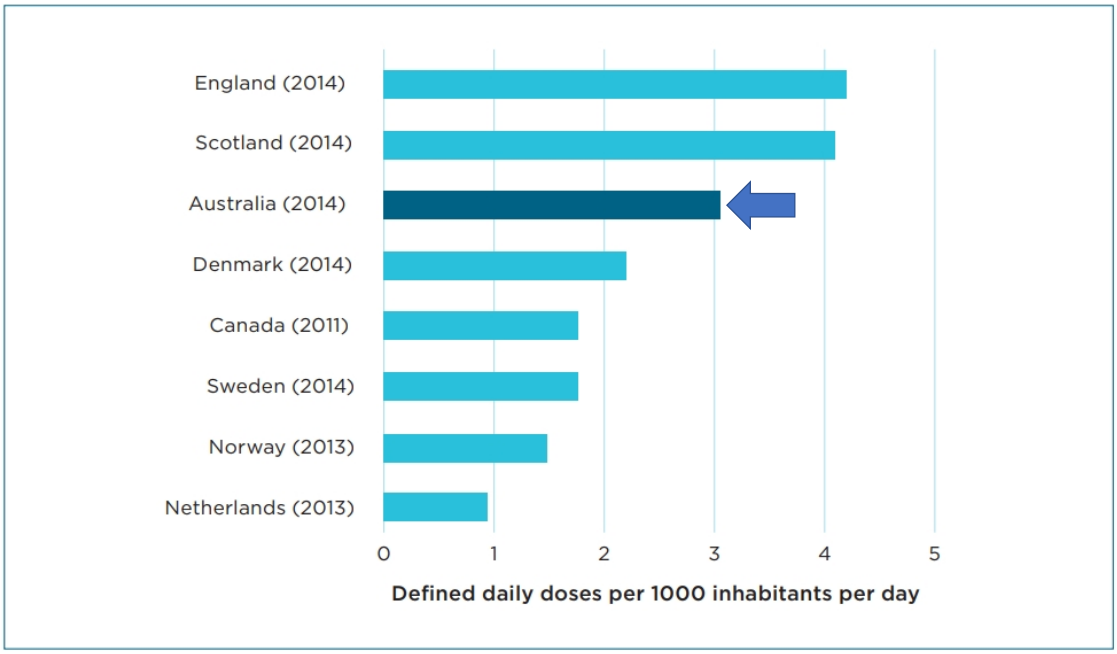
Australian Government
National Health and Medical Research Council
Australian Commission on Safety and Quality in Health Care

Australian Guidelines for the Prevention and Control of Infection in Healthcare

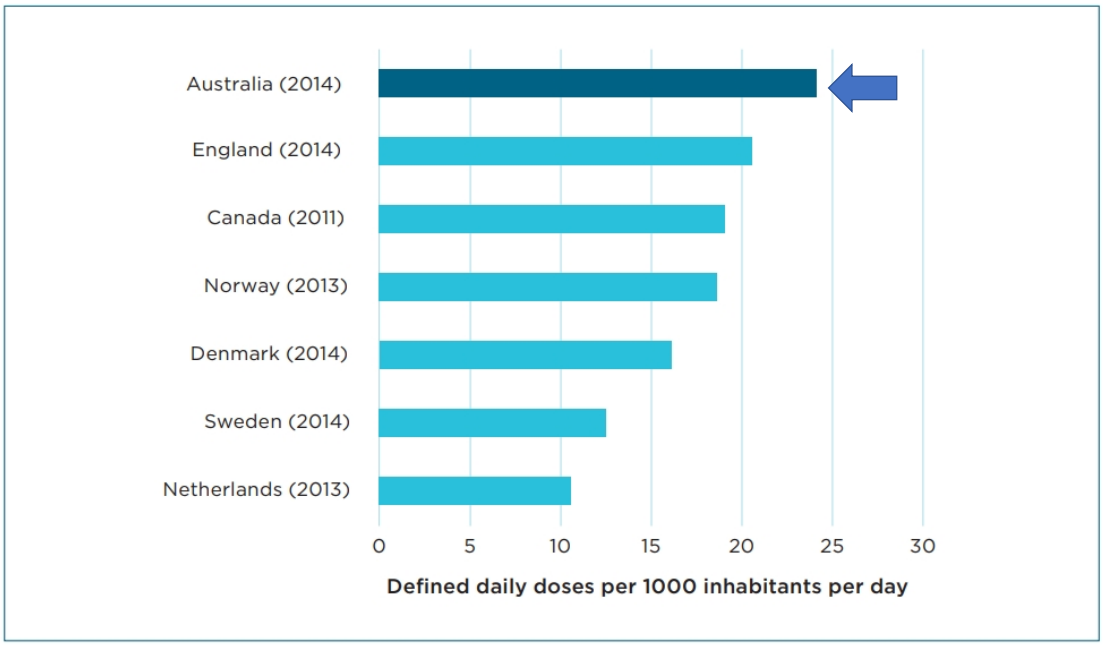
4.5 Antimicrobial Stewardship

Summary

- Resistance to antimicrobials is commonly found in Australian hospitals and increasingly so in the community. This resistance can have a significant impact on morbidity, mortality and treatment costs.
- A significant driver of antimicrobial resistance is the unnecessary or inappropriate use of antimicrobials. Around one third of all
- antimicrobial use in healthcare is unnecessary or inappropriately prescribed[376].



Antimicrobial use in Australian hospitals and other countries[376]



Antimicrobial use in the community in Australia and in other countries[376]

Australian Dental Journal
The official journal of the Australian Dental Association

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Trends in Australian dental prescribing of antibiotics: 2005–2016

LJ Walsh,* PJ Ford,* T McGuire,†,‡,§ M vanDriel,¶ SA Hollingworth†

*School of Dentistry, The University of Queensland, Brisbane, Qld, Australia.
†School of Pharmacy, The University of Queensland, Brisbane, Qld, Australia.
‡Faculty of Health Sciences and Medicine, Bond University, Gold Coast, Qld, Australia.
§Mater Pharmacy, Mater Health, South East Queensland, Brisbane, Qld, Australia.
¶Primary Care Clinical Unit, Faculty of Medicine, The University of Queensland, Brisbane, Qld, Australia.

