



Exploring the feasibility of using routinely collected data to produce antibiotic prescribing profiles for general dental practitioners in Wales

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This article describes a project that assessed whether routinely collected antibiotic prescribing and NHS dental treatment data could be linked to produce personalised prescribing profiles for general dental practitioners working in Wales, UK. Dental public health competencies required for this work included:

- Multi-agency working to develop a sustainable system of monitoring antibiotic prescribing in primary dental care in Wales
- Dental public health intelligence
- Development of dental service quality indicators.

Key words: *antibacterial agents; general practice, dental; primary healthcare; prescriptions*

Initial impetus for action

Antimicrobial resistance is an international public health problem that increases mortality, morbidity and healthcare costs (de Kraker *et al.*, 2011; European Centre for Disease Prevention and Control, 2015). Antibiotic use in primary care is recognised as a key driver of resistance (Shallcross and Davies, 2014) and prescribing by dentists accounts for approximately 9% of antibiotic use in primary care in Wales (Holyfield and Karki, 2009). Furthermore, there is evidence that many dental antibiotics are prescribed in situations where their use may confer little benefit (Cope *et al.*, 2015).

In 2012 the Wales Deanery at Cardiff University launched a clinical audit for dental practitioners working in Wales (Cope *et al.*, 2016). Developed in collaboration with 1000 Lives Improvement service, this aimed to support the most effective clinical use of antimicrobials and ultimately reduce the number of unnecessary prescriptions in general dental practices in Wales. However, whilst nearly a fifth of general dental practitioners working in Wales participated in the audit during its first three years, analysis of data collected during this time indicated that more work was required to support dental practitioners in making sustainable improvements to their antimicrobial prescribing practices (Cope *et al.*, 2016).

Solution

Before 2011, dental practices in Wales had generic prescription pads that made it impossible to identify individual dentists who were prescribing high numbers of

antibiotics. Furthermore, since dental practitioners may not routinely record whether an antibiotic was prescribed on FP17 forms, the record of dental activity submitted to NHS Business Services Authority (NHS BSA), it was also impossible to develop reliable prescribing profiles from these data.

One of the recommendations of the work undertaken by Holyfield and Karki (2009) was that the Welsh Government should consider introducing individualised prescription forms for NHS dentists in Wales. Prescription pads bearing the name, practice address and NHS Dental Performer Number of dentists working in Wales were subsequently issued in 2011. This resulted in a large database of prescriber-level dispensing data that could be used to provide dentists with feedback on their prescribing and facilitate greater understanding of variation in antibiotic prescribing.

Evidence from a study conducted in NHS Scotland indicated that providing general dental practitioners with personalised feedback on their antibiotic prescribing could result in a 6% reduction in dispensed prescriptions (Elouafkaoui *et al.*, 2016). There is also evidence from general medical practice in the UK that the development of prescribing indicators that assess prescribing at practice or local area level can be used to promote quality improvement in antibiotic use (Ashworth *et al.*, 2002). Hence, the dental public health team in Wales began developing a system of producing profiles describing antibiotic use at practitioner, practice and health board level.

It was envisaged that these would be produced at regular intervals to optimise antibiotic prescribing in dentistry in Wales and also inform local and national planning for future interventions relating to prescribing. The first step was to undertake a project to assess the feasibility of linking routinely collected prescriber-level dispensing data to NHS dental treatment information and to develop potential indicators relating to antibiotic use.

Data sources and linkage

A database of antibiotic prescriptions prescribed by dentists in Wales between April 2014 and March 2015 was obtained from NHS Wales Shared Services Partnership (NWSSP). This was compiled from dispensing data submitted by community pharmacies in Wales. The 2014/15 timeframe was selected as it was not until several years after the introduction of the named-practitioner prescribing pads in 2011 that they were widely used. In 2014/15, only 1.9% of antibiotic items prescribed by dentists in Wales were on the old-style generic prescription pads.

To identify appropriate denominators, data relating to NHS general dental service activity for Welsh contracts throughout the same period (2014/15 financial year) were obtained from the NHS BSA.

