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MANAGEMENT OF URINARY TRACT INFECTION BY EARLY-CAREER GENERAL PRACTITIONERS IN AUSTRALIA

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MANAGEMENT OF URINARY TRACT INFECTION BY EARLY-CAREER GENERAL PRACTITIONERS IN AUSTRALIA

ABSTRACT

Rationale, aims and objectives

Urinary tract infection (UTI) is a common presentation to general practitioners (GPs). There is increasing antimicrobial resistance in urinary pathogens in many healthcare systems. Adherence to principles of antimicrobial stewardship is important to combat this problem. Our aim was to describe the prevalence of presentations of clinically diagnosed new urinary tract infection to early-career general practitioners, to describe management choices made, and identify associations of prescribing antibiotics at the index consultation for urinary tract infection.

Method

A cross-sectional analysis of the Registrar Clinical Encounters in Training cohort study. Early-career general practitioners from five Australian states (urban to very remote practices) collected data on 60 consecutive patient encounters during each of three six-month training terms. Proportions of problems being new UTIs, antibiotics prescribed, urine microscopy and culture ordered, were calculated. Univariate and multivariable logistic regression established associations of patient, registrar and practice factors with prescribing antibiotics for a new UTI.

Results

1,333 early-career GPs diagnosed 2,850 new UTIs from 189,736 consultations (1.5% [95%CI 1.4-1.6]). Antibiotics were prescribed at 86% [95%CI 84.7-87.2] of these index consultations. Antibiotic choice followed Australian therapeutic guideline recommendations. Urine microscopy and culture was requested at the index consultation less than recommended by guidelines in men, 69.2% [95%CI 62.6-75.1], and children, 80.8% [95%CI 76.4-84.6]. Adults were significantly more likely to be treated with antibiotics at the index consultation than children under 16.

Conclusions

A new UTI is a common presentation to Australian early-career GPs. There is general adherence to guidelines for antibiotic choice in UTIs. Further research is needed, however, to understand some decisions made when managing UTI in children and men. This may reflect diagnostic uncertainty with consequent attention to antibiotic stewardship by deferring antibiotic prescription.

Keywords:

Urinary tract infections; General Practitioners; Prevalence; Anti-bacterial agents; Cross-sectional studies

MAIN TEXT

Introduction

Symptomatic urinary tract infection (UTI) is a common presentation to general practitioners (GP). In 2015-2016, new UTI was managed in 1.2% of Australian GP consultations, and was the 5th most common new problem managed.[1] In 2007, UTI represented 0.9% of all ambulatory visits in the USA.[2] In Canada, patients' self-reported history of physician diagnosis of one or more UTI was 12.6% per year for women and 3% per year for men.[2]

The most common cause of UTI is E. coli (51% to 73%) followed by other bacteria such as Enterococcus, Klebsiella and Proteus species.[3-5] Therefore, antibiotics are generally accepted as the standard of care for UTI but, as with any antibiotic use, creating resistance through overuse is a concern. Studies of non-antibiotic strategies for uncomplicated UTI in women concluded that although non-steroidal anti-inflammatories alone could be used in mild to moderate cases, they had inferior symptom control compared to antibiotics and there was possibly a higher risk of progressing to pyelonephritis.[6-8] More worryingly recent reports have concluded that delaying antibiotics may increase bloodstream infection and all-cause mortality in community-dwelling elderly.[9]

There is significant antimicrobial resistance to antibiotics used for UTI: in a French study, 25.5% of E. coli were resistant to trimethoprim-sulfamethoxazole, 17% to ofloxacin, 5.6% to cefixime and 2.2% to nitrofurantoin.[5] In an Australian study, 42% of E. coli were resistant to ampicillin and 21% to trimethoprim. Over the 5-years of that study there was a concerning increase in resistance to other commonly-used antibiotics.[3]

Guidelines recommend use of antibiotics for UTI. However, in the context of increasing antibiotic resistance it is important to promote judicious use. Antibiotic stewardship might entail: courses of

antibiotics for no longer than needed,[10] not prescribing antibiotics if there isn't a UTI (involving decisions regarding empirical treatment versus waiting for confirmation), and 'getting the antibiotic right' first time.[11]