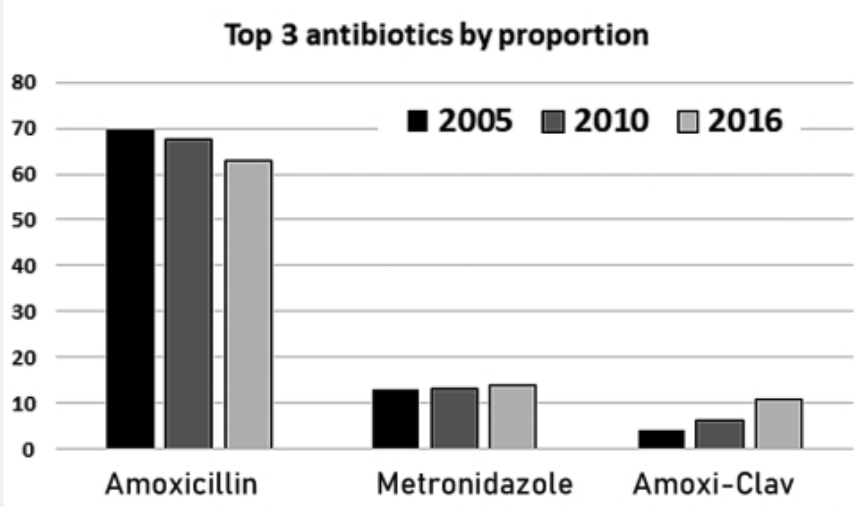

Fig. 4 Dispensed use (proportion of total prescribing for the top three as measured by defined daily doses per 1000 population per day) by Australian dentists for the three most commonly prescribed individual antibiotics (amoxi-clav – amoxicillin plus clavulanic acid) for 2005, 20010 and 2016.

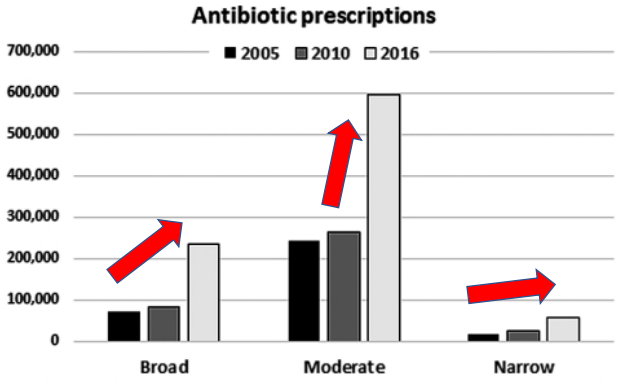

Fig. 1 Number of dental prescriptions of antibiotics by spectrum (broad, moderate and narrow) by year (2005, 2010 and 2016).

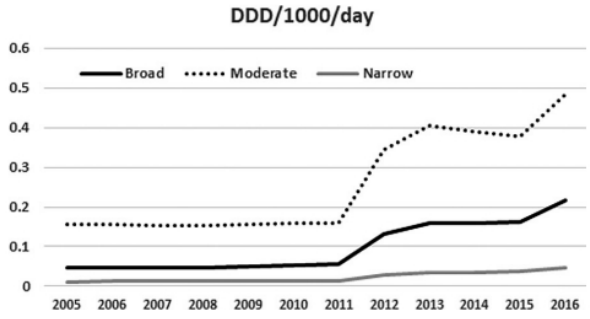

Fig. 2 Dispensed use (defined daily doses per 1000 population per day) of antibiotics by Australian dentists by spectrum (broad, moderate and narrow) between 2005 and 2016.

Acute infection: periapical abscess

Need physical treatments:

drainage of pus by removing the dental pulp (root canal treatment) or by extracting the tooth

ABT are **rarely** needed, and only are used when there has been systemic spread of infection and/or the host is immune compromised.

Key messages 1

- When **using antibiotics as an adjunct in managing dental infections**, the duration could just be 2 days or 3 days - after which time there is a review by the clinician (rather than "take until finished").
  - Taking antibiotics for longer than necessary, increases the risk of resistance. Hence, replace **prolonged** antibiotic courses by **short** courses.
  - A shorter course of antibiotics can be as effective as the long course from the past. Hence,replace **fixed duration courses** with **personalized duration** of antibiotic therapy.

AUSTRALIAN COMMISSION ON SAFETY AND QUALITY IN HEALTH CARE

Clinical Care Standards

Antimicrobial Stewardship

Clinical Care Standard

November 2020

AUSTRALIAN COMMISSION ON SAFETY AND QUALITY IN HEALTH CARE

Clinical Care Standards

2 Use of guidelines

What the standard says

When a patient is prescribed an antimicrobial, this is done in accordance with the current *Therapeutic Guidelines* or evidence-based, locally endorsed guidelines and the antimicrobial formulary.

What this means for you

Prescribe an antimicrobial according to the current *Therapeutic Guidelines* or locally endorsed guidelines including the appropriate:

- Active ingredient
- Dose
- Route of administration
- Formulation
- Frequency of administration
- Duration.

Prescribe, dispense and administer antimicrobials in line with local antimicrobial formularies and restrictions, where available, including those applied to broad-spectrum antimicrobials.

Consider the individual patient's characteristics, such as age, weight, renal function, allergies, other medicines prescribed and other health conditions.

7 Review of therapy

What the standard says

A patient prescribed an antimicrobial has regular clinical review of their therapy, with the frequency of review dependent on patient acuity and risk factors. The need for ongoing antimicrobial use, appropriate microbial spectrum of activity, dose, frequency and route of administration are assessed and adjusted accordingly. Investigation results are reviewed promptly when they are reported.

What this means for you

If antimicrobials are prescribed, review the patient's progress to assess whether ongoing treatment is needed. If the patient is on intravenous agents, consider oral options to reduce hospital-acquired infections. Ensure the antimicrobial agent and dose are appropriate for the site of the infection and patient parameters (such as renal function).

If microbiological tests are ordered, review the results within 24 hours of them being available, and use this information to consider whether changing or stopping antimicrobials is appropriate.

