International Endodontic Journal

doi:10.1111/j.1365-2591.2009.01642.x

Antibiotic prescribing in dental practice in Belgium

A. Mainjot[1], W. D'Hoore[2], A. Vanheusden[1] & J.-P. Van Nieuwenhuysen[3]

[1]Department of Fixed Prosthodontics, Institute of Dentistry, University Hospital (CHU) of Liege, University of Liege, Liege, Belgium; [2]School of Public Health, Health Systems Research, Université Catholique de Louvain, Louvain, Belgium; and [3]Department of Restorative Dentistry and Endodontics, Université Catholique de Louvain, Louvain, Belgium

Abstract

Mainjot A, D'Hoore W, Vanheusden A, Van Nieuwenhuysen J-P. Antibiotic prescribing in dental practice in Belgium. *International Endodontic Journal*, **42**, 1112–1117, 2009.

Aim To assess the types and frequency of antibiotic prescriptions by Belgian dentists, the indications for antibiotic prescription, and dentists' knowledge about recommended practice in antibiotic use.

Methodology In this cross-sectional survey, dental practitioners were asked to record information about all antibiotics prescribed to their patients during a 2-week period. The dental practitioners were also asked to complete a self-administered questionnaire regarding demographic data, prescribing practices, and knowledge about antibiotic use. A random sample of 268 Belgian dentists participated in the survey.

Results During the 2-week period, 24 421 patient encounters were recorded; 1033 patients were prescribed an antibiotic (4.2%). The median number of prescriptions per dentist for the 2 weeks was 3. Broad spectrum antibiotics were most commonly prescribed: 82% of all prescriptions were for amoxycillin, amoxycillin-clavulanic acid and clindamycin. Antibiotics were often prescribed in the absence of fever (92.2%) and without any local treatment (54.2%). The most frequent diagnosis for which antibiotics were prescribed was periapical abscess (51.9%). Antibiotics were prescribed to 63.3% of patients with periapical abscess and 4.3% of patients with pulpitis. Patterns of prescriptions were confirmed by the data from the self-reported practice.

Conclusions Discrepancies between observed and recommended practice support the need for educational initiatives to promote rational use of antibiotics in dentistry in Belgium.

Keywords: antibiotics, audit, dentistry, drug use review, prescription.

Received 31 March 2009; accepted 2 September 2009

Introduction

Overuse and misuse of antibiotics are well-known problems with a negative impact on the general population (American Dental Association Council on Scientific Affairs 2004). Adverse reactions, emergence and dissemination of resistance of some species through genetic routes, increase in the prevalence of drug-resistant bacterial infections, and economic waste have drawn the attention of health professionals, scientists and policymakers to the problems of antibiotic mis/overuse (Hawkey 2008). Dentists prescribe a considerable amount of antibiotics: It was estimated that antibiotic prescriptions amounted to 1.1 Defined Daily Doses/1000 inhabitants/day, for a total antibiotic expenditure of 7.4 million EUR in Belgium in 2004 (URL http://www.inami.fgov.be/drug/fr/statistics-scientific-information/pharmanet/Statistics-group/2004/pdf/t13101311.pdf). Surveys of dentists' prescribing habits have raised awareness of the quality of prescriptions in developed countries. For example, questionnaire surveys showed that 12.5% of UK general dental practitioners and 16.8% of US endodontists prescribed antibiotics for the treatment of acute pulpitis (Palmer *et al.* 2000, Yingling *et al.* 2002). However, a clinical study warned against this practice (Nagle *et al.* 2000). Whilst, some surveys have concluded that dental prescriptions do not follow clinical guidelines (Palmer & Batchelor 2004) other authors have emphasized that

Correspondence: Amélie Mainjot, Institut de Dentisterie Université de Liège, Quai G.Kurth, 45, B-4020 Liège, Belgium (Tel.: +32 4 270 31 00; fax: +32 4 270 31 10; e-mail: a.mainjot@chu.ulg.ac.be).

there is a lack of scientific information regarding appropriate and efficient prescription (Keenan *et al.* 2005).