Prescribing and dental activity data were linked via NHS Dental Performer Number in Microsoft SQL Server Management System and pseudonymised for analysis. Practitioners providing fewer than 100 courses of NHS treatment during the 2014/15 financial year and those working in community or emergency dental service clinics were excluded based on the fact their prescribing was likely to be unrepresentative of NHS general dental practitioners.

Analysis

The exploratory analysis sought to identify potential indicators that could be used to provide feedback to general dental practitioners on their use of systemic antibiotics and to assess whether it was possible to aggregate performer-level data to produce prescribing profiles of dental practices and health boards in Wales.

Actual outcome

After exclusions the linked dataset contained 178,301 antibiotic items associated with 1,079 general dental practitioners. In this context an antibiotic item related to a single-agent course of antibiotics, such that a prescription for amoxicillin and metronidazole would count as containing two antibiotic items.

The median number of antibiotics prescribed per year was 138 (interquartile range (IQR) 60 to 235, range from 1 to 903 items). Amoxicillin and metronidazole accounted for the majority (n=163,378, 91.6%) of antibiotic items. In total, 1.25% (n=2,223) of all antibiotic items were azithromycin, clindamycin, co-amoxiclav or clarithromycin, agents described as for second-line use by guidelines published by the Scottish Dental Clinical Effectiveness Programme (2016) and Faculty of General Dental Practice (2012). A further 0.7% of items (n=1,163) were cephalexin, cefradine, oxytetracycline or tetracycline, antibiotics not recommended by either guideline.

Antibiotic items dispensed per 100 courses of NHS dental treatment and antibiotic items dispensed per 100 NHS band 1 urgent claims were explored as potential indicators of prescribing behaviour. The former was the

primary outcome measure in the randomised trial conducted in Scotland by Elouafkaoui and colleagues (2016), whilst the latter was selected in an attempt to control for number of patients with urgent dental conditions treated by the practitioner. Both had positively skewed distributions with long tails (Figure 1; Table 1) but could feasibly be used to provide feedback as they would be relatively straightforward for practitioners to interpret.

Other potential indicators could include:

- the number of second-line antibiotic items as a proportion of all antibiotic items, or
- the number of antibiotic items not recommended for use by clinical guidelines as a proportion of all antibiotic items

Challenges encountered

The principal challenge for dental public health in conducting work related to the Antimicrobial Resistance Delivery Plan for Wales (Welsh Government, 2016) was the lesser demand from dental stakeholders to carry out this type of work compared to delivery of dental public health functions related to policy, oral health intelligence, oral health improvement and dental services reform and/or improvement. Hence it is important to ensure this work is included in dental public health work and delivery plans.

There were specific challenges in terms of quality of available prescribing data. During preliminary analysis of the prescribing data provided by NWSSP it was observed that each NHS Dental Performer Number (and therefore every dental practitioner) was associated with only one practice address. However, analysis of the NHS general dental service activity database revealed that just under a third (32.4%) of dental practitioners undertook dental activity at more than one practice during the financial year 2014/2015. Therefore, whilst practitioner-level analysis was completed, it was not possible to aggregate practitioner level data to produce practice and health board prescribing profiles. To overcome this challenge, NWSSP will have to provide two or more prescription pads (with different practice addresses) to all those practitioners who provide dental treatment from more than one location.

Large variation in the number of antibiotic items per 100 NHS courses of treatment and per 100 band 1 urgent claims was observed (Table 1), with a small number of extreme outliers. For both indicators approximately 10% of the sample had markedly outlying results. Differences between those in or above the 90th percentile (regarded as outliers) were compared with those below the 90th percentile using the unpaired t-test (parametric data) and Mann Whitney U Test (non-parametric data). Independent variables included the number of NHS courses of treatment completed during the year and the proportion of band 1, 2 and 3 and band 1 urgent claims as a proportion of the total courses of treatment. Two analyses were undertaken, first antibiotic items dispensed per 100 courses of NHS dental treatment and secondly for antibiotic items dispensed per 100 NHS band 1 urgent claims. Only a small number of practitioners were classified as outliers for both indicators. Analysis was conducted using STATA SE 14.0 and the level of significance was set at 5%. For both indicators, practitioners identified as outliers prescribed more antibiotic items (p<0.001) but completed fewer courses of NHS treatment (p<0.001) than those below the 90th percentile.