- **The "complete the course" message has persisted despite not being supported by evidence.**

thebmj

BMJ 2017;358:j3418 doi: 10.1136/bmj.j3418 (Published 2017 July 26)

ANALYSIS

Check for updates

The antibiotic course has had its day

With little evidence that failing to complete a prescribed antibiotic course contributes to antibiotic resistance, it's time for policy makers, educators, and doctors to drop this message, argue **Martin Llewelyn and colleagues**

Martin J Llewelyn *professor of infectious diseases*[1 2], Jennifer M Fitzpatrick *specialist registrar in infection*[2], Elizabeth Darwin *project manager*[3], SarahTonkin-Crine *health psychologist*[4], Cliff Gorton *retired building surveyor*[5], John Paul *consultant in microbiology*[6], Tim E A Peto *professor of infectious diseases*[7], Lucy Yardley *professor of health psychology*[8], Susan Hopkins *consultant in infectious diseases and microbiology*[9], Ann Sarah Walker *professor of medical statistics and epidemiology*[3]

[1]Department of Global Health and Infection, Brighton and Sussex Medical School, Falmer, BN1 9PS, UK; [2]Department of Microbiology and Infection, Brighton and Sussex University Hospitals NHS Trust, Brighton, UK ; [3]Nuffield Department of Medicine, University of Oxford, UK; [4]Nuffield Department of Primary Care Health Sciences, Oxford, UK; [5]Oxford, UK; [6]Public Health England, Royal Sussex County Hospital, Brighton, UK; [7]Oxford Biomedical Research Centre, Oxford, UK; [8]Faculty of Human and Social Sciences, University of Southampton, UK ; [9]Royal Free London NHS Foundation Trust, London, UK ; Correspondence to: M Llewelyn M.J.Llewelyn@bsms.ac.uk

The concept of a rigid antibiotic course ignores the fact that patients may respond differently to the same antibiotic, depending on diverse patient and disease factors.

In many situations, stopping antibiotics sooner **is a safe and effective way to reduce antibiotic overuse.**

Key messages 2

- It is not up to the patient to just decide **when to stop** taking their antibiotics.
- People must **not**
  - Use leftover antibiotics at home for self-medication without clinical evaluation.
  - Give their own antibiotics to friends/family without clinical evaluation.

  - *Why? Risks of adverse drug reactions, drug interactions, masking of underlying infectious processes, superinfection, and disruption of the microbiome*

What should happen

	MINDME
M	Microbiology guides therapy wherever possible
I	Indications should be evidence-based
N	Narrowest spectrum required
D	Dosage appropriate to the site and type of infection
M	Minimise duration of therapy
E	Ensure monotherapy in most situations

What actually happens !

Factors influencing decisions in primary health care to prescribe antimicrobials

Patient factors	Clinician factors	Contextual factors
Patient demand and expectations	Lack of knowledge about antimicrobial prescribing guidelines	Prescribing practices of peers and colleagues
Patient unwillingness or inability to receive definitive dental treatment	Diagnostic uncertainty about whether antimicrobials are indicated	Incentives
Perceived impact of antimicrobial refusal on patient satisfaction	Workload contributing to lack of time to provide definitive dental treatment	Health care context
Patient beliefs about positive impacts of antimicrobials on acute odontogenic pain	Concerns about medico-legal consequences of failure to prescribe	
Accessibility of dental care	Prescribing habits	
	Pressure from other clinicians (e.g., orthopaedic surgeons) to prescribe prophylactic antimicrobials when not clinically indicated	
	Concern about running late and impacts on patients who are waiting	

Challenge: Biofilms in protected sites <u>within teeth</u>

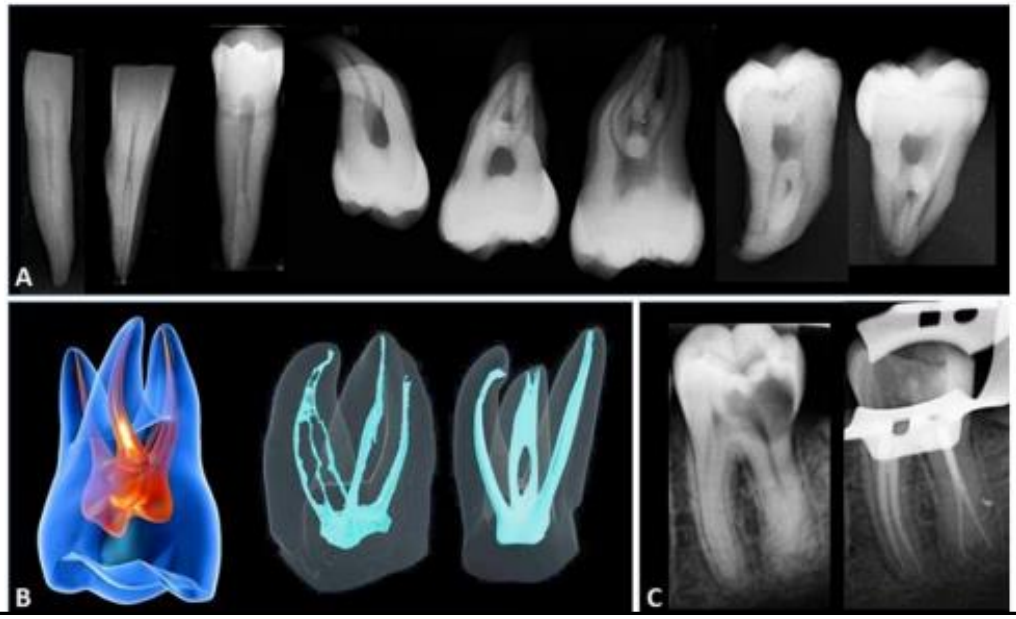

Table 1. The complex composition of endodontic biofilms.