Local patterns of UTI microbial aetiology, antimicrobial resistance and resource availabilities will determine the choice of antibiotic for treatment of UTI recommended by local evidence-based guidelines. In Australia the authoritative guidelines are the national 'Therapeutic Guidelines: Antibiotic' which are usually accessed electronically (eTG).[12]

Early-career general practitioners include specialist trainees in general practice - called 'GP-registrars' in Australia. These GP-registrars are in their first 18 months of clinical general practice and are at a formative phase in establishing their prescribing practices. They have prescribing rights equivalent to established GPs and considerable autonomy of practice, though with access to advice from their clinical supervisor on request. There is evidence that earlier career antibiotic prescribing patterns persist into later practice.[13] There is no existing evidence regarding the management practices of early-career GPs for UTI.

We aimed to describe the prevalence of clinically diagnosed new UTI presentations to GP-registrars; the proportion of new UTIs for which antibiotics were prescribed at the index consultation (and the associations of an antibiotic being prescribed); the specific antibiotics prescribed; and the proportion of new UTIs for which a mid-stream urine microscopy/culture/sensitivity (MSU) was ordered at the index consultation.

Methods

Participants

This was a cross-sectional analysis of data from the Registrar Clinical Encounters in Training (ReCEnT) cohort study. Data were from 14 rounds of data collection, 2010-16. The study methodology has been described in detail elsewhere.[14] Briefly, ReCEnT is an ongoing cohort study of GP-registrars' in-practice clinical experiences undertaken (2010-2015) in five of Australia's then seventeen Regional Training Providers (RTPs) across five states, and (in 2016) in three of Australia's current nine Regional Training Organisations (RTOs) across three states. These encompass major city, regional, remote and very remote practices. In this report, RTOs/RTPs will be referred to as 'regions'.

Procedures

Participating GP-registrar characteristics (at baseline) and the characteristics of their current training practice (in each six-month training term) are documented. GP-registrars then record the details of sixty consecutive office-based consultations (representing approximately one week of consultations) once in each of three compulsory six-month general-practice-based training terms (at approximately mid-term).

Outcome factors

The primary outcome factor was whether an antibiotic was prescribed at the index consultation for a 'new UTI' problem/diagnosis. Secondary outcome factors were a problem/diagnosis being a UTI (versus a non-UTI problem/diagnosis); the specific antibiotic prescribed for a 'new UTI' problem/diagnosis; and whether a mid-stream urine microscopy/culture/sensitivity (MSU) was requested for a 'new UTI' problem/diagnosis.

'New UTI' was a clinical problem/diagnosis made by the GP-registrar and recorded as being 'new' at the time of the index consultation. This definition included new episodes of UTI even if the patient had a history of previous UTIs. GP-registrars were requested to record provisional diagnoses (in the case of UTIs this would include presumptive UTI even if awaiting MSU result for confirmation). Problems/diagnoses addressed in the consultation were coded according to the International Classification of Primary Care, second edition (ICPC-2).(14) UTI problems/diagnoses were defined by ICPC-2 codes beginning U71 (cystitis/urinary infection) and U70 (pyelonephritis/pyelitis), excluding U71002 (trigonitis), U71003 (bacteriuria), U71005 (chronic cystitis), U71024 (interstitial cystitis), and U70007 (renal abscess).

Medications prescribed were classified using the Anatomic Therapeutic Chemical (ATC) Classification codes[15] with antibiotics defined by the medications code 'J01'.

Independent variables

Explanatory variables related to patient, GP-registrar, practice and consultation factors.

Patient factors were age, gender, Aboriginal or Torres Strait Islander status, non-English-speaking background (NESB) status, and whether the patient was a new patient for the GP-registrar or practice.

GP-registrar factors were age, gender, FTE status, training term, place of medical qualification (Australia or international), region (RTP/RTO enrolled with), and whether they had worked at the practice in previous terms.

