



# Irreversible Pulpitis – A Source of Antibiotic Over-Prescription?

Anirudha Agnihotry<sup>1</sup>, Karanjot Singh Gill<sup>2</sup>, Richard G Stevenson III<sup>3</sup>, Zbys Fedorowicz<sup>4</sup>, Vijay Kumar<sup>5</sup>, Julie Sprakel<sup>6</sup>, Stephen Cohen<sup>7</sup>, Wendy Thompson<sup>8</sup>

Antibiotic resistance is a growing public health concern. Antibiotics continue to be prescribed by some clinicians to resolve dental pain even though research indicates that antibiotics are not effective for treating conditions such as irreversible pulpitis. The objective of this study was to determine the extent to which current research and evidence around irreversible pulpitis has been translated into dental practice and the gaps in dentists' knowledge. An on-line clinical vignette format survey questionnaire about treatment of irreversible pulpitis was distributed to the members of the Academy of Operative Dentistry and Academy of General Dentistry (US based international dental bodies). Their responses were recorded and evaluated. A total of 403 dentists participated in the survey. Over a third (39.3%) indicated they would prescribe antibiotics for symptomatic irreversible pulpitis in a permanent tooth occurring without any signs of systemic infection. The rest indicated they would not prescribe antibiotics; most of them would prescribe an analgesic combined with pulpectomy. Those who had undertaken advanced education training achieved a significantly higher mean knowledge score compared to those with just a primary dental degree ( $p=0.011$ ). Similarly, full or part time academicians had a higher mean knowledge score than the clinicians who work only in private practice ( $p=0.014$ ). Some dentists continue to prescribe antibiotics inappropriately for alleviating pain due to irreversible pulpitis. Antibiotic prescribing practices of dentists with advanced education or academic engagement were better as compared to the other participants. There is clear evidence of antibiotic over-prescribing for irreversible pulpitis which needs to be addressed urgently.

## Introduction

There is growing concern that the unnecessary prescribing of antibiotics by healthcare providers is contributing to the development of drug-resistant bacteria (1). Each year around two million drug-resistant infections cause 23,000 fatalities in the United States (2). It is estimated that the economic burden of antibiotic resistant infections (ARI) will increase beyond the burden of cancer and could result in significant mortality figures (3). A steadily increasing trend of excessive antibiotic prescription by dentists for treating endodontic and orofacial infections has been reported to show that bacterial isolates from these infections are getting resistant to commonly used antibiotics (4). In 2014, dentists in the United States wrote 25.7 million antibiotic prescriptions, according to data released by the Centers for Disease Control (5). It is imperative for patient safety that antibiotics are prescribed only when necessary to avoid exposing patients to the unnecessary risk from drug-resistant infections.

Evidence-based guidelines for the appropriate use of antibiotics in endodontic infections have been developed by the American Association of Endodontics and European Society of Endodontology (6,7). Clinical situations that

require antibiotic therapy on an empirical basis are limited and include oral infection with evidence of systemic spread such as lymphadenopathy and trismus. Although, there is sufficient evidence to support the consensus that antibiotic use does not alleviate pain in symptomatic irreversible pulpitis, it appears that a considerable number of dentists could still be prescribing antibiotics for this purpose (8,9). In non-traumatic dental emergencies, irreversible pulpitis has been documented as the main reason patients present with pain (10). Substandard prescribing practices by dentists, are reported to be associated with several factors ranging from inadequate knowledge to social factors (which are described as convenience and patients demanding antibiotic prescriptions) (11).

The key objective of this study was to determine the extent to which the current evidence around irreversible pulpitis has been translated into practice. An online survey was conducted to understand the prescribing habits reported by general dentists and to identify gaps in their knowledge.