Bacteria—summary • Over 400 different bacterial species have been identified in the root canal of teeth • Endodontic biofilms typically contain around 20 species, but can have many as 30 or more species of bacteria • The most frequent bacteria in endodontic biofilms belong to the phyla *Firmicutes, Proteobacteria, Spirochaetes, Bacteroidetes*, and *Actinobacteria*
Gram-positive bacteria • Common streptococci include *Streptococcus intermedius, S. constellatus* and *S. mutans*, and other facultative or microaerophilic streptococci • Common enterococci include *Enterococcus faecalis* • Gram-positive anaerobes include species belonging to the genera *Peptostreptococcus, Eubacterium*, and *Pseudoramibacter*
Gram-negative bacteria • Gram-negative anaerobic bacteria include species belonging to the genera *Fusobacterium, Porphyromonas, Prevotella*, and *Campylobacter*. • Commonly found Gram-negative bacteria include *Tannerella forsythia, Porphyromonas gingivalis, P. endodontalis, Prevotella intermedia, P. nigrescens, Fusobacterium periodonticum, F. nucleatum*, and *Eikenella corrodens* • Spirochaetes (treponemes) include *Treponema denticola, T. socranskii, T. maltophilum, T. lecithinolyticum, T. vincentii, T. pectinovorum, T. amylovorum*, and *T. medium*
Archaea, such as *Methanobrevibacter oralis* and *M. filiformis*.
Fungi, including *Candida albicans*

The use of calcium hydroxide, antibiotics and biocides as antimicrobial medicaments in endodontics

B Athanassiadis,* PV Abbott,* LJ Walsh†

Table 1. Antibiotic resistance in *Enterococci species*, based on several studies[41,121,122]

Antibiotic	Mechanisms of resistance	Type of resistance
β-Lactams (e.g., penicillins, carbapenems, cephlosporins)	(a) Overproduction of low-affinity penicillin binding proteins and/or decreased affinity for binding β-Lactams (NB: Intrinsic resistance to almost all cephalosporins)	Intrinsic
	(b) β-Lactamase production	Acquired
Tetracyclines	(a) Ribosomal protection systems (Tet L,Tet M, Tet O genes)	Acquired
	(b) Efflux pump	Acquired
Lincosamides (e.g., clindamycin)	(a) Low level	Intrinsic
	(b) High level (MLSb phenotype-methylation in 23S ribosomal RNA)	Acquired
Macrolides (e.g., eryhromycin, azithromycin, clarithromycin)	(a) MLSb phenotype	Acquired
	(b) Efflux pump	Acquired
Streptogramin B (e.g., quinupristin) **Streptogramin A** (e.g., dalfopristin)	MLSb phenotype (NB: Virtually all E. faecalis isolates are resistant)	Acquired Intrinsic
Aminoglycosides (e.g., gentamycin, streptomycin, kanamycin)	(a) Aminoglycoside modifying enzyme (NB: Not effective as monotherapy needs addition of penicillin)	Acquired
	(b) Low level (limiting transport of drug across cell membrane)	Intrinsic
Glycopeptides (e.g., vamcomycin, teicoplanin)	(a) Van A phenotype	Acquired
	(b) Van B phenotype (suseptible to teicoplanin)	Acquired
Fluroquinolones (e.g., moxifloxacin)	(a) DNA gyrase (topoisomerase II,IV)	Acquired
	(b) Efflux pump	Acquired
Chloramphenicol	(a) Chloramphenicol acetyltransferase enzyme	Acquired
	(b) Efflux pump (NB: 50% of enterococci are resistant to chloramphenicol)	Acquired
Trimethoprim and **Sulfamethoxazole**	Chromosomal mutations in gene encodes dihydrofolate reductase	Acquired

Table 6. COMPARISON OF ANTIBIOTIC SENSITIVITY PROFILE

Streptococcus viridans				*Staphylococcus* Species			
Antibiotic Resistance				Antibiotic Resistance			
2009-2014 (n = 45)		1997-2003 (n = 78)[7]		2009-2014 (n = 30)		1997-2003 (n = 24)[7]	
Antibiotic	Species Resistant, %	Antibiotic	Species Resistant, %	Antibiotic	Species Resistant, %	Antibiotic	Species Resistant, %
Penicillin	2	Penicillin	12.9	Penicillin	73	Penicillin	72.7
Clindamycin	32	Clindamycin	13.7	Oxacillin	27	—	—
Erythromycin	29	Erythromycin	16.6	Clindamycin	23	Clindamycin	10.5
Vancomycin	0	Vancomycin	0	Erythromycin	30	Erythromycin	25
				Tetracycline	4	—	—
				Trimethoprim	14	—	—
				Vancomycin	0	Vancomycin	0

Kim, Chuang, and August. Antibiotic Resistance in Orofacial Infections. J Oral Maxillofac Surg 2017.

Antibiotic Resistance in Severe Orofacial Infections

*Min Kyoung Kim, *Sung-Kiang Chuang, DMD, MD,† and Meredith August, DMD, MD‡*

Unnecessary use

antibiotics

MDPI

Review

Antibiotic Prophylaxis in Dental Implant Procedures in Patients with Orthopaedic Prostheses: A Systematic Review

Angel-Orión Salgado-Peralvo [1,2], Juan-Francisco Peña-Cardelles [2,3,4*], Naresh Kewalramani [2,5], Alvaro Garcia-Sanchez [6], María-Victoria Mateos-Moreno [7], Eugenio Velasco-Ortega [1,2], Iván Ortiz-García [1,2], Álvaro Jiménez-Guerra [1,2], Dániel Végh [8], Ignacio Pedrinaci[9,10] and Loreto Monsalve-Guil [1,2]

Unnecessary use

Australian Dental Journal
The official journal of the Australian Dental Association

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doi: 10.1111/adj.12535

2018

Is there a consensus on antibiotic usage for dental implant placement in healthy patients?

J Park,* M Tennant,† LJ Walsh,‡ E Kruger†

*School of Dentistry, The University of Western Australia, Perth, Western Australia, Australia.
†Department of Anatomy, Physiology and Human Biology, International Research Collaborative, Oral Health and Equity, The University of Western Australia, Perth, Western Australia, Australia.
‡School of Dentistry, The University of Queensland, Brisbane, Queensland, Australia.

