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Antibiotic prescribing for sore throat: a cross-sectional analysis of the ReCEnT study exploring the habits of early-career doctors in family practice

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Abstract

Background. Acute sore throat is a common condition presenting to family practitioners. It is usually self-limiting, with antibiotic treatment recommended only for high-risk presentations. Overprescribing of antibiotics contributes to individual and community resistance. Learning to prescribe in the context of diagnostic uncertainty and patient pressures is a challenge for early-career doctors. Prescribing habits develop early and tend not to change with time.

Objective. To establish the prevalence and associations of antibiotic prescribing for acute sore throat by Australian vocational trainees in family practice.

Method. A cross-sectional analysis of data from the Registrar Clinical Encounters in Training (ReCEnT) study. This ongoing, multicentre prospective cohort study documents the nature of trainees' consultation-based clinical experiences. Univariate and logistic regression analyses were conducted on data recorded in consultations for sore throat in nine collection periods during 2010–14.

Results. Data from 856 individual trainees (response rate 95.2%) were analysed. Sore throat was managed in 2.3% encounters. Antibiotics were prescribed for 71.5% of sore throat diagnoses. The variables associated with prescribing were inner-regional location and higher socio-economic area. There was no significant association with younger age of patient or greater trainee experience. If an antibiotic was prescribed, the trainee was more likely to seek information from guidelines or a supervisor.

Conclusions. The high frequency of antibiotic prescribing and the lack of attenuation in prescribing with increased experience suggest current educational interventions and the apprenticeship model of training is not fostering appropriate practice in this important clinical area. Targeted educational interventions, for supervisors as well as trainees, are indicated.

Key words. Antibacterial agents, drug resistance, evidence-based medicine, general practice, graduate medical education, microbial, physician prescribing patterns.

Introduction

Acute sore throat presents a particular challenge for family practitioners. It is a common condition—in Australia 2.5 of every 100 presentations to general practice are for sore throat, making it the 10th most common reason for attendance in the period 2013–14 (1). Complaints of sore throat in general practice settings internationally range between approximately one and four per cent of presentations (2,3). Group A streptococcal pharyngitis is responsible in the USA for 5–15% of presentations of sore throat in adults, and 20–30% in children (3), with comparable population statistics being demonstrated in Australian studies (4). The peak incidence is in school-aged children (4).

Antibiotic therapy reduces the small risk of complications such as rheumatic fever, otitis media, acute sinusitis and quinsy if the aetiology is bacterial (3). However, not only are these complications very rare, but determining bacterial aetiology of sore throat is difficult (5) and there are significant differences in guideline recommendations across the world. Both UK (NICE guidelines) and Australian (6) guidelines suggest avoiding antibiotic use in sore throat, apart from the small minority of patients who are at risk of rheumatic fever (for example in Australian Aboriginal communities) or who have severe clinical features (such as high fever, lymphadenopathy and difficulty swallowing). Overuse of antibiotics contributes to resistance in communities and individuals (7) and to unnecessary adverse side effects and cost.

Rates of complication associated with sore throat caused by Group A streptococcus are reduced by the use of antibiotics. These include the aforementioned suppurative and non-suppurative complications, but these are uncommon and usually confined to particular high-risk populations. The use of antibiotics for sore throat in general is associated with only modest benefits, shortening illness duration by an average of 16 hours and with a high number needed to treat in high-income countries to prevent severe complications (8). Thus, the prescription of antibiotics for sore throat remains controversial.

Prescribing in the context of diagnostic uncertainty and patient pressures is a challenge for doctors in family practice (9), especially early-career or trainee GPs, as they adapt to the different disease spectrum of community as opposed to hospital practice (10). Antibiotic prescribing practices in these early-career stages are of particular importance as prescribing patterns, once established, tend not to change over time (11). In Australia, vocational trainees practice as independent clinicians (including for prescribing purposes) while under the oversight of experienced clinician supervisors in an apprenticeship model. They also receive formal education from their regional training providers (RTPs). Apprenticeship models of General Practice education are common worldwide.

This study aims to establish the prevalence and associations of antibiotic prescribing for acute sore throat by Australian vocational trainees in family practice.