Practice factors were practice size (full-time equivalent number of GPs), routinely bulk-bills (that is, there is no financial cost to the patient for the consultation), rurality, and socio-economic status of

the practice location. Practice postcode was used to define the Australian Standard Geographical Classification-Remoteness Area (ASGC-RA) classification[16] (the degree of rurality) and the Socioeconomic Index for Areas (SEIFA) Index of Disadvantage[17] of the practice location.

Consultation factors were duration of consultation, number of problems/diagnoses dealt with, pathology or imaging ordered, referral made, whether the GP-registrar sought clinical information or assistance during the consultation (from their GP supervisor, a specialist, other health professional, or from electronic or hard-copy resources), whether a follow-up consultation was ordered, and whether they generated any 'learning goals' (clinical questions to be pursued after the consultation had finished).

Data Analysis

Analyses were at the level of the problem/diagnosis and were interpreted in relation to the eTG that were current at the time of collecting data.

The proportion of all problems/diagnoses that were a new UTI was calculated with 95% Confidence Interval (95% CI).

In analyses confined to those problems classified as a new UTI, univariate and multivariable logistic regressions were conducted to determine the associations of prescribing an antibiotic. Logistic regression was used within the generalised estimating equations (GEE) framework to account for repeated measures within GP-registrars. An exchangeable working correlation structure was assumed. Covariates with a p-value < 0.20 in the univariate analysis were considered for inclusion in the multivariable regression model. Covariates which were no longer significant (at $p < 0.20$) in the multivariable model were removed from the final model providing the covariate's removal did not substantively change the resulting model.

The proportions of individual antibiotics prescribed for new UTIs at the index consultation were calculated. The proportion of new UTIs for which an MSU was ordered and for which antibiotics were prescribed at the index consultation were calculated with 95% CIs.

In post hoc analyses, the proportions of each source of in-consultation information or assistance, the proportion of MSU ordered and antibiotic prescribed for treatment subgroups in the eTG (females aged 16 years or older, males aged 16 years or older, all children aged under 16 years), and the proportion of new UTIs for which neither an antibiotic was prescribed nor an MSU requested were calculated.

Analyses were programmed using Stata 13.1 (Statacorp, College Station, TX, USA) and SAS V9.4 (SAS Institute Inc., Cary, NC, USA).

Ethics approval

The ReCEnT project has approval from the University of Newcastle Human Research Ethics Committee, Reference H-2009-0323.

Results

1,333 GP-registrars (response rate 95.8%) contributed data from 189,736 consultations comprising 3,195 registrar-rounds of data collection. The characteristics of GP-registrars and their practices are presented in Table 1. There were 293,824 problems/diagnoses recorded. Patients with a new UTI (n=2,850) represented 0.97% [95%CI 0.94-1.01] of all problems/diagnoses in 1.5% [95%CI 1.4-1.6] of consultations. New UTI represented 2,186 (1.4% [95%CI 1.3-1.5]) problems for females aged 16 years and over, 211 (0.25% [95%CI 0.22-0.28]) problems for males aged 16 years and over, and 365

(0.85% [95%CI 0.76-0.94]) problems for patients aged under 16 years. Of 2,850 patients with a new UTI, 2,461 (86.4% [95%CI 85.0-87.6] were prescribed antibiotics at the index consultation.

Characteristics of consultations involving a new UTI are presented in Table 2. Results for univariate and multivariable modelling are presented in Table 3.

The multivariable model demonstrated several significant associations. Treating a new UTI problem with antibiotics at the index consultation was significantly more likely for adult patients than for children (age under 16). Term 3 GP-registrars, or those whose initial medical qualification was from Australia were more likely to treat a new UTI with antibiotics. GP-registrars seeking in-consultation information or assistance, not making a referral to other health professionals, or addressing fewer problems (than consultations not involving a new UTI) were also more likely when prescribing antibiotics for a new UTI.

