Antimicrobial prescribing by dentists in Wales, UK: findings of the first cycle of a clinical audit

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In brief

Highlights that antimicrobial resistance threatens the effective prevention and treatment of an ever-increasing range of infections and is therefore a major public health concern.

Suggests the judicious use of antimicrobials by all prescribers, including dentists, is therefore a vital step in stemming the emergence and spread of resistance.

Proposes that clinical audit is a way by which dental practitioners can assess their compliance with latest evidence based guidelines on antimicrobial prescribing

Objective To describe the findings of the first cycle of a clinical audit of antimicrobial use by general dental practitioners (GDPs). **Setting** General dental practices in Wales, UK. **Subjects and methods** Between April 2012 and March 2015, 279 GDPs completed the audit. Anonymous information about patients prescribed antimicrobials was recorded. Clinical information about the presentation and management of patients was compared to clinical guidelines published by the Scottish Dental Clinical Effectiveness Programme (SDCEP). **Results** During the data collection period, 5,782 antimicrobials were prescribed in clinical encounters with 5,460 patients. Of these 95.3% were antibiotic preparations, 2.7% were antifungal agents, and 0.6% were antivirals. Of all patients prescribed antibiotics, only 37.2% had signs of spreading infection or systemic involvement recorded, and 31.2% received no dental treatment. In total, 79.2% of antibiotic, 69.4% of antifungal, and 57.6% of antiviral preparations met audit standards for dose, frequency, and duration. GDPs identified that failure of previous local measures, patient unwillingness or inability to receive treatment, patient demand, time pressures, and patients' medical history may influence their prescribing behaviours. **Conclusions** The findings of the audit indicate a need for interventions to support GDPs so that they may make sustainable improvements to their antimicrobial prescribing practices.

Introduction

Antimicrobial resistance represents a serious threat to public health. Many medical and surgical treatments that we take for granted are contingent on the ability to effectively prevent and treat infections. However, as existing antimicrobials are increasingly rendered ineffective by the growing prevalence of resistant strains, even common infections may become more difficult to treat, potentially resulting in excess morbidity and mortality.[1] The scale of the problem is such that the World Health Organisation, European Commission, bodies such as the National Institute for Health and Care Excellence, and many governments worldwide have produced strategies to address the problem of resistance.[2–5] A key feature of all such policies is the need to conserve the effectiveness of existing antimicrobials through stewardship.[2–5] This will ensure that these drugs are used only when they are likely to result in clinical benefit and, when they are required, they are prescribed at the correct dose, frequency, and for an appropriate duration.

In 2014, dentists in England prescribed 3.7 million antimicrobial preparations.[6] In total, over 99% of these were systemic antibiotics, while antifungals and antivirals together accounted for the remaining 1%.[7] Within dental practice in the UK, most antibiotics are prescribed for the management of acute dental conditions such as acute apical abscesses or periodontal infections.[8,9] However, clinical guidelines, such as those produced by the Scottish Dental Clinical Effectiveness Programme (SDCEP), advise that the first step in the treatment of such conditions should be local measures such as exodontia, pulpectomy, or incision and drainage of a swelling, and that antibiotics should be used only where there is spreading infection, systemic involvement, or persistent swelling despite local treatment.[10] Furthermore, guidelines recommend that antibiotics should be prescribed in conjunction with, not instead of, local measures.

While antibiotics play an essential role in the treatment of spreading dentoalveolar infections, there is evidence that some general dental practitioners (GDPs) prescribe antimicrobials when they are not indicated, such as in the management of irreversible pulpitis or alveolar osteitis (dry socket).[11,12] Antibiotics prescribed for such conditions are unlikely to provide additional benefit over local treatments yet carry the risk that, following administration, the patient will harbour residual resistant bacteria.[13] In addition, antibiotics provided

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inappropriately unnecessarily expose patients to the risk of adverse events such as hypersensitivity reaction or Clostridium difficile-associated disease.[14] There are also reports that many of the antibiotic courses prescribed by dentists are at doses, frequencies or durations that fall outside clinical guidelines.[9,15] Of particular concern are long courses of antibiotics (≥7 days), as these increase the likelihood of resistance developing while conferring no additional clinical benefit.[13,16]

Previous clinical audits have resulted in a reduction of both the number of errors made by GDPs when prescribing, as well as the number of antibiotics issued inappropriately.[8,9] The aim of this paper was to describe the findings of the first cycle of a clinical audit of antimicrobial use by GDPs in Wales, UK. The specific objectives were to:

- Describe the use of antibiotics, antifungal, and antiviral preparations by GDPs
- Describe the use of surgical and non-surgical local measures by GDPs in instances where antimicrobials are prescribed
- Examine the extent to which dose, frequency, and duration of antimicrobials prescribed conformed to SDCEP guidelines
- Explore factors that may contribute to a patient being prescribed an antimicrobial for a dental condition.