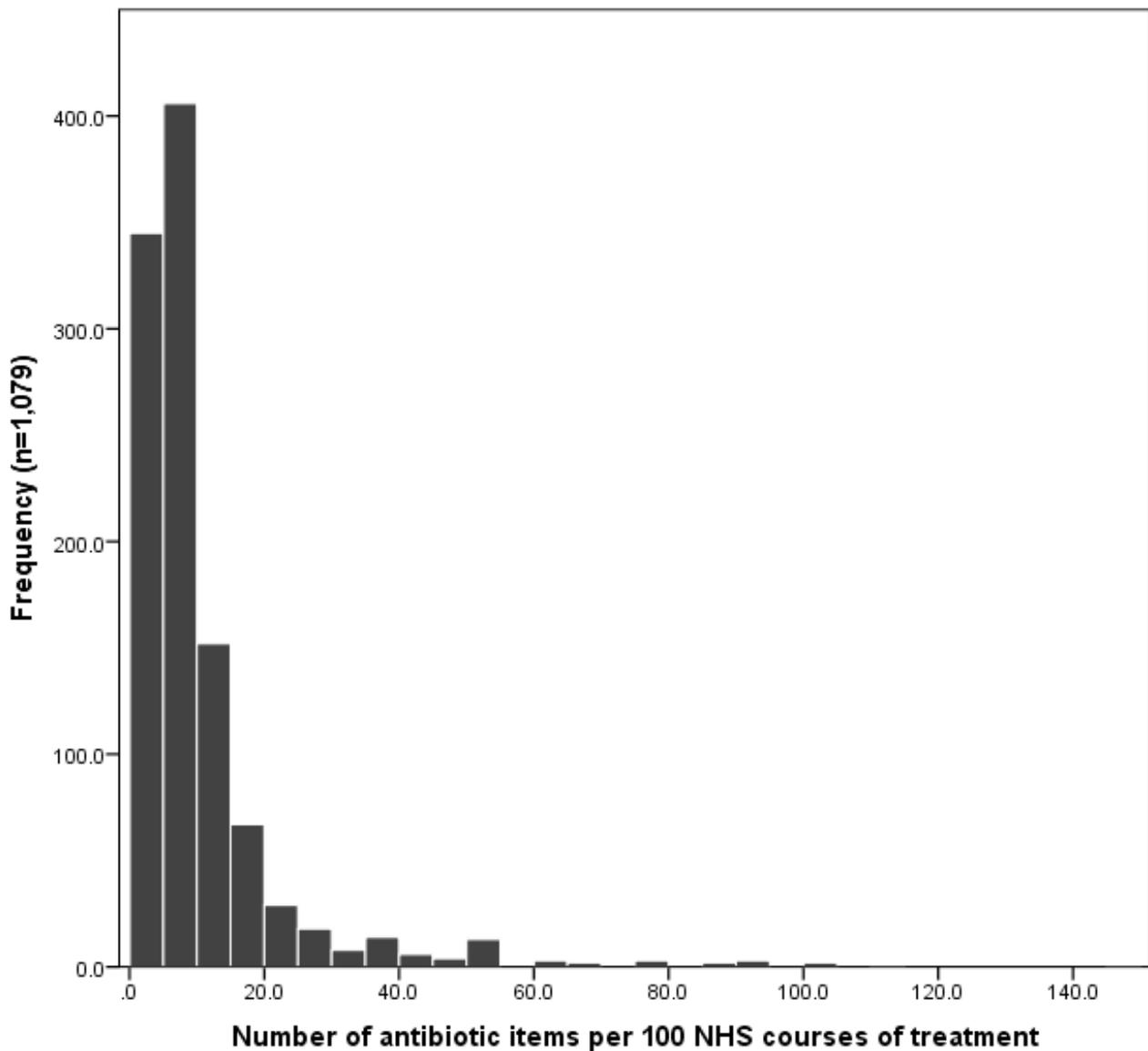


Figure 1 Number of antibiotic items per 100 NHS courses of treatment per general dental practitioner in Wales 2014/15