ABSTRACT

This systematic review aimed to determine whether there is consensus for antibiotic prescription in healthy patients undergoing implant placement. A search of PubMed, Embase and Medline databases was conducted in January 2016 to find published journal articles on the use of antibiotics in implant placement, according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The inclusion criteria were prospective human clinical trials investigating antibiotic usage during implant placement. Fifteen studies were deemed suitable. In 13 studies, no statistical difference was found between antibiotic use and the incidence of prosthetic failure, implant failure and early postoperative infections. These were rated as having low to high risk bias. Contrary results were reported in two studies, both of which were rated as having a high potential for bias. In conclusion, antibiotic use in healthy patients for the prophylaxis of surgical infection associated with dental implant placement does not appear to improve clinical outcomes. Practitioners should apply principles of antimicrobial stewardship and not use antibiotics as a routine measure in healthy patients.

2019

antibiotics

MDPI

Review

Antibiotic Prophylaxis on Third Molar Extraction: Systematic Review of Recent Data

Gabriele Cervino [1], Marco Cicciù [1,*], Antonio Biondi [2], Salvatore Bocchieri [1], Alan Scott Herford [3], Luigi Laino [4] and Luca Fiorillo [1,4]

2018

medicina

MDPI

Article

A Systematic Review and Meta-Analysis Evaluating Antibiotic Prophylaxis in Dental Implants and Extraction Procedures

Amrik Singh Gill, Hana Morrissey and Ayesha Rahman *

Results: Seven randomised clinical trials (RCTs) were included in the final review comprising n = 1368 patients requiring either tooth extraction(s) or dental implant(s). No statistically significant evidence was found to support the routine use of prophylactic antibiotics in reducing the risk of implant failure (p = 0.09, RR 0.43; 95% CI 0.16–1.14) or post-operative complications (p = 0.47, RR: 0.74; 95% CI 0.34–1.65) under normal conditions. Approximately 33 patients undergoing dental implant surgery need to receive antibiotics in order to prevent one implant failure from occurring. *Conclusions:* There is little conclusive evidence to suggest the routine use of antibiotic prophylaxis for third molar extractive surgery in healthy young adults. There was no statistical evidence for adverse events experienced for antibiotics vs. placebo. Based on our analysis, even if financially feasible, clinicians must carefully consider the appropriate use of antibiotics in dental implants and extraction procedures due to the risk of allergic reactions and the development of microbial drug resistance.

antibiotics

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Article

Discrepancy in Therapeutic and Prophylactic Antibiotic Prescribing in General Dentists and Maxillofacial Specialists in Australia

Cheryl Chen *, Nicole Gilpin and Laurence Walsh

Faculty of Health and Behavioural Sciences, The University of Queensland School of Dentistry, UQ Oral Health Centre, 288 Herston Road, Herston, QLD 4006, Australia; n.v.gilpin@gmail.com (N.G.); l.walsh@uq.edu.au (L.W.)

* Correspondence: cheryl.chen@uq.net.au; Tel.: +61-458-988-627

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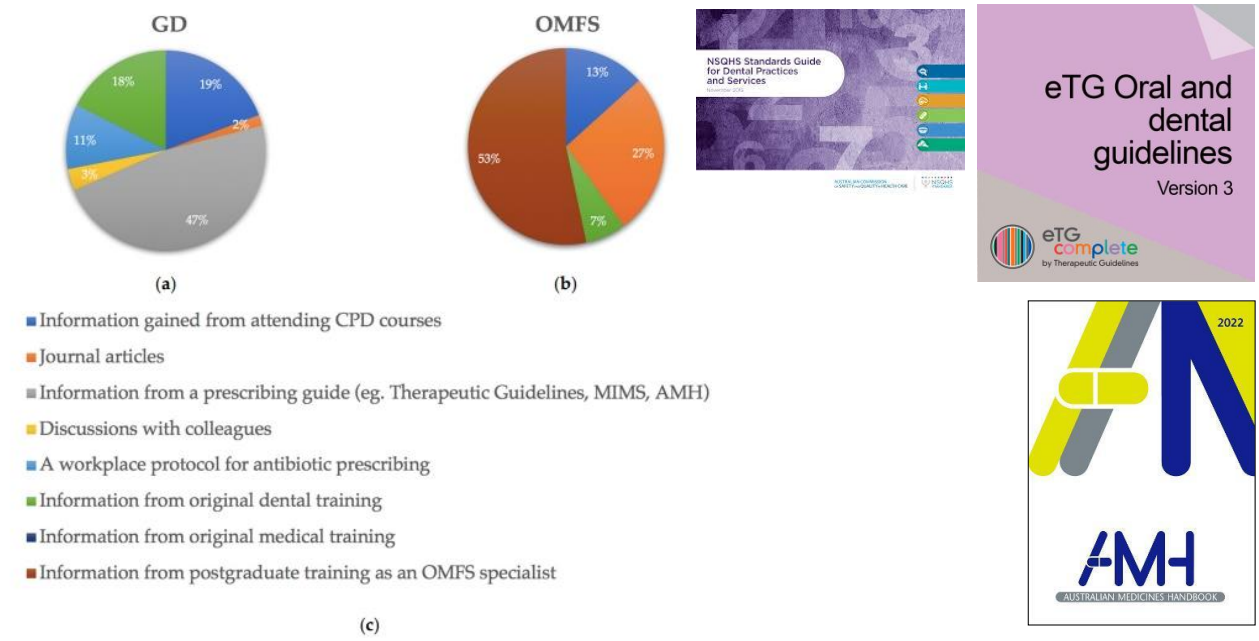
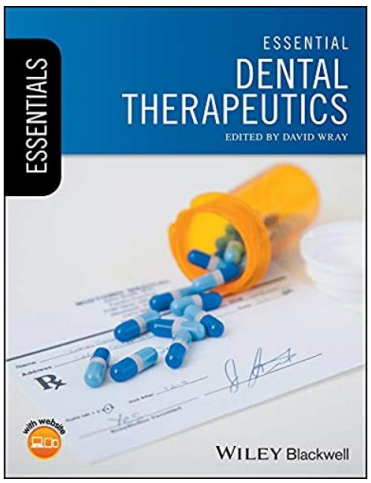
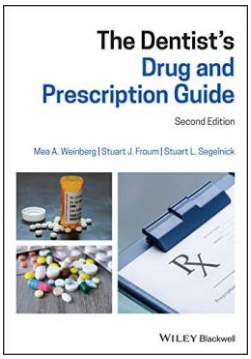
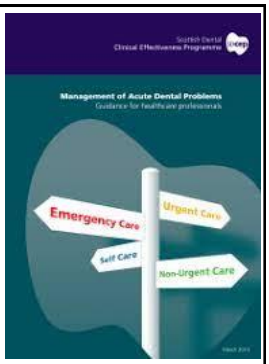