In-consultation information or assistance was sought in 427 (17.4% [95%CI 15.9-18.9] of new UTI where an antibiotic was prescribed. Overwhelmingly the most common source used for in-consultation information/assistance was an electronic source, 343 problems (80.3% [95%CI 76.3-83.8]), followed by advice from the supervisor or another doctor in the practice, 69 problems (16.2% [95%CI 13.0-20.0]). The most common electronic source was the eTG which was used in 68.2% [95%CI 63.1-72.8] of instances of electronic information/assistance seeking.

The proportions of individual antibiotics prescribed for a new UTI are shown in Table 4. These proportions follow the order of choices recommended by the eTG for treatment of UTI in adult women and men. For children, the eTG recommends trimethoprim containing medications first followed by cefalexin, but that order is reversed in our data. The other antibiotic choices follow the order recommended by the eTG.

An MSU was ordered in 1,702 (77.9% [95%CI 76.1-79.6]) of new UTI problems/diagnoses in females aged 16 years or older, 146 (69.2% [95%CI 62.6-75.1]) for males aged 16 years or older, and 295 (80.8% [95%CI 76.4-84.6]) for patients under 16 years old.

An antibiotic was prescribed at the index consultation in 1,936 (88.6% [95%CI 87.2-89.8]) of problems for a new UTI in females aged 16 years or older, 174 (82.5% [95%CI 76.7-87.1]) for males aged 16 years or older, and 275 (75.3% [95%CI 70.6-79.5]) for patients under 16 years of age.

No MSU was ordered and no antibiotics were prescribed at the index consultation in 43 (2.0% [95%CI 1.5-2.6]) of new UTI in females aged 16 years or older, 14 (6.6% [95%CI 4.0-10.9]) for males aged 16 years or older, and 11 (3.0% [95%CI 1.7-5.4]) for all patients under 16 years old. Of this total of 72 problems, 37 had some other action(s) taken: 23 had specific follow-up arranged in the practice, 11 had other pathology tests and imaging ordered, 4 were referred to the emergency department, 4 were treated with a urine alkaliniser, 1 was referred for urologist review.

Discussion

We found UTI to be a frequent problem, being seen in 1.5% of consultations, comparable with established Australian GPs' practice who manage a new UTI in 1.2% of consultations.[1]

Our finding that 86.4% of all new UTIs prompted an antibiotic prescription at the index consultation is consistent with the eTG recommendation of empirical antibiotic treatment for UTI.

However, an antibiotic being prescribed for a new UTI at the index consultation was significantly more likely for adults than for children. An antibiotic was only prescribed at 75.3% of consultations with children. Since there are practical barriers to obtaining a urine sample from younger children at

the index consultation, it is possible that prescription of antibiotics may sometimes have been deferred until more data was available to guide decision-making.

Associations with consultations involving fewer problems managed and with not being referred are consistent with a new UTI often being an acute uncomplicated problem that is confidently treated in primary care. The finding, however, that GP-registrars are more likely to treat with antibiotics in their final training term likely reflects some degree of clinical uncertainty in diagnosis in earlier terms which attenuates with increasing experience in the general practice setting.

Our data showed that empiric antibiotic choice followed the eTG recommendations for each group considered (women >=16years, men >=16years, children<16).[12] We do not have the data to comment on UTI in pregnant women but we would expect a similar concordance with guidelines based upon our findings in the other groups. This adherence to guidelines is supported by the positive association with in-consultation information-seeking for new UTI. When in-consultation help was sought (17.4% of all new UTI consultations) the substantial majority used the eTG.

There was some use of amoxicillin alone as empiric treatment in each group. It is not a recommended choice for empirical therapy. This was most prevalent in children (6.7%) and points to an evidence-practice gap that could be addressed by targeted education of early-career GPs while their prescribing habits are becoming established.