In Belgium, little is known about the antibiotic prescribing patterns of dentists. A questionnaire survey was conducted to assess the types and frequency of antibiotic prescriptions by dentists, the indications for antibiotics, and dentists' knowledge about recommended practice in antibiotic use.

Material and methods

This cross-sectional survey was performed in September 2004 and consisted of two parts. In part 1 (prescriptions), dental practitioners were asked to record information about all the antibiotics they prescribed to their patients during a 2-week period. In part 2 (self-reported practice), dental practitioners completed a self-administered questionnaire about demographic data, prescribing practices, and knowledge about antibiotic use. Questionnaires were sent in August 2004 and the survey ended on October 7th, 2004.

Participants

The study sample was drawn from the Belgian population of dentists accreditated in 2004 by the Belgian social security office (Institut National d'Assurance Maladie Invalidité – Rijksinstituut voor Ziekte- en Invaliditeitsverzekering). The Belgian accreditation is a premium based system focusing on continuing education and participating to epidemiologic data collection. In 2004, there were 3917 accredited dentists, i.e. 45.6% of all dentists. A random sample of 150 Dutch-speaking and 150 French-speaking dentists was drawn.

Prescriptions

Informed consent was required from every patient. Dentists were asked to complete a form for every patient who was prescribed antibiotics, including type, dose, and duration of antibiotic, patient history (allergies and pregnancy), patient-related factors which may influence prescription, concomitant prescription of nonsteroidal anti-inflammatory drugs (NSAIDs), analgesics, and mouthwashes. A difference was made between therapeutic and prophylactic (e.g. prevention of endocarditis) prescriptions. In cases of antibiotherapy, dentists were also asked to supply details about diagnosis and dental treatment.

Self-reported practice

Practitioners were invited to complete a self-administered questionnaire including demographic data (age, gender), speciality, average activity (patients per week, emergencies). The numbers of cases of pulpitis, periapical abscess and periodontal abscess diagnosed during the 2-week period were also recorded. Dentists were asked to describe their usual prescription patterns (type and frequency of antibiotic prescriptions; type, dosage and duration of antibiotics prescribed for selected diseases and prophylaxis), and factors influencing prescription (patient demand and health status, antibiotic cost). Dentists were also asked to rate their satisfaction with the information that they receive about antibiotics from various channels (social security authorities, university training sessions, scientific or professional societies, peers and pharmaceutical companies). Finally, the dentists were asked to estimate their own role in and information level about antimicrobial resistance, and its possible influence on their prescribing behaviour. Space was allowed for additional comments. Dentists received either the Dutch or French version of the questionnaire. Translations were supervised by professional translators and native Dutch- and French-speaking dentists. Questionnaires were formatted for optical reading.

Statistical analysis

Chi-square and Fisher's exact tests were used to test the significance of associations in cross Tables. To compare means, Student's *t*-test and ANOVA were used.

All statistical analysis was performed with the SAS system software (9.1 release; SAS Institute Inc., Cary, NC, USA).

Results

A total of 268 practitioners participated in the survey (response rate = 89.3%); 56.3% were male. The sample represented 3.1% of the Belgian dentist population and 6.8% of accredited dentists. Only 3.7% of the dentists were qualified in periodontics or orthodontics, the two official dental specializations in Belgium.

During the 2-week period, 24 421 patient encounters were recorded; 1033 were prescribed an antibiotic (4.2% of all patient encounters). In 936 patient encounters (90.6%), antibiotics were prescribed for therapeutic reasons, in 46 patient encounters for prophylactic reasons, and the reasons for the remaining 51 were undetermined.

Table 1 Distribution of actual antibiotics prescribed for therapeutic reasons versus self-reported prescribing patterns

Antibiotic	Prescriptions *n* (%)	Self-reported prescribing patterns (%)
Amoxycillin	478 (51.1)	33.6
Amoxycillin + clavulanic acid	225 (24.0)	22.1
Clindamycin	62 (6.6)	13.9
Azythromycin	50 (5.3)	4.8
Clarithromycin	41 (4.4)	5.1
Doxycycline	34 (3.6)	9.0
Spiramycin	21 (2.2)	1.6
Erythromycin	11 (1.2)	7.4
Other	10 (1.1)	0.9
Ciprofloxacin	2 (0.2)	0
Cefadroxil	1 (0.1)	0.3
Minocycline	1 (0.1)	0.3
Cefuroxime	0 (0)	0.15
Never prescribe antibiotic	–	1
Total	936 (100)	100

Amongst the respondents, 11.2% did not prescribe any antibiotics during the 2-week period. The median number of prescriptions for the 2 weeks was 3 (minimum = 0, maximum = 21).