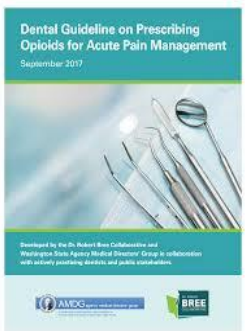
Figure 1. Most important factor or resource affecting practitioners' prescribing decisions. (**a**) GD group (n = 60); (**b**) OMFS group (n = 18); (**c**) Key.

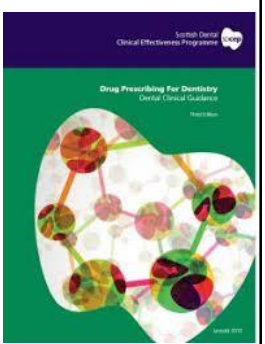
Information from overseas











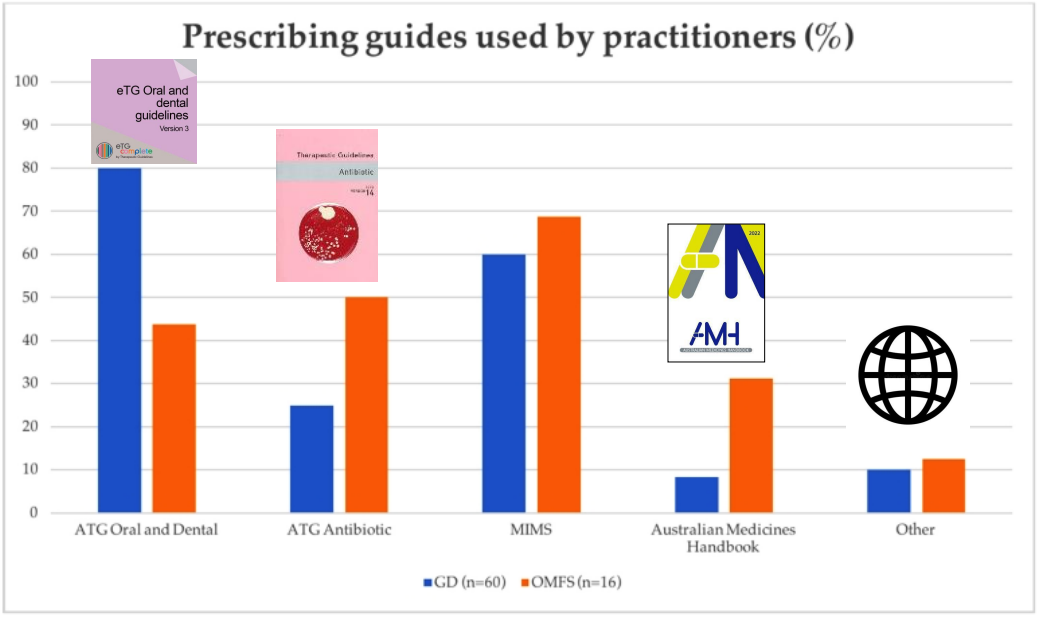


Figure 2. Percentage (%) use of prescribing guides within GD (n = 60) and OMFS (n = 16) groups.

Scenario 1 (Third molar surgical extraction): A healthy 19-year-old patient has been referred to you for extraction of 18, 28, 38, and 48. Imaging and intraoral examination reveals that the 18, 28, and 48 are all completely erupted into the oral cavity. The 38 is mesially impacted and only partially erupted, with a recent (but now resolved) episode of pericoronitis. The patient has no medical conditions and the planned surgical removal will be performed in two appointments under local anesthetic (LA) and sterile surgical conditions, starting with 28/38.

Scenario 2 (Single implant placement): You are going to place an implant to replace the 46 edentulous space in a healthy 45-year-old male patient. The 46 was extracted 6 months ago due to a vertical root fracture. There were no signs of infection at the time of extraction and there are no current signs of infection now. The planned procedure will be a two-stage tissue-level single implant and will involve raising a flap and bone removal. No block or particulate grafting is needed. The procedure will be performed under sterile surgical conditions.

Neither of these common situations warrants the use of antibiotics as surgical prophylaxis.

Table 4. Preferred antibiotic agent/s of practitioners who prescribed antibiotics [1].

Procedure	Respondent Type		Preferred Antibiotic Agent/s (%)				
			Amoxicillin Only	Phenoxymethylpenicillin Only	Cephalexin Only	Metronidazole Plus Amoxicillin	Amoxicillin/ Clavulanic Acid
Third molar surgical extraction	Total	$n = 23$	78.3	8.7	4.3	4.3	0.0
	GDs [1]	$n = 12$	75	8.3	0.0	8.3	0.0
	OMFSs	$n = 11$	81.8	9.1	9.2	0.0	0.0
Single implant placement	Total	$n = 31$	77.4	0.0	6.5	9.7	6.5
	GDs	$n = 18$	83.3	0.0	5.6	11.1	0.0
	OMFSs	$n = 13$	69.2	7.7	7.7	7.7	15.4

[1] One GD did not specify their preferred antibiotic agent in the third molar surgical extraction case scenario.

Table 5. Medical conditions for which practitioners provide antibiotic prophylaxis.