Also, there was a high proportion of ordering an MSU in each group analysed. For women >=16 years it was 77.9% but the eTG advises that an MSU is not mandatory for uncomplicated cystitis in non-pregnant women (it is mandatory in pregnant women). This high proportion of MSU may reflect concerns about antibiotic resistance which is known to be increasing in the community.[3] For men >=16 years, MSU was ordered in 69.2% but the eTG recommends that all men with suspected UTI

should have an MSU (all UTI are considered as complex in males). For children under 16 years our early-career GPs ordered an MSU in 80.8% even though the eTG recommends that an MSU is mandatory in this group whenever UTI is suspected. These results may also indicate an evidence-practice gap that could be addressed by education. But they could also reflect the relatively greater difficulty in making a diagnosis of UTI in children and in obtaining a urine sample for dipstick testing in younger children. That is, our findings may reflect a temporal disconnect of provisional diagnosis and antibiotic prescription - between index and subsequent consultations – with clinical uncertainty leading to delay in prescribing while awaiting diagnostic confirmation. This may also be the case in male patients where the pre-test probability of UTI may frequently be lower than in female patients.

Of the 72 problems where no antibiotic was prescribed and no MSU ordered at the consultation, 37 had some form of appropriate action taken that is consistent with a review appointment of a prior undiagnosed problem. In the remaining cases, it is possible that symptoms were resolving at the time of the index consultation and patients elected a conservative course of action (fluid intake/urine alkalinisation/non-steroidal anti-inflammatory) for the presumptive UTI. It is also possible that actions taken in the remaining cases may not have been recorded in our data collection method (for example, the patient already having taken 'standby' medication but still presenting for review or for work/carers certificate etc).

Limitations and Strengths

Our study's high response rate, unusual for studies in general practice,[18] is a strength.

A limitation is our reliance upon the GP-registrar identifying a problem as a new UTI, and so our estimate of prevalence of new UTI presentations is subject to risk of misdiagnosis. UTI is usually a straightforward diagnosis and this risk is likely to be modest. However, our findings of compliance

with recommended investigation and management are robust given that these depend upon the diagnosis at the time of the consultation, and that we have consultation-level documentation of the actual management choices made by the GP-registrars.

Our methodology does not identify which patients were pregnant and does not include aged-care residents, which means we are unable to comment on adherence to the eTG recommendations for those groups. We are unable to account for patients who may not need a new antibiotic prescription written at the index consultation, for example having used a pre-existing prescription held on 'standby' for recurrent UTI, or a repeat prescription from previous UTI treatment. Although our methodology calls for participants to record medications which are recommended be taken even if no prescription is written at the index consultation, adherence to this may not be as stringent as to recording of prescribed medicines. This may explain a proportion of new UTI where an antibiotic prescription was not written.

Implications for practice and further research

Even though our early-career general practitioners seem to adhere to guidelines for the management of acute uncomplicated UTIs, it is unclear if the recommendations regarding duration and dose are followed. Also, the broad range of antibiotics recommended in guidelines may not serve antimicrobial stewardship efforts.

The association of non-prescription of antibiotics at the index consultation with children and male adults may reflect delayed prescribing (awaiting diagnostic conformation) consequent upon clinical uncertainty in these harder-to-diagnose or lower pre-test probability groups. This may, in turn, reflect prudent antibiotic stewardship – avoiding antibiotics in situations not requiring them. There

is, however, evidence that delaying antibiotic commencement in UTIs may result in higher risk of pyelonephritis,[6-8] and bloodstream infection and all-cause mortality in the elderly.[9]

Thus, antibiotic prescribing in suspected UTIs may not always be as straightforward as is assumed. In this situation, there is scope for qualitative research to understand the decision-making regarding ordering an MSU and prescribing an antibiotic for new UTI in children and males 16 years or older.

Conclusion

A new UTI is a common presentation for Australian early-career GPs and occurs with a similar frequency to established GPs in Australia. Further research is needed to understand some decisions made when managing UTI in children and adult men. However, early career general practitioners have demonstrated adherence to Australian guidelines for antibiotic choice in UTI.

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Conflict of Interest

The authors declare no conflicts of interest.

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Table 1: Demographics of participating GP-registrars and their practices.