Materials and methods

Participants

All GDPs (n = 1,696) working in Wales were eligible to participate.[17] Dental practices were informed of the audit via postal flyers, online advertisements on the Wales Deanery (PGMDE) website, and via a newsletter. All GDPs within a practice were encouraged to register at the same time so that they could later discuss their results in peer-review or practice meetings.

Audit

The audit was developed by the Wales Deanery (PGMDE), Cardiff University in collaboration with 1000 Lives Service Improvement. The latter is a national healthcare improvement programme incorporated into Public Health Wales and supported by the Welsh Government. The audit was designed in line with 1000 Lives Improvement's Improvement Methodology,[18] and its aims were: to support the most effective clinical use of antimicrobials, and to reduce the number of unnecessary prescriptions in general dental practice in Wales. During the audit, GDPs were supported by staff and audit tutors from the Wales Deanery.

Data collection

After registration, participants were sent an audit pack via email. This included: completion instructions; a printable data collection form; a link to an online data collection form; and a summary of recommendations made by the SDCEP '*Drug prescribing in dentistry: Dental clinical guidance*' (2nd edition).[10] Practitioners were advised that the full version of this guidance could be accessed online or via a mobile application.

Enrolled GDPs recorded information about 20 consecutive patients, of any age, who they prescribed an antimicrobial to, after treating them according to their usual practice. The forms recorded information, regarding: patient age; clinical diagnosis; reasons for prescribing (signs and symptoms); interventions made in addition to prescribing; additional observations (for example, time pressures, patient demand for antimicrobials), and the type, dose, frequency and duration of the antimicrobial prescribed. GDPs completed one hard-copy form and one online form per patient, and there was a facility to record multiple antimicrobials, if required. The hard-copy form was retained by the practitioner for reflective purposes.

Following data collection, practices were provided with anonymised feedback on their prescribing activities, collated from their online submissions. Enrolled practitioners were asked to reflect on their practice's prescribing activity – either individually, or

Table 1 Types of antimicrobials prescribed by GDPs in Wales

Antimicrobial	Frequency (n = 5,782)	Proportion of all antimicrobials (%)
Antibiotics	5,508	95.30%
Amoxicillin	3,246	56.1
Metronidazole	1,812	31.3
Erythromycin	253	4.4
Phenoxymethylpenicillin	81	1.4
Clindamycin	33	0.6
Co-amoxiclav	21	0.4
Cefalexin	19	0.3
Doxycycline	18	0.3
Ampicillin	9	0.2
Sodium fusidate	4	0.1
Azithromycin	3	0.1
Clarithromycin	3	0.1
Tetracycline	3	0.1
Oxytetracycline	2	<0.1
Cefradine	1	<0.1
Antifungals	157	2.70%
Miconazole	106	1.8
Fluconazole	29	0.5
Nystatin	22	0.4
Antivirals	33	0.60%
Aciclovir	19	0.3
Penciclovir	14	0.2
Other	84	1.40%
Other preparations with antimicrobial action (predominantly chlorhexidine gluconate preparations)	84	1.4

collaboratively with colleagues. Following this, every dentist returned an evaluation describing the changes they intended to make to their antimicrobial usage. All practitioners received a certificate of verifiable CPD, and those with a Welsh NHS contract received a Clinical Audit and Peer Review payment as reimbursement for the time taken to complete the audit.

Analysis

The data presented in this paper covers the first three years of the audit, from April 2012 to March 2015. Descriptive statistics were used to present the types of antimicrobials prescribed, clinical diagnoses associated with antimicrobial use, and additional observations explaining why an antibiotic was prescribed. Patients were judged to have had signs of spreading infection and/or systemic involvement if they had a diagnosis of 'acute apical abscess with systemic involvement' or one of the following symptoms: diffuse facial swelling, lymphadenopathy, cellulitis, or fever and malaise.