As seen in Table 1, the most frequently prescribed antibiotics for therapeutic reasons were amoxycillin and the combination of amoxycillin and clavulanic acid (75.1%). The orders in which antibiotics were ranked were similar in the prescription and the self-reported data.

In penicillin-allergic patients, 49 prescriptions were recorded. As expected, the most frequently prescribed antibiotics in these patients were macrolides (57.1%), followed by clindamycin (16.3%).

There was no difference in antibiotic choice according to the diagnosis: Amoxycillin followed by the combination of amoxycillin and clavulanic acid were the most frequently prescribed antibiotics, except for rapidly progressive periodontitis for which doxycycline was second on the list.

The antibiotics most commonly prescribed for prophylaxis were amoxycillin and the combination of amoxycillin and clavulanic acid (73.9%).

In Table 2, the number of actual patient encounters and associated diagnoses for which antibiotherapy was ordered is compared with self-reported prescription patterns. The most common indications for antibiotherapy were periapical abscess (51.9%) and periodontal abscess (14.2%). Pulpitis accounted for 4.4% of all prescriptions. In more than 90% of antibiotherapy for periapical or periodontal abscess and pulpitis, fever was absent. Prescription rates, i.e. the proportion of diagnoses leading to antibiotic prescriptions, were very high for periapical abscess (63.3%) and high for periodontal abscess (28.8%); they were much lower for pulpitis (4.3%). Antibiotics were prescribed without any local treatment in 59.0% of periapical abscesses, in 46.4% of periodontal abscesses, and in 31.7% of cases of pulpitis.

The data for antibioprophylaxis were not analysed because of the small number of cases.

Several items were analysed to describe patterns of antibiotherapy. First, in 40.7% of prescriptions, dentists reported that there was patient demand for antibiotics, meaning that prescribing does not only depend on the oral health status. Secondly, in 33.4% of prescriptions, dentists recommended that antibiotics not be taken unless symptoms become more severe, meaning that

Table 2 Indications for antibiotherapy: comparison between actual prescriptions and self-reported prescribing patterns

Diagnosis	Indications for antibiotherapy (1), *n* (%)	Frequency of diagnosis (2)	Prescription rate (1)/(2) %	Self-reported prescription patterns (3) %
Periapical abscess	476 (51.9)	752	63.3	82.7
Periodontal abscess	130 (14.2)	452	28.8	63.2
Others	75 (8.2)	–	–	–
Pericoronitis	70 (7.6)	–	–	52.2
Rapidly progressive periodontitis	43 (4.7)	–	–	23.5
Pulpitis	40 (4.4)	933	4.3	5.9
Alveolar osteitis	37 (4.0)	–	–	41.9
Chronic adult periodontitis	25 (2.7)	–	–	–
Cellulitis	22 (2.4)	–	–	44.1
Total	918 (100)	–	–	–

(1): Total number and % of diagnoses for which antibiotics were prescribed, during the 2-week period.
(2): Total number of three selected diagnoses recorded during the 2-week period.
(1)/(2): Proportion of diagnoses leading to antibiotic prescription.
(3): Proportion of dentists who reported antibiotic prescription for each diagnosis.

the link between antibiotic prescriptions and antibiotic consumption is not linear. Thirdly, there was wide variability in antibiotic courses and regimens. For example, a higher initial dose was prescribed in 17.2% of cases of antibiotherapy (with unequal distribution amongst antibiotics: 17.9% for amoxycillin versus 13.8% for the combination of amoxycillin and clavulanic acid, $P < 0.01$). Treatment duration varied around an average of 4.8 days (SD = 2.1) with a lower mean of 3.0 days for azithromycin and a higher mean of 7.9 days for doxycycline ($P < 0.01$).