Method

This was a cross-sectional analysis of data from the Registrar Clinical Encounters in Training (ReCEnT) study. ReCEnT is an ongoing, multicentre prospective cohort study of GP trainees (registrars) in 5 of Australia's 17 RTPs in 5 of the 6 Australian states. These RTPs have opted to participate in the educational, reflective feedback and research components of the ReCEnT project. They provide a broad and representative sample of the different training conditions (urban, regional, remote and very remote) that are present in the Australian General Practice environment.

ReCEnT documents the nature and associations of the in-practice consultation-based clinical and educational experiences of GP trainees. The study protocol is described in detail elsewhere (12). Briefly, trainees complete paper-based forms recording details of 60 consecutive consultations in each of their three 6-month general practice training terms (12 monthly for part-time trainees). Trainees at one of the five RTPs also collected data during an optional fourth training term. Trainees complete this process as a compulsory part of their training, and may consent to their data to be used for research purposes.

Trainee demographics and practice data are documented at the start of each collection period, and patient demographics and clinical details are recorded for each patient encounter. Trainee variables recorded are age, gender, training term, whether in full-time or part-time (<8 half-day clinical sessions per week) training, place of primary medical qualification (Australia or international), and whether the trainee had worked at the practice in a previous term.

Patient variables recorded are age, gender, Aboriginal or Torres Strait Islander status, non-English speaking background (NESB) status, the patient being new to the practice and the patient being new to the trainee.

Practice variables recorded are size (small practice considered <6 doctors) and billing policy (whether the practice routinely bulk bills—that is, government subsidy is accepted as full payment and there is no cost to the patient). Practice postcode was used to determine the Australian Standard Geographical Classification-Remoteness Area (ASGC-RA) classification to define the practice locations' degree of rurality (very remote, remote, outer regional, inner-regional or major city location) and Socioeconomic Index for Area (SEIFA) Index of Disadvantage.

Consultation variables recorded are duration, the nature of problems/diagnoses managed, if the problem/diagnosis was a new or pre-existing one, and whether pathology or imaging tests were ordered, or referrals or follow-up arranged. Educational factors included whether the trainee sought advice or information during the consultation (from their supervisor or other resources, such as specialists, books or electronic resources), or generated learning goals.

Problems/diagnoses are coded according to the International Primary Care Classification (ICPC-2) and medications according to the Anatomic Therapeutic Chemical (ATC) Classification.

The analyses in this study used data from nine collection periods during 2010–14. Individual RTPs contributed from one to nine rounds of data depending on the RTPs' date of commencement in the study. We defined acute sore throat as those problems/diagnoses coded as ICPC-2 codes R72 (strep throat), R76 (tonsillitis, acute), R74008 (pharyngitis, acute), R74006 (infection, throat), R74017 (pharyngitis) and R21005 (sore throat). Codes R72001 (scarlet fever), R72003 (scarlatina) and R72004 (scarlet fever) were excluded from the analysis, as antibiotics are recommended for all cases of these conditions in the authoritative Australian guidelines (6).

Statistical analysis

The unit of analysis was the individual problem/diagnosis rather than the trainee consultation.

The proportion of presentations for R72, 76, 74008, 74006, 74017 and 21005 coded problems/diagnoses were calculated with 95% confidence intervals (CIs). Proportions of R72, 76, 74008, 74006, 74017 and 21005 coded problems/diagnoses for which antibiotics were prescribed were calculated with 95% CIs. Proportions of particular antibiotics prescribed were also calculated.

For our primary analysis, the outcome factor was whether an antibiotic had been prescribed. To test associations of an acute sore throat being treated with antibiotics, simple and multiple logistic regression models were used within a generalized estimating equations (GEEs) framework to account for the repeated measures on trainees. Exact methods were used for covariates with low expected values in 25% or more of cells in the cross tabulation of the covariate and the outcome. These are marked as 'Exact' in the univariate tables. All variables with a *P*-value <0.2 and relevant effect size in the univariate analysis were included in the multiple regression models. Variables which had a small effect size and were no longer significant in the multivariate model were removed from the final model as long as removal of the variable did not change the resultant model.

For those sore throat problems/diagnoses where in-consultation information or advice was sought, proportions of particular sources consulted were calculated with 95% CIs.