Proportions of patients receiving surgical and non-surgical interventions were calculated. Surgical local measures were considered to be: exodontia; incision of a swelling; endodontic treatment; periodontal irrigation with debridement, or a direct restoration. Non-surgical local measures were judged to have been undertaken if the GDP had provided one of the following: denture or oral hygiene advice; instructions on steam inhalation with or without ephedrine nasal drops (in the case of sinusitis); and analgesia, or other advice on local measures.

Compliance with clinical guidelines with regard to the dose, duration, and frequency of antimicrobials were judged against the recommendations published by the SDCEP.[10] Recommendations made in November 2013 which doubled the recommended dose of amoxicillin were accounted for in the analysis.[10] Practitioners were informed of this change via a letter from Welsh Government.

Results

Between April 2012 and March 2015, 279 GDPs completed the audit, recording 5,760 clinical encounters. Three hundred forms were incomplete, leaving 5,460 clinical encounters which met the inclusion criteria and were suitable for analysis. Of these 5,081 (93.1%) related to patients aged 13 years of age or older. In total 5,782 antimicrobials were prescribed, of which 95.3% were antibiotics, 2.7% were antifungal agents, 0.6% were antivirals, and 1.4% were other agents with antimicrobial action such as chlorhexidine gluconate (Table 1).

Antibiotic preparations

The majority of patients included in the audit were prescribed an antibiotic (5,226/5,460; 95.7%), and most of these (4,849/5,226; 92.8%) were 13 years of age or older. Diagnoses associated with antibiotic prescription are shown in Table 2. Acute apical abscess, periodontal abscess or pericoronitis accounted for 64.2% of clinical diagnoses associated with antibiotic prescription. There were 27 instances where antibiotics were prescribed for patients diagnosed with reversible pulpitis, and 268 occasions in which antibiotics were prescribed for patients with irreversible pulpitis. Just over a third of patients prescribed an antibiotic (1,944/5,226; 37.2%) had one or more signs of spreading infection or systemic involvement. In 282 instances more than one antibiotic was prescribed, in the majority of these cases

Table 2 Diagnoses associated with antibiotic preparations

Diagnosis	Frequency (n = 5,595*)
Acute apical abscess	1,684
Pericoronitis	816
Periodontal abscess	547
Acute apical abscess with systemic involvement	545
Acute apical periodontitis	493
Alveolar osteitis	370
Irreversible pulpitis	268
Chronic apical periodontitis	231
Acute ulcerative gingivitis	221
Sinusitis	76
Reversible pulpitis	27
Angular cheilitis	6
Fungal infection	6
Recurrent aphthous stomatitis	4
Viral	2
Other	299

*More than one diagnosis could be selected per patient

Table 3 Interventions made in addition to prescription of antibiotics

Intervention	Frequency (n = 4,392*)
Advise local measures	1,625
Other – surgical intervention	662
Exodontia	579
Establish drainage – opening tooth	421
Dress tooth – with pulp treatment	340
Establish drainage – incision and drainage	266
Other – appointment made for definitive treatment	171
Other – referral made	170
Dress tooth – no pulp treatment	79
Other – non-surgical intervention	79

*More than one intervention could be selected per patient

(262/282; 94.6%) this was a combination of amoxicillin and metronidazole.

In total 31.2% of patients (1,630/5,226) prescribed an antibiotic received no other surgical or non-surgical local measures. The remaining 3,596 patients received 4,392 interventions (GDPs were asked to record all interventions undertaken) (Table 3). Of the interventions undertaken, 53.4% (2,347/4,392) were surgical local measures such as exodontia or establishing drainage, and 38.8% (1,704/4,392) were non-surgical local measures such as oral hygiene advice. A small proportion of patients were advised to return for definitive treatment at a later date (171/5,226), or referred to another dentist or dental care professional (171/5,226).

Practitioners indicated that in 15.6% (813/5,226) of instances where an antibiotic was prescribed previous local measures had failed, and in 7.9% (415/5,226) of cases the patient had declined treatment. Other factors which influenced the prescription of antibiotics included: instances where a patient was unable to cooperate (7% of occasions in which an antibiotic was prescribed); time pressures (6.7%), patient demand (5.5%), and relevant medical history (4.3%). In total, one or more of the above modifying factors was present in 40.5% (2,114/5,226) of instances where an antibiotic was prescribed. Patient allergy to certain antimicrobials was reported to have influenced prescribing in 6.2% of encounters.