Companion treatments of antibiotherapy included NSAIDs (38.7%), analgesics (22.8%) and mouthwashes (45.0%). The NSAIDs and analgesics most frequently prescribed were ibuprofen (82.5%) and paracetamol (78.7%). Surprisingly, a majority of patients with pain did not receive analgesics (75.2%) or NSAIDs (54.6%).

The satisfaction rate of practitioners with information about antibiotic use was high (81%). Colleagues were considered as the best source of information (87%) whereas university continuing education sessions were less satisfying (73.5%). However, satisfaction with information contrasted with knowledge. For example, in self-reported data, it was observed that American Heart Association and American Academy of Orthopaedic Surgeons guidelines (Tong & Rothwell 2000) were followed in 44.8% and 35.8% of cases, respectively. Finally, amongst practitioners who felt responsible for development of resistant strains (64.6%), the majority (61.8%) did not change their prescribing practices.

Discussion

The findings of this cross-sectional survey show that a minority of patient encounters (4.2%) lead to antibiotic prescription. Periapical abscess was the most frequent diagnosis associated with prescription (51.9%) and the prescription rate for this diagnosis was 63.3%. In a majority of patients, antibiotics were prescribed in the absence of general symptoms, indicating defensive practice. Moreover, a substantial percentage of cases (54.2%) were treated without any local treatment.

If continuing education and the Belgian system of accreditation improve quality of care, the sample studied here should reflect best practice amongst Belgian practitioners. The combination of data about actual prescriptions and from the self-administered questionnaire allows reported and perceived practices to be compared. Collection of data about diagnosis, local treatment, and patient-related factors that can influence prescription provided information about the qualitative aspects of the prescriptions. In particular, records of the numbers of cases of pulpitis, periapical abscess, and periodontal abscess diagnosed during the 2-week period highlighted the prescription rate for these diagnoses. The self-administered questionnaire enabled evaluation of practitioners' knowledge about antibiotic use and about the dissemination of knowledge in Belgium.

Some quantitative estimates of the frequency of antibiotic prescriptions by dentists were found in the literature. Two studies conducted in England, on 175 and 212 dental practitioners, respectively, over a 6-week period (Palmer *et al.* 2001, Chate *et al.* 2006) reported similar prescription rates (2.2 and 2.31 prescriptions/dentist/week), from a quantitative point of view, to the present study (1.9 prescriptions/dentist/week). In contrast, in a study conducted in Saudi Arabia, the mean number of declared prescriptions per week was 5–10 (Al-Mubarak *et al.* 2004). However, comparisons between regions or countries are meaningless as case-mix, professional standards, and local regulations are unknown. In Belgium, no economic incentives favour prescribing antibiotics.

Qualitative analysis of prescription practices allows evaluation of the quality of treatment. It highlights the misuse and abuse of antibiotics, which can increase the risk of toxicity and may also result in development of antibiotic-resistant bacteria. Indeed, the development of resistance to antibiotics by many important human pathogens has been linked to exposure to antibiotics over time (Hawkey 2008). In this study, broad spectrum antibiotics were most commonly prescribed: Amoxycillin, amoxycillin-clavulanic acid and clindamycin accounted for 82% of all prescriptions. However, use of broad-spectrum antibiotics, like amoxycillin-clavulanic acid (24.0% of prescriptions for therapeutic reasons in our study), is questionable. Selected antibiotics should possess a spectrum of action as narrow as possible (Handal & Olsen 2000), based on the susceptibility of pathogens (Sweeney *et al.* 2004). Empirical and inappropriate prescription leads to selection of resistant strains which is potentially damaging to the community (Sweeney *et al.* 2004). In contrast with Belgian practitioners, in 2004, dentists in Norway showed a conservative antibiotic practice and prescribed the narrow-spectrum, phenoxymethylpenicillin, as their first choice (75% of their total prescriptions) (Al-Haroni & Skaug 2007).