## Material and Methods

An on-line clinical vignette style survey (Fig. 1) was developed and the study was certified exempt by the

<sup>1</sup>Family HealthCare Network, Porterville, CA, USA

<sup>2</sup>University of Detroit Mercy, School of Dentistry, Detroit, MI, USA

<sup>3</sup>Stevenson Dental Solutions, Inc, San Dimas, CA, USA

<sup>4</sup>Veritas Health Sciences Consultancy, London, UK

<sup>5</sup>Public Health Dentistry MDS 2018, Government Dental College and Research Institute, Victoria Hospital, Near City Market, Kalasipalayam, Bengaluru, Karnataka, India

<sup>6</sup>Department of Gynecology and Obstetrics Ribeirao Preto Medical School, USP – Universidade de São Paulo, SP, Brazil

<sup>7</sup>Arthur A Dugoni School of Dentistry, University of the Pacific, San Francisco, CA, USA

<sup>8</sup>University of Leeds, Worsley Building, Clarendon Way, Leeds, UK

Correspondence: Anirudha Agnihotry, 1711 W Henderson Ave Porterville CA 93257 USA. e-mail: anirudha.agnihotry@gmail.com

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Institutional Review Board at the University of California, Los Angeles (IRB #16-000500). The survey consisted of a single question with six possible treatment options, two of which provided a preference for prescribing of antibiotics for irreversible pulpitis. Survey participants consisted of members of the Academy of General Dentistry (AGD) and the Academy of Operative Dentistry (AOD). The participants were a sample of: general dentists (predominantly from

United States but a global sample); dentists in military/public health services, Indian Health Service (for American Indians and Alaska Natives) and other health services; dentists not currently practicing clinical dentistry; prosthodontists from private practice; postdoctoral residents in Prosthodontics, Advanced Education in General Dentistry, and General Practice residency who are members of the Academy of Operative Dentistry (AOD) or Academy of General Dentistry

## Pulpitis Survey

### Specialty

- General Practitioner
- Prosthodontist

### Practice Arrangement

- Private Practice
- Full-time Academics with clinical practice
- Full-time Academics without clinical practice
- Private Practice and Part-time Academics
- Not currently practicing clinical dentistry
- Military/Public Health Services/Indian Health Services
- Other: \_\_\_\_\_

### Highest Level of Dental Training

- Advanced Education in General Dentistry (AEGD)/ General Practice Residency (GPR) - 1 year
- Advanced Education in General Dentistry (AEGD)/ General Practice Residency (GPR) - 2 years
- Operative Dentistry Graduate Program (2-3 years)
- Prosthodontics Residency
- BDS/DDS/DMD
- Resident Student - AEGD/GPR/Operative Dentistry Graduate Program/Prosthodontics
- Student - BDS/DDS/DMD

### Are you an American Board of Operative Dentistry certified dentist?

- Yes
- No

### Number of years after graduation (primary qualification: DDS/BDS).

For irreversible pulpitis in a permanent tooth, with vital pulp confirmed by the standard tests, and without any evidence of soft tissue swelling do you:

Select ONE only

- Immediately prescribe antibiotics and schedule for root canal treatment later
- Immediately prescribe analgesics and schedule for root canal treatment later
- Immediately prescribe both antibiotics and analgesics and schedule for root canal treatment later
- Prescribe analgesic and perform concurrent pulpectomy
- Prescribe antibiotic and perform concurrent pulpectomy
- Prescribe both antibiotic and analgesic; and perform concurrent pulpectomy

Location: (City, State, Country)

Figure 1. On-line clinical vignette style survey developed for the study.

(AGD); academics (full or part-time, with or without clinical practice). All the participants were asked to indicate their highest level of dental training and their number of years of experience in the field of dentistry, but their identities were kept anonymous.

A link to the survey questionnaire was distributed via direct email for AOD members and via the weekly online newsletter, "AGDinAction" sent through 'news@agd.org' for AGD members: [https://docs.google.com/forms/d/e/1FAIpQLSf0n\\_NNDqqOHwlvYrJRD8x-PsZR3\\_buPGH6VDV2vuAl7r9wbA/viewform](https://docs.google.com/forms/d/e/1FAIpQLSf0n_NNDqqOHwlvYrJRD8x-PsZR3_buPGH6VDV2vuAl7r9wbA/viewform). It was circulated to AGD participants on two occasions (June 15th, 2016 and July 13th, 2016) using the web resources of AGD. The responses were registered, imported into Microsoft Excel and further analyzed.