Table 1. Number of antibiotic items dispensed by general dental practitioners in Wales 2014/15

	<i>Antibiotic items dispensed per 100 courses of NHS dental treatment per practitioner</i>	<i>Antibiotic items dispensed per 100 NHS band 1 urgent claims per practitioner</i>
Mean (SD)	10.6 (13.3)	433.1 (2971.2)
Median (IQR)	7.0 (4.1-11.5)	88.9 (46.2-184.5)
Range	0.1 to 145.8	0.8 to 85,500.0

For the antibiotic items per 100 band 1 urgent claims indicator, outlying practitioners submitted proportionately fewer band 1 urgent claims but more band 1 claims than non-outlying practitioners (both $p < 0.001$). This indicates there may be differences in case mix between outlying and non-outlying practitioners relating to the number of urgent cases seen and/or the way they claim for NHS dental activity. It is worth considering that this indicator reflects not only practitioners' antibiotic prescribing habits but also the number of band 1 urgent claims they submit. As such, practitioners who do not submit high numbers of these claims but who instead treat patients with urgent conditions as part of routine courses of treatment may appear as outliers.

Future implications

This exploratory project indicates that it is possible to link routinely collected antibiotic dispensing data and NHS general dental services data to produce personalised feedback profiles for general dental practitioners working in NHS Wales. Since there is evidence that providing dentists with personalised feedback on their prescribing patterns is associated with a reduction in antibiotic use, it is prudent to pursue this line of work further. With some improvements to data collection systems, it should also be possible to produce analyses describing variation in antibiotic prescribing at practitioner, practice and health board level.

However, further work is required to investigate why certain practitioners may appear as extreme outliers within the datasets, especially when an assumption is made that the majority of antibiotic items are associated with urgent courses of treatment, which may or may not be the case.

The next step for the dental public health team is to work with NWSSP to improve the existing dental prescribing database so that, once linked with the NHS general dental service activity database, practitioner-level data can be aggregated to produce practice and health board prescribing profiles. Development of such a system would also provide an opportunity to explore the effectiveness of interventions aimed at reducing antibiotic prescribing in dentistry in Wales.

While greater understanding of the value and limitations of the prescribing indicators identified as part of this project is required, in time it may be appropriate to add one or more of these measures to the basket of quality indicators already in existence for primary dental care in Wales. However, since indicators of this type cannot be used to judge the appropriateness of individual prescribing decisions, dental public health specialists will have a role, presumably through dental practice advisors, to ensure any antibiotic prescribing profiles produced are interpreted accurately by practitioners, practices owners and service commissioners.

Learning points

Since the introduction of individualised prescription pads for dental practitioners in Wales in 2011 and the launch of an educational audit a year later, antibiotic prescribing by dentists in Wales has decreased by approximately 22%. However, evidence suggests there is still room for improvement (Cope *et al.*, 2016). This project was undertaken as a step towards developing a sustainable system of providing feedback on antibiotic prescribing in primary dental care in Wales. Providing dentists with feedback on their antibiotic prescribing is only one part of promoting antimicrobial stewardship within the profession. It is also important to account for complex factors that influence the antibiotic prescribing behaviours of dental practitioners such as perceived patient expectation and pressures of time and workload (Cope *et al.*, 2014; 2015). Hence, a learning point from this project is that ongoing work in this area is required, even after a system of producing regular antibiotic prescribing profiles is developed.

The key learning points for the dental public health team from this work are that it is important to work with key partners over a period of time to:

- develop a system that produces meaningful antibiotic prescribing profiles; and
- subsequently make meaningful use of antibiotic prescribing profiles to improve the use of these important agents in dental care.

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