Regarding the indications for antibiotherapy, the prescription data showed that antibiotics were pre-

scribed independently of local treatments, as shown in previous audits in the United Kingdom (Choudhury *et al.* 2001, Dailey & Martin 2001). For periapical abscesses, the prescription rate was 63.3%, although drainage of the purulent collection and suppression of the cause of infection by disinfection of the root canal system alone are recognized as adequate treatment (Matthews *et al.* 2003, Kuriyama *et al.* 2005, Lopez-Piriz *et al.* 2007). The prescription rates for periodontal abscesses and pulpitis also seemed rather high (28.8 and 4.3%, respectively) as it is known that local treatment constitutes effective treatment (Keenan *et al.* 2005). Moreover, in patients with periapical abscess who were prescribed antibiotics, 59.0% did not receive any local treatment; the percentages for periodontal abscess and pulpitis were 46.4% and 31.7%, respectively. Our study did not provide information about the organization of patient care, but it is likely that lack of time, working schedules, and technical difficulties prevent dentists from performing timely local treatments. It was also striking that antibiotics were used in the absence of general symptoms and fever (92.2%). Antibiotic use should be saved for patients with general symptoms of disseminating infection, such as the presence of fever, extended swelling (cellulitis), or for cases where local treatment is impossible.

On the qualitative side of this study, other findings suggested poor antibiotic use. First, in 33.4% of registered prescriptions, patients were told not to take the prescribed antibiotics unless symptoms worsening. This defensive attitude results in waste for the social security, and may also promote risky self-prescription, leaving patients with the opportunity to misuse the same drug later. Another consequence of this practice is that the amount of antibiotics prescribed does not reflect the amount of antibiotics used by patients. This apparently positive situation may hamper the collection of accurate data about antibiotic consumption and the evaluation of antibiotic effectiveness due to the uncertainty regarding antibiotic consumption. Finally, this could generate environmental problems. Secondly, there was wide variability in antibiotic courses and regimens, as indicated also in a study by Roy & Bagg in Scotland (Roy & Bagg 2000). One reason for this finding may be the lack of relevant recommendations about antibiotic use.

The results of the analysis of prescriptions contrast with the respondents' high level of satisfaction about information on antibiotic use, indicating a lack of awareness of good clinical practices. This is confirmed by responses to simulated cases about prophylaxis of endocarditis and artificial joint infections: results show that a majority of practitioners (55.2 and 64.2%, respectively) do not follow international guidelines (Tong & Rothwell 2000). The importance of colleagues as information source highlights the poor efficacy, visibility, and/or legitimacy of official sources, such as university continuing education sessions.

The findings of this study support the need for interventions to promote rational use of antibiotics in dentistry. Experience with medical practitioners shows that various interventions may improve antibiotic prescribing practices in ambulatory care, as demonstrated in the Cochrane review by Arnold & Straus (2005). Selection of the most effective intervention appears to be condition and situation specific. In particular, as patient demand for antibiotics is still problematic (in 40.7% of registered prescriptions patients expected antibiotics), patient education should form part of multi-faceted interventions, which appear to play an important role in reducing the inappropriate use of antibiotics in community settings. Educational components and setting standards for antibiotic prescribing by dental practitioners were successfully tested in England (Palmer *et al.* 2001, Palmer & Dailey 2002, Chate *et al.* 2006). Pre- and post-audit measurements should provide feedback on practitioners' practices. Repeated surveys, measuring the impact and durability of interventions, can be used in this perspective. In this context, the present study constitutes the first step in a drug utilization review concerning antibiotic prescribing in dental practice in Belgium. It should be followed by national consensus meetings to elaborate guidelines in this area. Guidelines about antibiotic choice should be dynamic and take into consideration local factors, such as local resistant bacteria status and professional realities. Post- and re-audit should be planned after introduction interventions designed to alter prescribing practices.

Conclusions

Discrepancies between observed and recommended practice support the need for educational initiatives to promote rational use of antibiotics in dentistry.

Acknowledgements

The Belgian «Institut National d'Assurance Maladie-Invalidité» supported this research.

References

Al-Haroni M, Skaug N (2007) Incidence of antibiotic prescribing in dental practice in Norway and its contribution to national consumption. *Journal of Antimicrobial Chemotherapy* **59**, 1161–6.