## Results

A total of 403 participants contributed to the survey. Among these, 388 (96.3%) were general dentists and 15 (3.7%) were prosthodontists. Just over half of the participants (54.5%) were working towards or had only achieved a primary dental degree (BDS/DDS/DMD); the rest were in or had achieved some form of advanced training program [Advanced Education in General Dentistry (AEGD), General Practice Residency (GPR), Operative Dentistry Graduate Program or Prosthodontics Residency] (Fig. 2). A total of 262 (65%) worked in private practice followed by 64 (15.9%), who were full-time academics with clinical practice. Thirty-six (8.9%) of the study participants were certified by the American Board of Operative Dentistry. The mean duration of clinical practice for all participants was  $22.14 \pm 14.1$  years.

A total of 244 (60.7%) of the study participants would not prescribe antibiotics for irreversible pulpitis in a permanent tooth, with vital pulp confirmed by the standard tests, and without any evidence of soft-tissue swelling. The majority of these participants (56.3%) would prescribe analgesics and perform concurrent pulpectomy. A small minority (4.2%) would prescribe analgesics immediately and schedule

a root canal treatment for a later time.

In the present study, 39.3% of the participants reported they would prescribe antibiotics for irreversible pulpitis affecting a permanent tooth without any signs of systemic infection. There was no significant difference in mean knowledge score based on number of years of clinical practice ( $p=0.66$ ), although there was a trend towards reducing knowledge scores with increasing number of years in practice (Fig. 3). When participants were categorized on the basis of their level of dental training, those who had 1 or 2 years of advanced training (AEGD or GPR) had a significantly higher mean knowledge score compared to those with primary qualifications (BDS/DDS/DMD). ( $p=0.011$ ). Participants with an academic element to their role (those in full-time academia with a clinical practice, full-time academics without a clinical practice or part-time academics with a private practice) had a significantly higher mean knowledge score than private practitioners ( $p=0.014$ ).

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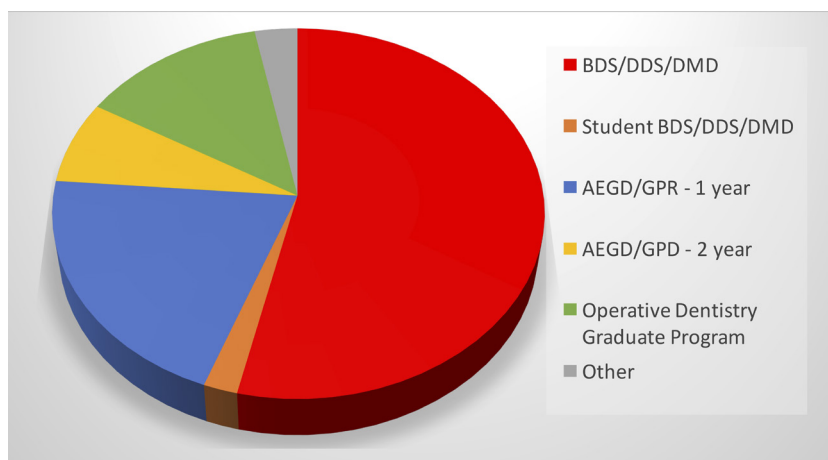


Figure 2. Highest dental education of the participants.

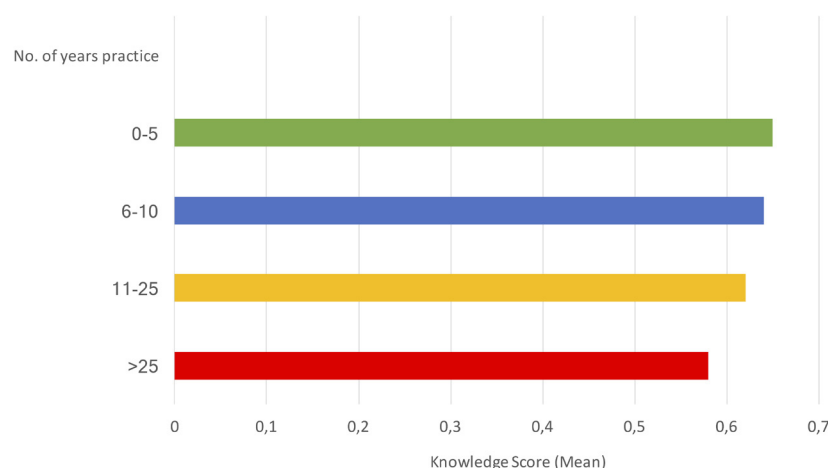


Figure 3. Mean knowledge score and years of practice of dentistry of the participants.