Medical History	Third Molar Surgical Extraction		Single Implant Placement	
	% of practitioners providing antibiotic prophylaxis			
	GDs ($n = 50$)	OMFSs ($n = 18$)	GDs ($n = 27$)	OMFSs ($n = 17$)
Patients on oral anticoagulants or platelet inhibitors	4.0	5.6	11.1	17.7
HIV positive	24.0 [1]	55.6 [1]	37.0	47.1
History of injecting drug use	8.0 [2]	38.9 [2]	14.8	41.2
Chronic hepatitis B or C	14.0	33.3	22.2	41.2
Uncontrolled diabetes mellitus	56.0 [3]	100.0 [3]	63.0 [2]	100.0 [2]
Cardiac valve replacement or mitral valve prolapse	92.0	83.3	85.2	88.2
Prosthetic joint in past two years	48.0	72.2	59.3	76.5
History of head and neck cancer and radiotherapy	48.0	55.6	48.2	64.7
Oral bisphosphonate therapy for the past three years	66.0	83.3	63.0	82.4
History of intravenous bisphosphonate therapy	68.0	88.9	55.6 [1]	88.2 [1]

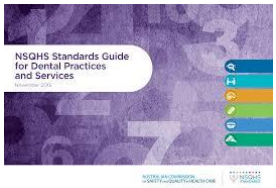
[1] Significant finding ($p < 0.05$). Calculated using Fisher's exact test. [2] Very significant finding ($p < 0.01$). Calculated using Fisher's exact test. [3] Extremely significant finding ($p < 0.001$). Calculated using Fisher's exact test.

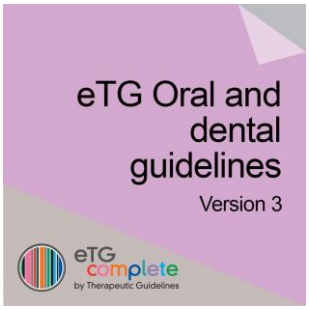
- Antimicrobial resistance (AMR) continues to be one of the greatest threats for our community and the overuse of antimicrobials is a significant contributor to AMR. Overprescribing and inappropriate prescribing of antimicrobials in the management of odontogenic complaints is well documented.

- Antimicrobial prescriptions by dentists are a significant contributor to the overall volume of antimicrobials dispensed to the Australian community each year.

- Dental practice has a crucial role to play in AMS to reduce inappropriate antimicrobial use and AMR in the community.

- AMS in dental practice encompasses multiple interventions, including:
  - Professional education for dentists
  - Increased use of prescribing guidelines in dental practice
  - Audit and individual clinician feedback on prescribing practices





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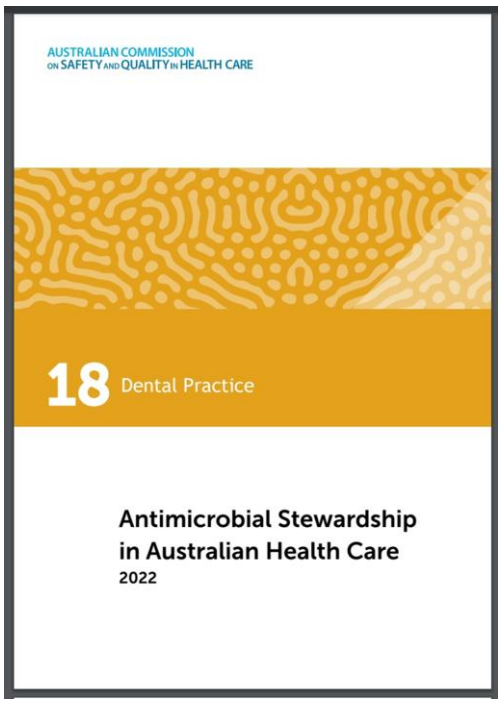
Chapter 18 published

https://www.safetyandquality.gov.au/publications-and-resources/resource-library/antimicrobial-stewardship-australian-health-care



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Approaches to overcome issues of antimicrobial resistance

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Review

Non-antibiotic antimicrobial agents to combat biofilm-forming bacteria

Yuxue Cao[a,b], Mahdi Naseri[c], Yan He[b,d,**], Chun Xu[b], Laurence J. Walsh[b], Zyta M. Ziora[e,*]

[a] School of Chemistry and Molecular Biosciences, The University of Queensland, QLD 4072, Australia
[b] School of Dentistry, The University of Queensland, QLD 4006, Australia
[c] Bioresource Processing Research Institute of Australia (BioPRIA), Department of Chemical Engineering, Monash University, VIC 3800, Australia
[d] Department of Oral and Maxillofacial Surgery, Massachusetts General Hospital and Harvard School of Dental Medicine, Boston, MA 02114, USA
[e] Institute for Molecular Bioscience, The University of Queensland, QLD 4072, Australia

Table 1
Anti-biofilm activities of silver and zinc oxide nanoparticles.

Agent	Bacteria	Anti-biofilm effect
Ag NP-based coating	*E. coli*	A layer of Ag NPs deposited on glass slides inhibited initial stages of biofilm formation [28]
Ag NPs (size 7–20 nm), colloid	*S. aureus*	Ag NPs (50 μg/mL) completely killed the bacteria in a 48h biofilm. [29]
Ag NPs (size 20 nm), colloid	*E. faecalis*	Ag NPs (30 μg/mL) gave a similar anti-biofilm effect as 2% chlorhexidine gluconate when tested against a bacterial biofilm growing on dentine of the root canal walls [30]
Curcumin with Ag NP (size 30 nm), colloid	*P. aeruginosa, S. aureus*	Nanoparticles (100 μg/mL) disrupted established bacterial biofilms [31]
$AgNO_3$ solution	*P. aeruginosa, E. coli*	$AgNO_3$ solution inhibited the growth of *P. aeruginosa* and *E. coli* biofilms (MIC of 62.5 μM and 125 μM, respectively) [32]
Ag NPs (35 nm), colloid	Methicillin-resistant coagulase-negative Staphylococci	Ag NPs (55 μg/mL) inhibited biofilm formation by 91% [33]
Ag NPs (30 nm), colloid	*P. aeruginosa*	AgNPs (18 μg/mL) completely prevented the biofilm development [34]
ZnO NPs (15 nm), colloid	*S. pneumoniae*	ZnO NPs (12 μg/mL) decreased biofilm formation by 50% [35].
ZnO NPs (50 nm), colloid	*B. subtilis*	ZnO NPs (5–10 ppm) inhibited the growth, protein expression and biofilm formation of *B. subtilis* [36]
ZnO NPs (20–50 nm in width and 20–100 nm in length) coated onto titanium used for a dental implant	Human saliva biofilm	ZnO NPs successfully inhibited the formation of biofilm for 96 h [37]
ZnO NPs (size 65 nm), colloid	*P. aeruginosa*	ZnO NPs (1 mmol/L) inhibited biofilm formation by 26–100%, elastase production (by 23–100%) and pyocyanin production (by 50–95%) in six clinical sub-strains of *P. aeruginosa* [38]
TiO_2 NPs (size 14 nm), colloid	*S. mitis*	TiO_2 NPs (100 μg/ml) killed 40–80% of biofilm bacteria when used as a topical oral hygiene agent (IC50 was 77 μg/mL for planktonic bacteria) [39]
TiO_2, colloid used to prevent oral diseases	*S. mutans*	TiO_2 (0.1 mg/mL) eliminated an *S. mutans* biofilm in 40 minutes under visible light [40]
TiO_2 NP-coated carbon film on medical implants	*S. aureus*	The coating inhibited biofilm formation [41]
TiO_2 NP coated titanium implants	Oral multi-species	The coating inhibited 99% of the oral biofilm growth after 16.5 h, compared with the commercially pure titanium [42]
TiO_2 NPs (size 40–100 nm), colloid	*Enterobacter* spp.	TiO_2 NPs at 700 μg/mL caused membrane damage to the outer layer of bacteria in the biofilm. Treatment at 1000 μg/mL dispersed the biofilm into small clumps [43]