Amoxicillin and metronidazole were the most commonly prescribed antibiotics, and together accounted for over 90% of antibacterials prescribed during the audit (Table 1). During the audit there were 37 prescriptions issued for antibiotics not recommended by the SDCEP guidelines: ampicillin; azithromycin; cefalexine; cefradine; oxytetracycline, and tetracycline. In total, 79.2% of antibiotic prescriptions (4,360/5,508) were at doses, durations, and frequencies advised by SDCEP guidelines. In total 75.2% of amoxicillin prescriptions (2,440/3,246) and 92.7% of metronidazole prescriptions (1,680/1,812) met SDCEP recommendations. Of the 806 amoxicillin prescriptions that deviated from the guidelines, 498 (61.8%) had a duration of course exceeding that recommended by the SDCEP.

Antifungal preparations

One hundred and fifty four patients (2.8%) were prescribed an antifungal preparation, all of whom were 13 years of age or older. Diagnoses associated with antifungal diagnosis are shown in Table 4. In total, 120 (77.9%) patients who were prescribed an antifungal agent had a diagnosis of either a fungal infection (including denture stomatitis) or angular cheilitis. In three instances more than one antifungal agent was provided.

Table 4 Diagnoses associated with antifungal preparations

Diagnosis	Frequency (n = 170*)
Fungal infection	94
Angular cheilitis	36
Pericoronitis	8
Alveolar osteitis	4
Acute apical abscess	3
Acute apical abscess with systemic involvement	3
Periodontal abscess	3
Recurrent aphthous stomatitis	3
Acute apical periodontitis	2
Chronic apical periodontitis	2
Irreversible pulpitis	1
Acute ulcerative gingivitis	1
Other	10

*More than one diagnosis could be selected per patient

In addition to their prescription, 61.7% of patients (95/154) also received advice on local measures such as denture hygiene instruction. In 22 cases (14.3%) an antifungal was prescribed following failure of previous local measures, and in another nine cases (5.8%), prescribing was influenced by the patient's medical history.

Topical miconazole was the most commonly prescribed antifungal agent (106/157). Systemic fluconazole (29/157) and topical nystatin (22/157) were prescribed less frequently (Table 1). In total, 69.4% (109/157) of antifungal prescriptions complied with SDCEP guidance regarding dose, duration, and frequency of antimicrobials.

Antiviral preparations

Thirty three patients (0.6%) were prescribed an antiviral preparation, of which 32 (97.0%) were 13 years of age or older. Most of the patients receiving a prescription for an antiviral had received a diagnosis of a viral infection (27/33), but four patients had received the preparation for a condition unlikely to be of viral origin (acute apical abscess, acute apical periodontitis, pericoronitis, and a periodontal abscess).

In total 60.6% of patients (20/33) had not received other interventions in addition to the antiviral prescription, while 30.3% had been advised about local measures (10/33). Patient demand for a prescription was recorded in four cases (12.1%), and in another four cases the patients' medical history had influenced prescribing (12.1%).

Aciclovir was the most commonly prescribed antiviral preparation (19/33), followed by penciclovir (14/33). In total, 57.6% (19/33) of antiviral prescriptions complied with SDCEP guidance regarding dose, duration, and frequency of antimicrobials.

Discussion

Clinical audit is a quality improvement process which seeks to improve patient care and outcomes by reviewing existing performance against explicit criteria and identifying potential changes in practice where necessary.[19] The current audit was designed to provide feedback to GDPs regarding their use of antimicrobial agents to encourage them to identify areas of their prescribing practices where improvement could be made, such as undertaking appropriate local treatment measures wherever possible.

During the first three years of the audit most of the antimicrobials prescribed were antibiotics. Just over a third of patients who received an antibiotic had signs of spreading infection or systemic involvement. Despite clinical guidance recommending that antibiotics should not be prescribed in the absence of adjunctive dental treatment,[10] a third of

patients treated with an antibiotic received no other local measures. Failure of previous local measures, patient unwillingness or inability to undergo treatment, patient demand for antimicrobials, time pressures, and features of a patients' medical history were identified as factors that may influence antimicrobial prescribing behaviours of GDPs. Compliance with SDCEP guidelines on dose, frequency, and duration of antimicrobials varied between preparations, with 79.2% of antibiotic, 69.4% of antifungal, and 57.6% of antiviral preparations meeting audit standards.