## Discussion

There is sufficient evidence to show that antibiotics are largely ineffective in controlling pain due to irreversible pulpitis (8). However, over a third of dentists participating in our survey chose to prescribe antibiotics. Our findings concur with a report from Saudi Arabia, where 42% of dentists prescribed antibiotics (12) and the Spanish Endodontic Society which reported a figure of 40% in 2008 (13). A survey in 2016 by the American Association of Endodontics found that 8.1% of its members would prescribe antibiotics for irreversible pulpitis (14). Similarly, a Welsh national audit of antibiotic prescribing published in 2016 found that 5% of all antibiotics prescribed by general dentists during the audit period were for irreversible pulpitis (15). These figures show a clear and unmistakable trend of over-prescription for irreversible pulpitis at the global level.

### Education

The number of years of experience post-graduation showed little effect on the prescribing habits reported by dentists. In spite of the shift towards an evidence-based approach in dentistry and with the availability of clinical practice guidelines, this illustrates that irrespective of when dental clinicians graduated (and by inference what they were taught at dental school) there appears to be little difference in the approach to prescribing for irreversible pulpitis. Courses delivered as CE/CPD could provide the dentists with an understanding of the harmful effects of antibiotic over-prescription and educate them about the evidence-based guidelines on when to prescribe antibiotics. Given the high profile and patient safety risks associated with the over-prescription of antibiotics, it would be prudent for dental regulatory authorities to consider introducing a minimum requirement of CE/CPD credits in relation to antibiotic prescription in dentistry (16).

General dental practitioners with advanced training (AEGD or GPR) prescribed antibiotics less frequently than general dental practitioners with just a primary dental degree (BDS/DDS/DMD). These dentists could provide advocacy and be role models of optimal antibiotic prescribing for less highly qualified colleagues working in practice. As trusted colleagues of other general dentists, they could also be ideally placed to deliver the CE/CPD courses identified above.

### Academic Role

Another area with potential for future targeting in order to reduce overprescribing is the finding that dentists working in an academic environment (either part-time, or full time) were less likely to prescribe antibiotics for irreversible pulpitis than general dental practitioners working exclusively in a private practice setting. This

suggests that spending time in an academic environment might help instill more optimal antibiotic prescription practices. Encouraging more general dentists to spend time working at least part-time in academia may be an effective way of improving knowledge about (and hence reducing overprescribing of) antibiotics. Whether a similar pattern could be seen in relation to other guidelines/issues would be an interesting area for further research.

### Difficulty Achieving Anesthesia

One further interesting element of the survey which was raised by some of the responders in personal correspondence to the survey authors was failure to achieve anesthesia of a 'hot tooth'. Around half of patients diagnosed with irreversible pulpitis have been reported as difficult to anesthetize (17,18). This was referred to in the survey as 'hot tooth'. A condition which arises as a result of inflammation, and with local changes occurring in the nerve tissue causing heightened response to stimuli such as for example hot or cold (19). In these cases, the traditional methods of local anesthesia may be less than effective. Many methods have been advocated to increase the chances of success of anesthesia for this condition, such as intra-bony anesthetic injections, nitrous oxide sedation, using high concentrations of long acting anesthesia, using corticosteroids; but reinjection improves success rates to level of 92%-96% (20-26). In these 'hot tooth' clinical situations, some dentists appear to confuse inflammation with infection, and inappropriately prescribe antibiotics. Evidence-based guidance on the optimal analgesic routine for use by general dentists to treat teeth with irreversible pulpitis during urgent appointments could be a helpful way of reducing the over-prescription of antibiotics.

### Dental Antibiotic Stewardship

Governments around the world are setting out their antibiotic stewardship plan to address the risk of drug-resistant infections by reducing the overprescribing of antibiotics, including in outpatient settings (27,28). In response, national dental bodies, faculties and associations (such as the American Dental Association (ADA)) have pledged to improve the dental prescribing practices, including by providing evidence-based recommendations and systematic reviews (28-30). Our findings suggest that irreversible pulpitis is a condition which should be explicitly included in approaches to dental antibiotic stewardship.