Variable	Class	n (%)
Registrar variables (n=1333)		
Gender	Male	462 (34.7)
Qualified as a doctor in Australia	Yes	1064 (80.5)
Pathway	General	968 (73.2)
Registrar-term or practice-term variables (n=3195)		
Registrar training term	Term 1	1233 (38.6)
	Term 2	1140 (35.7)
	Term 3	822 (25.7)
Registrar age (years)	Mean (SD)	32.6 (6.3)
Registrar worked at practice previously	Yes	837 (26.6)
Registrar works full-time	Yes	2418 (77.6)
Practice routinely bulk bills	Yes	561 (17.9)
Number of GPs working at practice	5 or more	2045 (65.8)
Rurality of practice	Major city	1833 (57.4)
	Inner regional	839 (26.3)
	Outer regional or remote	519 (16.3)
SEIFA (decile) of practice	Mean (SD)	5.6 (2.9)

Note: SEIFA=Socio-Economic Indexes for Areas for Disadvantage; SD=Standard Deviation.

Table 2: Characteristics of antibiotic prescribing in index consultations involving a new UTI

Factor group	Variable	Class	No antibiotic prescribed	Antibiotic prescribed	P
Patient factors	Patient age/gender	<16yrs	90 (24%)	275 (12%)	<0.001
		Males >=16 years	37 (10%)	174 (7%)	
		Females >=16 years	250 (66%)	1936 (81%)	
	Aboriginal or Torres Strait Islander	No	360 (99%)	2297 (99%)	0.68
		Yes	5 (1%)	28 (1%)	
	NESB[#]	No	350 (94%)	2206 (94%)	0.91
		Yes	23 (6%)	138 (6%)	
	Patient/practice status	Existing patient	135 (36%)	759 (31%)	0.04
		New to registrar	207 (55%)	1474 (61%)	
		New to practice	37 (10%)	178 (7%)	
Registrar factors	Registrar gender	Male	110 (28%)	741 (30%)	0.43
		Female	279 (72%)	1720 (70%)	
	Registrar Full Time or Part Time	Part-time	93 (24%)	558 (23%)	0.59
		Full-time	288 (76%)	1857 (77%)	
	Term	Term 1	163 (42%)	940 (38%)	0.18
		Term 2	144 (37%)	886 (36%)	
		Term 3	82 (21%)	635 (26%)	
	Worked at practice previously	No	274 (72%)	1794 (74%)	0.53
		Yes	106 (28%)	633 (26%)	
	Qualified as doctor in Australia	No	112 (29%)	518 (21%)	0.003
		Yes	274 (71%)	1923 (79%)	
	Registrar age	mean (SD)	34 (7)	32 (6)	0.002
Practice factors	Practice size	Small	122 (32%)	786 (33%)	0.36
		Large	260 (68%)	1624 (67%)	
	Practice routinely bulk bills	No	309 (81%)	2049 (85%)	0.16

Factor group	Variable	Class	No antibiotic prescribed	Antibiotic prescribed	P
		Yes	72 (19%)	374 (15%)	
	Rurality	Major city	206 (53%)	1403 (57%)	0.28
		Inner regional	129 (33%)	722 (29%)	
		Outer regional/ remote	54 (14%)	335 (14%)	
	Region	Region 1	131 (34%)	738 (30%)	0.07
		Region 2	63 (16%)	284 (12%)	
		Region 3	45 (12%)	306 (12%)	
		Region 4	140 (36%)	1052 (43%)	
		Region 5	10 (3%)	81 (3%)	
	SEIFA* index	mean (SD)	6 (3)	6 (3)	0.12
Consultation factors	Chronic problem	No	389 (100%)	2461 (100%)	
	Sought help any source	No	342 (88%)	2034 (83%)	0.01
		Yes	47 (12%)	427 (17%)	
	Pathology ordered	No	79 (20%)	504 (20%)	0.90
		Yes	310 (80%)	1957 (80%)	
	Imaging ordered	No	374 (96%)	2359 (96%)	0.87
		Yes	15 (4%)	102 (4%)	
	Follow-up ordered	No	162 (42%)	1137 (46%)	0.30
		Yes	227 (58%)	1324 (54%)	
	Learning goals generated	No	324 (89%)	2149 (92%)	0.17
		Yes	39 (11%)	195 (8%)	
	Referral ordered	No	369 (95%)	2427 (99%)	<0.001
		Yes	20 (5%)	34 (1%)	
	Consultation duration	mean (SD)	21 (11)	18 (8)	<0.001
	Number of problems	mean (SD)	2 (1)	2 (1)	<0.001