The findings from this audit corroborate those of other studies which have described the widespread use of antibiotics by dentists in the management of acute dental conditions in the absence of signs of spreading infection and/or without adjunctive local measures.[8,9,11,12,20,21] In the current audit, large numbers of antibiotics were prescribed for primarily inflammatory conditions such as acute apical periodontitis, alveolar osteitis, and irreversible pulpitis. However, there is currently no evidence to suggest that antibiotics are effective in the management of any of these conditions.[22–24] Similarly, some patients for whom antibiotics were prescribed had conditions of viral or fungal aetiology, and vice versa (Tables 2 and 4). This practice increases patients' risk of developing adverse reactions from antimicrobial agents and resistant microbial colonies, yet is unlikely to speed recovery. In addition, failing to relieve or remove the source of odontogenic infection may also place patients at risk of experiencing a longer and more severe period of infection.[25,26]

Dentists' prescribing practices are influenced not only by their knowledge of antimicrobial use, but also characteristics of the healthcare environment in which care is being provided.[27] Pressures of clinical time and workload have consistently been reported as an important influence on GDPs' prescribing behaviours,[8,9] and it has been suggested that shortage of time may restrict practitioners' ability to make a diagnosis or perform local measures through operative treatment.[11] However alleviating the time pressures associated with the management of acute conditions is unlikely to be straightforward. While previous clinical audits have highlighted the need to increase the time allocated to patients with dental emergencies,[28] in reality, speculatively allocating large portions of clinical time to treat potential acute cases may result in unfilled chair-time and is likely to be unprofitable for many dental practices. Further work is therefore required to explore ways by which dental practitioners could be encouraged to undertake more appropriate operative treatment for patients with acute conditions.

This audit has also highlighted the influence that patients' willingness to undergo recommended operative treatment and demand for antimicrobials can have on prescribing in general dental practice. This corroborates the findings of other studies, which have described the impact patient expectation of antibiotics can have on GDPs' prescribing decisions.[9,12] This emphasises the importance of effectively communicating to patients treatment choices regarding the management of dental pain. Dentists should also be encouraged to discuss with their patients instances where antibiotics are and are not likely to be beneficial, and the risks associated with inappropriate prescribing.

Consistent with previous studies, there were substantial variation in the dose, frequency, and duration of antimicrobials prescribed.[15,29] Many of the prescriptions that deviated from guideline recommendations did so because of excessive treatment duration. Current SDCEP guidelines recommend that systemic antibiotics prescribed for odontogenic infections should be for a maximum of five days in duration.[10] Furthermore, there is evidence that shorter courses of antibiotics, when provided together with local measures, are adequate for the resolution of odontogenic infections while minimising the likelihood of resistance.[16, 30] More therefore needs to be done to reinforce to practitioners the appropriate type, dose, duration, and frequency of antimicrobials for oro-dental conditions.

During its first three years, this audit has collated one of the largest datasets of GDP antimicrobial prescribing records. Approximately 16.5% of dentists registered to work in Wales, had completed the audit by March 2015. However, the results of the audit should be interpreted with the following limitations in mind. Firstly, while all independent prescribers, including dentists, should demonstrate clinical competence in antimicrobial stewardship,[31] it is likely that GDPs who participated in the audit may have a greater interest in antimicrobial prescribing and quality and safety issues. Secondly, despite asking dentists to treat patients according to their usual practice, participating in the audit may have focused the attention of GDPs on their prescribing habits and led to more 'professionally-desirable' prescribing behaviours and a potentially greater frequency of local measures. Furthermore, providing GDPs with a summary of current guideline recommendations may have modified prescribers' behaviour. However, other evidence suggests that simply providing practitioners with guidelines does not significantly improve dentists' prescribing of antibiotics,[32] therefore the current findings are likely to be a good representation of existing practice.

Conclusions

The results of this first audit cycle of antimicrobial prescribing in general dental practices, in Wales, indicates that clinical audit can be a useful tool by which dental practitioners can identify examples of guideline-incongruent antimicrobial use. Such findings indicate a need for a continuing appraisal of prescribing practices of GDPs in Wales, and could inform the development of other interventions to optimise antimicrobial stewardship within the profession. Within the population studied, there were high rates of prescribing in the absence of appropriate clinical indication, and substantial deviation from the guidelines with regard to dose, frequency, and duration of preparations. This emphasises an ongoing need to support dental practitioners to make sustainable improvements to their prescribing behaviours.

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