Statistical analyses were completed using STATA 13.1 and SAS v9.4. Predictors were considered statistically significant if the *P*-value was <0.05.

Results

A total of 856 individual trainees (response rate 95.2%) contributed 1832 trainee rounds of data (including details of 108 759 individual consultations and 169 303 problems/diagnoses).

The demographics of the participating trainees and practices are presented in Table 1.

Sore throat was managed in 2495 (2.3%) (95% CI: 2.2–2.4) encounters and comprised 1.5% (95% CI: 1.4–1.5) of problems/diagnoses managed. Antibiotics were prescribed for 1783 (71.5%) (95% CI: 69.7–73.2) of sore throat (R72, 76, 74008, 74006, 74017 and 21005 coded problems/diagnoses).

The individual antibiotics prescribed are presented in Table 2. The most commonly prescribed was phenoxymethylpenicillin or benzathine phenoxymethylpenicillin (62.5% of total antibiotics).

Associations of antibiotic prescribing for sore throat

Univariate associations of prescribing an antibiotic are presented in Table 3. There were significant univariate associations of antibiotics having been prescribed with patient age, with the patient not being new to the practice, with the problem being new (i.e. the initial presentation of a sore throat), with in-consultation advice or information being sought, with follow-up of the patient being arranged and with a greater number of problems being managed in the index consultation.

The multiple logistic regression models for prescribing of an antibiotic are presented in Table 4. An antibiotic was more likely to be prescribed by trainees working in inner-regional areas compared to major cities (Odds ratio 1.37, 95% CI: 1.05–1.79), and patients at

Table 1. Characteristics of participating trainees, practices and consultations (ReCEnT data collection rounds 2010–14)

Variable	Class	*n*[a]	% (95% CIs) or mean (SD)
Trainee variables (*n* = 856)			
Trainee gender	Female	562	65.7% (62.4–68.8)
Pathway trainee enrolled	General	641	75.2% (72.2–78.0)
	Rural	211	24.8% (22.0–27.8)
Qualified as a doctor in Australia	Yes	664	78.5% (75.6–81.1)
Trainee age (years)	Mean (SD)		32.5 (6.3)
Trainee-term or practice-term variables (*n* = 1832)			
Trainee training term	Term 1	765	42.8% (39.5–44.0)
	Term 2	538	29.4% (27.3–31.5)
	Term 3	454	24.8% (22.9–26.8)
	Term 4	75	4.1% (3.3–5.1)
Trainee works full-time	Yes	1395	77.8% (75.8–79.6)
Trainee worked at the practice previously	Yes	486	26.9% (24.9–29.0)
Practice routinely bulk bills[b]	Yes	317	17.4% (15.8–19.2)
Number of GPs working at the practice	1–4	604	33.7% (31.6–35.9)
	5–10+	1187	66.3% (64.1–68.4)
Rurality of practice	Major city	1060	57.9% (55.6–60.1)
	Inner-regional	521	28.4% (26.4–30.6)
	Outer regional/remote/very remote	251	13.7% (12.2–15.4)
SEIFA (decile) of practice[c]	Mean (SD)		5.4 (2.9)

[a]May not add to 865 or 1832 due to missing data.
[b]Consultation at no cost to the patient.
[c]Socioeconomic Index for Area (SEIFA) Relative Index of Disadvantage.

Table 2. Individual antibiotics prescribed by GP trainees for presentations of sore throat

Antibiotic name	Frequency	%
Phenoxymethylpenicillin	1 079	60.3
Amoxicillin	297	16.6
Roxithromycin	136	7.6
Cefalexin	103	5.8
Amoxicillin + enzyme inhibitor	41	2.3
Benzathine phenoxymethylpenicillin	39	2.2
Erythromycin	38	2.1
Cefaclor	21	1.2
Other antibiotics	37	2.1
Total	1 791	100

practices located in higher SEIFA deciles (that is, in areas with less socio-economic disadvantage) were more likely to be prescribed an antibiotic (OR 1.06, 95% CI: 1.01–1.10).