* Socioeconomic Index for Areas of Disadvantage

Non-English-Speaking Background

Table 3: Associations with an antibiotic being prescribed at the index consultation for a new UTI

			Univariate		Adjusted*	
Factor group	**Variable**	**Class**	**OR (95% CI)**	**P**	**OR (95% CI)**	**p**
Patient factors	Patient age/gender (referent: children < 16 years)	Females >=16 years	2.46 (1.87, 3.24)	<0.001	3.53 (2.53, 4.92)	<0.01
		Males >=16 years	1.52 (1.00, 2.30)	0.05	2.14 (1.33, 3.44)	0.002
Registrar factors	Term (referent: Term 1)	Term 2	1.06 (0.82, 1.36)	0.67	1.12 (0.85, 1.48)	0.43
		Term 3	1.31 (0.98, 1.74)	0.07	1.51 (1.09, 2.09)	0.01
	Qualified as doctor in Australia	Yes	1.52 (1.15, 2.00)	0.003	1.66 (1.20, 2.28)	0.002
Practice factors	Practice routinely bulk bills	Yes	0.80 (0.59, 1.09)	0.16	0.78 (0.55, 1.10)	0.15
	Region (referent: Region 1)	Region 2	0.82 (0.55, 1.22)	0.33	0.73 (0.47, 1.14)	0.17
		Region 3	1.22 (0.83, 1.79)	0.31	1.32 (0.84, 2.09)	0.23
		Region 4	1.34 (1.01, 1.77)	0.04	1.18 (0.85, 1.63)	0.33
		Region 5	1.49 (0.77, 2.88)	0.24	1.26 (0.60, 2.65)	0.54
Consultation factors	Sought information/assistance	Yes	1.49 (1.08, 2.04)	0.01	2.38 (1.62, 3.49)	<0.001
	Learning goals generated	Yes	0.78 (0.54, 1.11)	0.17	0.87 (0.57, 1.32)	0.51
	Referral ordered	Yes	0.28 (0.15, 0.51)	<0.001	0.33 (0.15, 0.72)	0.006
	Consultation duration		0.96 (0.95, 0.98)	<0.001	0.99 (0.97, 1.00)	0.12
	Number of problems		0.62 (0.56, 0.69)	<0.001	0.61 (0.53, 0.70)	<0.001

* Hosmer-Lemeshow chi=28.27 p=0.058, indicating the model was a good fit. The c-statistic for the analysis was 0.727, indicating a good model.

Table 4: Most common antibiotics prescribed for a new UTI

Anitbiotic	**Female 16 years and older n=1,938 (%)**	**Male 16 years and older n=176 (%)**	**All under 16 years old n=280 (%)**
Trimethoprim	1016 (50.1)	80 (45.2)	41 (14.5)
Cefalexin	699 (34.9)	57 (32.2)	166 (58.7)
amoxicillin and enzyme inhibitor	118 (5.9)	23 (13.0)	23 (8.1)
Amoxicillin	34 (1.7)	5 (2.8)	19 (6.7)
Nitrofurantoin	31 (1.6)	1 (0.6)	5 (1.8)
Norfloxacin	23 (1.2)	5 (2.8)	0
sulfamethoxazole and trimethoprim	6 (0.3)	2 (1.1)	16 (5.7)

= Empiric antibiotic choice recommended by eTG (electronic Therapeutic Guidelines)

Table 1: Demographics of participating GP-registrars and their practices.