Guidelines alone, however, are unlikely to be the answer to reducing overprescribing (31). There is evidence that audit and feedback of an individual's prescribing practice against guidelines can be effective at optimizing their prescribing. A good example of this is the Scottish 'Reducing Antibiotic Prescribing in Dentistry' (RAPiD) trial. The results of this

trial illustrated that using routinely collected national data to provide feedback to primary care dentists resulted in a significant reduction in antibiotic prescribing rates, with the highest prescribers showing the greatest reduction in their prescribing rate (32). Similarly, in the US, the Centers for Medicare & Medicaid Services (CMS) Antibiotic Stewardship program has instituted the provision of added incentives for clinicians to optimize their prescribing through a quality based payment program: Merit-based Incentive Payment System (MIPS) (33). CMS Antibiotic Stewardship to improve prescription behaviors for certain high-priority conditions is one of the elements of this program.

### Limitation of the Study

A limitation of the study is the low response rate. This is fairly typical of surveys of health professionals and has been further reinforced by response rates showing a decrease over recent years (34). Although the response rate recorded for this survey was less than 2% of all the members of AGD, it is unclear how many of its members read the online newsletter which included details about participating in the survey. Thus, we cannot be precise about the percentage of people who read but chose not to respond to the survey. Exploration of how to use electronic media to best effect, including increasing reach as well as response rates from members of the dental team, is identified as an area ripe for future research.

### Antibiotic Over Prescription Across Healthcare

Antibiotic over prescription all across healthcare has been a challenge. Amongst a group of inpatient physicians, it was found that over prescription was largely due to anxiety of missing an infection, whereas potential adverse effects of antibiotics had no strong influence over decision making. (35). It has been seen as an issue with urinary tract infections (36) and respiratory tract infections (37) very commonly. Interestingly, antibiotic prescriptions for childhood infections in primary care often result from "just in case" prescribing while the physicians mentioned social pressure from the parents as a cause for prescribing, even though, they were concerned about adverse effects and resistance of the antibiotics. (38). Some parallels can be drawn here with dental over prescription.

A significant proportion of general dentists overprescribe antibiotics for irreversible pulpitis. Whilst a dentist's number of years of experience showed no statistically significant difference on his or her reported antibiotic prescription behavior, there was a trend towards increased over-prescribing with increasing years in practice. Those dentists who have an academic element to their role and/or those having undertaken advanced training post-graduation reported prescribing antibiotics less frequently. It is

suggested that irreversible pulpitis should be included as a key condition to be addressed within dental antibiotic stewardship programs (including training, guideline development and other interventions).

## Resumo

A resistência aos antibióticos é uma preocupação crescente para a saúde pública. Os antibióticos continuam a ser prescritos por alguns dentistas para resolver a dor dentária, embora pesquisas indiquem que os antibióticos não são eficazes no tratamento de condições como a pulpite irreversível. O objetivo deste estudo foi determinar em que medida as pesquisas atuais e as evidências em torno da pulpite irreversível foram traduzidas em prática odontológica e as lacunas existentes no conhecimento dos dentistas. Um questionário de pesquisa em formato de vinheta clínica on-line sobre o tratamento da pulpite irreversível foi distribuído para os membros da Academia de Odontologia Operatória e da Academia de Odontologia Geral (órgãos dentários internacionais dos EUA). Suas respostas foram registradas e avaliadas. Um total de 403 dentistas participou da pesquisa. Mais de um terço (39,3%) indicaram que prescreveriam antibióticos para pulpite irreversível sintomática em um dente permanente sem qualquer sinal de infecção sistêmica. O restante respondeu que eles não prescreveriam antibióticos; a maioria deles prescreveria um analgésico combinado com pulpectomia. Aqueles que realizaram o treinamento de educação avançada obtiveram uma pontuação de conhecimento médio significativamente maior em comparação com aqueles com apenas um grau primário de conhecimento odontológico ( $p=0,011$ ). Da mesma forma, acadêmicos em tempo integral ou parcial tiveram uma pontuação média de conhecimento maior do que os clínicos que trabalham apenas em consultório particular ( $p=0,014$ ). Alguns dentistas continuam a prescrever antibióticos inadequadamente para aliviar a dor decorrente de pulpite irreversível. Práticas de prescrição de antibióticos por dentistas com educação avançada ou envolvimento acadêmico foram melhores em comparação com os outros participantes. Há evidências claras de excesso de prescrição de antibiótico para pulpite irreversível que precisa ser tratada com urgência.

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