Information or advice was sought by trainees in 19.9% of consultations for sore throat. Trainees who prescribed an antibiotic were more likely to access information or advice during the consultation (OR 2.37, 95% CI: 1.65–3.40). Examining this further, this included asking a supervisor [on 17.8% (95% CI: 14.1–22.2) of occasions when advice was sought] or using online [71.5% (95% CI: 66.5–76.0)] or hardcopy [10.5% (95% CI: 7.7–14.1)] resources.

There was no reduction in antibiotic prescribing with greater level of experience (later training term). In fact, there was a non-significant trend to more prescribing in Term 2 compared to Term 1 (OR 1.19, 95% CI: 0.90–1.58) and significantly higher prescribing in Term 4.

There were no statistically significant differences between prescribing for patients in younger age groups (0–2 and 3–14 years compared with 15–50 year age group). There was significantly less prescribing for patients aged over 51 years. Aboriginal and Torres Strait Islander status was not significantly associated with antibiotic prescriptions, however, the total number of patients from this population was small.

Discussion

Patients presenting with acute sore throat were prescribed an antibiotic in 71.5% of instances. This is a very large proportion given that authoritative Australian guidelines state that most patients with sore throat do not require antibiotic treatment. It is recommended that antibiotics be reserved for patients at high risk of non-suppurative complications or patients with particularly severe clinical features suggestive of streptococcal infection (6). The rate of prescribing is well in excess of quality indicators for antibiotic prescribing in acute tonsillitis (13), and suggests that trainees are not prescribing antibiotics in an evidence-based manner.

Established Australian GPs' antibiotic prescribing rates are comparable at 88.1% of presentations for sore throat (14). To compare this with other high-income countries, one study of Dutch GPs reported antibiotics prescribed in 33% of consultations for sore throat (15), and US physicians prescribed antibiotics in 60% sore throat presentations (2).

This report builds on previous work describing trainees' prescribing of antibiotics for upper respiratory tract infection and acute bronchitis (16), which similarly showed non-evidence-based prescribing patterns. GP trainees see more acute presentations than their more established colleagues, including a high rate of respiratory infections (17). Inappropriate antibiotic prescribing by trainees in these conditions is therefore a concern in its own right as a contribution to high rates of community antibiotic use, as well as for the longer term effects on trainee prescribing patterns.

Penicillin is the recommended first-line antibiotic for treatment of bacterial pharyngitis (6)—trainees are adhering to this choice in somewhat more than half the cases, and fall short of quality indicators for this condition (13). Our data does not include individual patients' contextual information including penicillin allergy so we cannot assess the appropriateness of prescribing decisions for other antibiotics, for example cefalexin and roxithromycin. However, the frequency of use of amoxicillin, and amoxicillin plus enzyme inhibitor (together accounting for 18.9% of antibiotics prescribed) suggests that penicillin allergy may not be a major factor in the inappropriate prescribing rate.

The lack of significant association of prescribing with younger patient age group is notable. Though there were significant differences on univariate analyses, these were of small effect size and on multivariable analyses the differences were no longer significant. Streptococcal pharyngitis is most prevalent in the age group 5–15 years (3). That those in this age group did not receive significantly more prescriptions for antibiotics than those in younger (0–2 years) and older (15–50 years) age groups suggests that trainees may not be considering the epidemiology of streptococcal as opposed to viral infections in their prescribing decisions.

Another explanation for these high prescribing rates could be patient pressure. This is often cited in the literature as a major driver for antibiotic prescribing (9), in spite of evidence from multiple sources that patient demand for antibiotics might be related to lack of information or concerns about the course of their disease (18). Patients from higher socio-economic areas were more likely to be prescribed an antibiotic, potentially due to pressure placed on the doctor by a more affluent demographic.

We found a significant association of antibiotic prescribing with practice location in an inner-regional area and a non-significant association with rural/remote location (both compared with major city practices). This may relate to the greater access to care in major cities. Lesser access to a follow-up consultation may lead a trainee to prescribe more liberally at the index consultation. Concerns regarding access to medications and further medical attention are reasons noted by trainees (10) and experienced practitioners for increased likelihood to prescribe an antibiotic.