Bacteria listed in this table include *Escherichia coli*; *Enterococcus faecalis*; *Pseudomonas aeruginosa*; *Staphylococcus aureus*; Methicillin-resistant *Staphylococcus aureus* (MRSA); *Acinetobacter baumannii*; *Bacillus subtilis*; *Streptococcus pneumoniae*; *Streptococcus mitis*; and *Streptococcus mutans*.

antibiotics

MDPI

Review

Novel Approaches to Detect and Treat Biofilms within the Root Canals of Teeth: A Review

Laurence J. Walsh

Faculty of Health and Behavioural Sciences, The University of Queensland School of Dentistry, UQ Oral Health Centre, 288 Herston Road, Herston, QLD 4006, Australia; l.walsh@uq.edu.au

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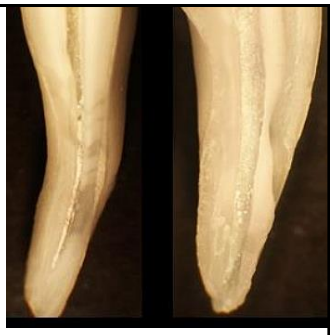
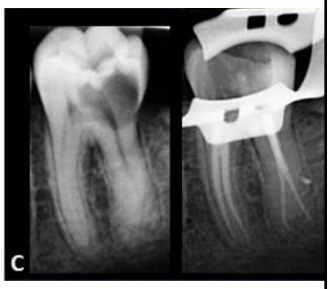
Abstract: Biofilms located within the root canals of teeth are a unique and pressing concern in dentistry and in medical microbiology. These multispecies biofilms, which include fungi as well as bacteria, form in a protected site with low shear stress and low oxygen tension. Systemic antibiotics are of limited value because of the lack of blood flow of the site, and issues with innate and acquired resistance. Physical disruption using hand or rotary powered instruments does not reach all locations in the root canal system where biofilms are present. Alternative strategies including agitated irrigation fluids, continuous chelation, materials with highly alkaline pH, and antimicrobial nanoparticles are being explored to meet the challenge. Detection and quantification of biofilms using fluorescence-based optical methods could provide an indication of successful biofilm removal and an endpoint for physical and chemical treatments.





Broad spectrum antibacterial and antifungal actions, no resistance

Australian Dental Journal Supplement 2007;52:(1 Suppl):S64-S82

The use of calcium hydroxide, antibiotics and biocides as antimicrobial medicaments in endodontics

B Athanassiadis,* PV Abbott,* LJ Walsh†

Abstract

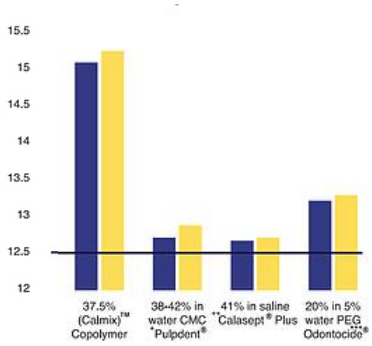
Bacteria have been implicated in the pathogenesis and progression of pulp and periapical diseases. The primary aim of endodontic treatment is to remove as many bacteria as possible from the root canal system and then to create an environment in which any remaining organisms cannot survive. This can only be achieved through the use of a combination of aseptic treatment techniques, chemomechanical preparation of the root canal, antimicrobial irrigating solutions and intracanal medicaments. The choice of which intracanal medicament to use is dependent on having an accurate diagnosis of the condition being treated, as well as a thorough knowledge of the type of organisms likely to be involved and their mechanisms of growth and survival. Since the

development of apical periodontitis associated with root-filled teeth, although studies have shown that the microflora differs in these teeth from that present when there has been pulp necrosis with infection.[5,6]

Bacteria can exist within the root canal itself, or within other related regions such as the dentinal tubules, accessory canals, canal ramifications, apical deltas, fins, and transverse anastomoses.[7] Apart from the canal itself, all of these other areas are inaccessible to mechanical instrumentation procedures and to the irrigating solutions used during endodontic treatment.

In order to predictably eliminate as many bacteria as possible from the entire root canal system, a combination of mechanical instrumentation and

Disclosure: Co-inventor.
AU, NZ and EU patents.



Better dissolution of Calcium Hydroxide ➡ Higher ionisation and pH achieved (Calmix recorded > 14)

High pH> high antimicrobial potential: effective against E.faecalis and C.albicans

Greater diffusion of hydroxyl ions ➡ Stimulates hard tissue formation

Contains Ziconium Dioxide ➡ Calmix is more radiopaque

Water free and no methyl cellulose ➡ will not dry out

Ergonomic syringes, capillary tips and microtips ➡ easy to use no manual mixing