Al-Mubarak S, Al-Nowaiser A, Abou Rass M *et al.* (2004) Antibiotic prescription and dental practice within Saudi Arabia; the need to reinforce guidelines and implement specialty needs. *Journal of the International Academy of Periodontology* **6**, 47–55.

American Dental Association Council on Scientific Affairs (2004) Combating antibiotic resistance. *Journal of the American Dental Association* **135**, 484–7.

Arnold SR, Straus SE (2005) Interventions to improve antibiotic prescribing practices in ambulatory care. *Cochrane Database of Systematic Reviews* issue 4, Art. No. CD003539. pub.2. DOI:10.1002/14651858.

Chate RA, White S, Hale LR *et al.* (2006) The impact of clinical audit on antibiotic prescribing in general dental practice. *British Dental Journal* **201**, 635–41.

Choudhury M, Needleman I, Gillam D, Moles DR (2001) Systemic and local antimicrobial use in periodontal therapy in England and Wales. *Journal of Clinical Periodontology* **28**, 833–9.

Dailey YM, Martin MV (2001) Are antibiotics being used appropriately for emergency dental treatment? *British Dental Journal* **191**, 391–3.

Handal T, Olsen I (2000) Antimicrobial resistance with focus on oral beta-lactamases. *European Journal of Oral Sciences* **108**, 163–74.

Hawkey PM (2008) The growing burden of antimicrobial resistance. *Journal of Antimicrobial Chemotherapy* **62**, i1–9.

Keenan JV, Farman AG, Fedorowicz Z, Newton JT (2005) Antibiotic use for irreversible pulpitis. *Cochrane Database of Systematic Reviews* issue 2, Art. No.: CD004969.pub2. DOI:10.1002/14651858.

Kuriyama T, Absi EG, Williams DW, Lewis MAO (2005) An outcome audit of the treatment of acute dentoalveolar infection: impact of penicillin resistance. *British Dental Journal* **198**, 759–63.

Lopez-Piriz R, Aguilar L, Gimenez M (2007) Management of odontogenic infection of pulpal and periodontal origin. *Medicina Oral, Patología Oral y Cirugía Bucal* **12**, E154–9.

Matthews DC, Sutherland S, Basrani B (2003) Emergency management of acute apical abscesses in the permanent dentition: a systematic review of the literature. *Journal of the Canadian Dental Association* **69**, 660.

Nagle D, Reader A, Beck M, Weaver J (2000) Effect of systemic penicillin on pain in untreated irreversible pulpitis. *Oral Surgery, Oral Medicine, Oral Pathology, Oral radiology Endodontics* **90**, 636–40.

Palmer NA, Batchelor PA (2004) An audit of antibiotic prescribing by vocational dental practitioners. *Primary Dental Care* **1**, 77–80.

Palmer NA, Dailey YM (2002) General dental practitioners' experiences of a collaborative clinical audit on antibiotic prescribing: a qualitative study. *British Dental Journal* **193**, 46–9.

Palmer NA, Pealing R, Ireland RS, Martin MV (2000) A study of therapeutic antibiotic prescribing in National Health Service general dental practice in England. *British Dental Journal* **10**, 554–8.

Palmer NA, Dailey YM, Martin MV (2001) Can audit improve antibiotic prescribing in general dental practice? *British Dental Journal* **191**, 253–5.

Roy KM, Bagg J (2000) Antibiotic prescribing by general dental practitioners in the Greater Glasgow Health Board, Scotland. *British Dental Journal* **188**, 674–6.

Sweeney LC, Dave J, Chambers PA, Heritage J (2004) Antibiotic resistance in general dental practice – a cause for concern? *Journal of Antimicrobial Chemotherapy* **53**, 567–76.

Tong DC, Rothwell BR (2000) Antibiotic prophylaxis in dentistry: a review and practice recommendations. *Journal of the American Dental Association* **131**, 366–74.

Yingling NM, Byrne EB, Hartwell GR (2002) Antibiotic use by members of the American association of endodontists in the year 2000: report of a national survey. *Journal of Endodontics* **28**, 396–404.