The association of in-consultation information and advice seeking with antibiotic prescribing is seemingly anomalous. Authoritative Australian evidence-based guidelines, if accessed, recommend restricted prescribing (6). In consultations where an antibiotic was prescribed, 19.9% of trainees sought advice. Of these, many used electronic (71.5%) or hardcopy (10.5%) resources [including Australian Therapeutic Guidelines (6)], and 17.8% consulted a supervisor. Trainees may seek advice or information for more severely ill patients (in whom antibiotic prescription may be appropriate) and this may contribute to the association of information seeking with antibiotic prescribing. Given the very high prescribing rates and use of electronic resources, however, we hypothesize that trainees are consulting resources for dose checking without enacting the clear recommendations against antibiotic prescribing for most cases of sore throat.

In a previous qualitative study, we found that GP trainees acknowledge the transition to general practice from their initial training in the hospital to primary care as a shift from an environment of low-prevalence/high-morbidity infections and (appropriately) aggressive antibiotic treatment to a community environment of high-prevalence/low-morbidity infections that often do not require antibiotics (10). We would therefore expect that trainees

Table 3. Associations of prescribing of antibiotics by GP trainees for presentations of sore throat: univariate analyses

	Variable	Class	Antibiotics prescribed		
			No (n = 712)	Yes (n = 1783)	P
Patient factors	Patient age group	0–2	60 (8.5%)	149 (8.4%)	0.002
		3–14	193 (27.5%)	566 (32.0%)	
		15–50	365 (51.9%)	923 (52.2%)	
		51+	85 (12.1%)	130 (7.4%)	
	Patient gender	Male	256 (37.0%)	701 (40.2%)	0.103
		Female	435 (63.0%)	1042 (59.8%)	
	Aboriginal or Torres Strait Islander	No	672 (99.1%)	1671 (98.9%)	0.650
		Yes	6 (0.9%)	18 (1.1%)	
	Non-English speaking background	No	645 (94.9%)	1623 (95.5%)	0.653
		Yes	35 (5.1%)	76 (4.5%)	
	Patient/practice status	Existing patient	230 (32.8%)	456 (26.1%)	0.0001
		New patient to trainee	436 (62.1%)	1132 (64.9%)	
		New patient to practice	36 (5.1%)	156 (8.9%)	
Trainee factors	Trainee gender	Male	271 (38.1%)	655 (36.7%)	0.507
		Female	441 (61.9%)	1128 (63.3%)	
	Trainee age	mean (SD)	33.5 (7.3)	33.4 (7.1)	0.744
	Employed full-time or part-time	Part-time	160 (22.9%)	350 (20.0%)	0.215
		Full-time	538 (77.1%)	1399 (80.0%)	
	Training term	Term 1	310 (43.5%)	726 (40.7%)	0.092
		Term 2	210 (29.5%)	547 (30.7%)	
		Term 3	173 (24.3%)	421 (23.6%)	
		Term 4	19 (2.7%)	89 (5.0%)	
	Worked at the practice previously	No	521 (73.9%)	1289 (72.8%)	0.734
		Yes	184 (26.1%)	481 (27.2%)	
	Qualified as a doctor in Australia	No	194 (27.8%)	478 (27.1%)	0.928
		Yes	505 (72.2%)	1286 (72.9%)	
Practice factors	Practice size	Small	244 (34.9%)	554 (31.5%)	0.089
		Large	456 (65.1%)	1206 (68.5%)	
	Practice routinely bulk bills	No	586 (82.5%)	1447 (81.8%)	0.931
		Yes	124 (17.5%)	321 (18.2%)	
	Rurality	Major city	453 (63.6%)	1058 (59.3%)	0.078
		Inner-regional	172 (24.2%)	518 (29.1%)	
		Outer regional/remote	87 (12.2%)	207 (11.6%)	
	SEIFA Index (decile)[a]	Mean (SD)	5.7 (2.9)	6.0 (2.8)	0.052
Consultation factors	Sought in-consultation advice	No	649 (91.2%)	1429 (80.1%)	<0.0001
		Yes	63 (8.8%)	354 (19.9%)	
	Pathology ordered	No	642 (90.2%)	1586 (89.0%)	0.352
		Yes	70 (9.8%)	197 (11.0%)	
	Imaging ordered	No	711 (99.9%)	1783 (100%)	0.285 (exact)
		Yes	1 (0.1%)	0 (0%)	
	Follow-up ordered	No	501 (70.4%)	1174 (65.8%)	0.024
		Yes	211 (29.6%)	609 (34.2%)	
	Learning goals	No	637 (91.9%)	1601 (92.3%)	0.848
		Yes	56 (8.1%)	133 (7.7%)	
	Referral ordered	No	685 (96.2%)	1737 (97.4%)	0.103
		Yes	27 (3.8%)	46 (2.6%)	
	New problem	No	132 (19.8%)	133 (8.2%)	<0.0001
		Yes	533 (80.2%)	1489 (91.8%)	
	Number of problems	Mean (SD)	1.5 (0.8)	1.3 (0.6)	<0.0001
	Consultation duration (min)	Mean (SD)	14.5 (7.2)	14.0 (6.0)	0.137

[a]SEIFA—Socioeconomic Index for Area (SEIFA) Relative Index of Disadvantage.

in the later stages of their GP training would prescribe antibiotics less frequently. However, our findings are contrary to this expectation, which suggests that the current apprenticeship model of GP training (in place in Australia and many other countries) may not be (in the area of antibiotic prescribing) adequately supporting trainees through the transition to community practice (19). Our finding, however, should be treated with some caution. Our analysis is cross-sectional and the lack of difference may reflect cohort effects rather than lack of temporal changes in trainees' prescribing.

Strengths and limitations of the study

To our knowledge, ReCEnT is the largest study of trainee GPs. The large sample size includes trainees from five training regions across five Australian states, located in major city to very remote areas. The profile of trainees sampled by ReCEnT is similar to that of the population of GP trainees in Australia. The high response rate 95.2% is an important strength.

Our data, however, do not allow judgement of the clinical appropriateness of individual prescribing decisions (20). We are also

Table 4. Associations of prescribing of antibiotics by trainees for presentations of sore throat: multiple logistic regression analysis

	Variable (referent)	OR (95% CI)	*P*-value
Patient factors	Patient age (15–50)		
	0–2	0.95 (0.68, 1.34)	0.778
	3–14	1.12 (0.89, 1.43)	0.336
	51+	0.66 (0.48, 0.90)	0.009
	New patient to trainee	1.00 (0.79, 1.25)	0.981
	New patient to practice	1.57 (1.03, 2.39)	0.036
Trainee factors	Female	0.92 (0.76, 1.13)	0.425
	Training term (1)		
	2	1.19 (0.90, 1.58)	0.232
	3	1.05 (0.80, 1.39)	0.704
	4	2.10 (1.08, 4.08)	0.029
Practice factors	Rurality (urban)		
	Inner-regional	1.37 (1.05, 1.79)	0.019
	Outer regional/remote/very remote	1.32 (0.88, 1.99)	0.181
	Practice size (large)	1.13 (0.89, 1.44)	0.316
	SEIFA Index decile[a]	1.06 (1.01, 1.10)	0.018
Consultation factors	Follow-up ordered	1.26 (1.00, 1.58)	0.053
	Sought in-consultation advice/information	2.37 (1.65, 3.40)	<0.0001
	New problem	2.66 (1.99, 3.55)	<0.0001
	Number of problems	0.75 (0.64, 0.87)	0.0002
	Consultation duration	1.00 (0.97, 1.02)	0.643

[a]SEIFA—Socioeconomic Index for Area (SEIFA) Relative Index of Disadvantage.

unable to determine whether prescriptions written were filled or consumed by patients—however, prescribing decisions made by trainees precede subsequent patient behaviour.

A further limitation is that the largest burden of complications of Group A streptococcal pharyngitis is in the Australian Aboriginal and Torres Strait Islander population (6). Our analysis is not powered to examine the effect of Aboriginal and Torres Strait Islander status on trainees' antibiotic prescribing.

Conclusions

The very high frequency of antibiotic prescribing and the lack of attenuation in prescribing frequency in more senior terms suggest (despite the caveats outlined above) that both current educational interventions and the apprenticeship model of training are failing to foster appropriate clinical practice during the transition from hospital to community practice in this important clinical area. Targeted educational interventions, which may need to include supervisors as well as trainees, are indicated. Our results suggest that education encouraging application of evidence, epidemiology and guidelines to everyday clinical practice might be of benefit to early-career doctors in general practice.

Declaration

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