Variable	Class	n (%)
Registrar variables (n=1333)		
Gender	Male	462 (34.7)
Qualified as a doctor in Australia	Yes	1064 (80.5)
Pathway	General	968 (73.2)
Registrar-term or practice-term variables (n=3195)		
Registrar training term	Term 1	1233 (38.6)
	Term 2	1140 (35.7)
	Term 3	822 (25.7)
Registrar age (years)	Mean (SD)	32.6 (6.3)
Registrar worked at practice previously	Yes	837 (26.6)
Registrar works full-time	Yes	2418 (77.6)
Practice routinely bulk bills	Yes	561 (17.9)
Number of GPs working at practice	5 or more	2045 (65.8)
Rurality of practice	Major city	1833 (57.4)
	Inner regional	839 (26.3)
	Outer regional or remote	519 (16.3)
SEIFA (decile) of practice	Mean (SD)	5.6 (2.9)

Note: SEIFA=Socio-Economic Indexes for Areas for Disadvantage; SD=Standard Deviation.

Table 2: Characteristics of antibiotic prescribing in index consultations involving a new UTI

Factor group	Variable	Class	No antibiotic prescribed	Antibiotic prescribed	P
Patient factors	Patient age/gender	<16yrs	90 (24%)	275 (12%)	<0.001
		Males >=16 years	37 (10%)	174 (7%)	
		Females >=16 years	250 (66%)	1936 (81%)	
	Aboriginal or Torres Strait Islander	No	360 (99%)	2297 (99%)	0.68
		Yes	5 (1%)	28 (1%)	
	NESB[#]	No	350 (94%)	2206 (94%)	0.91
		Yes	23 (6%)	138 (6%)	
	Patient/practice status	Existing patient	135 (36%)	759 (31%)	0.04
		New to registrar	207 (55%)	1474 (61%)	
		New to practice	37 (10%)	178 (7%)	
Registrar factors	Registrar gender	Male	110 (28%)	741 (30%)	0.43
		Female	279 (72%)	1720 (70%)	
	Registrar Full Time or Part Time	Part-time	93 (24%)	558 (23%)	0.59
		Full-time	288 (76%)	1857 (77%)	
	Term	Term 1	163 (42%)	940 (38%)	0.18
		Term 2	144 (37%)	886 (36%)	
		Term 3	82 (21%)	635 (26%)	
	Worked at practice previously	No	274 (72%)	1794 (74%)	0.53
		Yes	106 (28%)	633 (26%)	
	Qualified as doctor in Australia	No	112 (29%)	518 (21%)	0.003
		Yes	274 (71%)	1923 (79%)	
	Registrar age	mean (SD)	34 (7)	32 (6)	0.002
Practice factors	Practice size	Small	122 (32%)	786 (33%)	0.36
		Large	260 (68%)	1624 (67%)	
	Practice routinely bulk bills	No	309 (81%)	2049 (85%)	0.16
		Yes	72 (19%)	374 (15%)	
	Rurality	Major city	206 (53%)	1403 (57%)	0.28
		Inner regional	129 (33%)	722 (29%)	

Factor group	Variable	Class	No antibiotic prescribed	Antibiotic prescribed	P
		Outer regional/ remote	54 (14%)	335 (14%)	
	Region	Region 1	131 (34%)	738 (30%)	0.07
		Region 2	63 (16%)	284 (12%)	
		Region 3	45 (12%)	306 (12%)	
		Region 4	140 (36%)	1052 (43%)	
		Region 5	10 (3%)	81 (3%)	
	SEIFA* index	mean (SD)	6 (3)	6 (3)	0.12
Consultation factors	Chronic problem	No	389 (100%)	2461 (100%)	
	Sought help any source	No	342 (88%)	2034 (83%)	0.01
		Yes	47 (12%)	427 (17%)	
	Pathology ordered	No	79 (20%)	504 (20%)	0.90
		Yes	310 (80%)	1957 (80%)	
	Imaging ordered	No	374 (96%)	2359 (96%)	0.87
		Yes	15 (4%)	102 (4%)	
	Follow-up ordered	No	162 (42%)	1137 (46%)	0.30
		Yes	227 (58%)	1324 (54%)	
	Learning goals generated	No	324 (89%)	2149 (92%)	0.17
		Yes	39 (11%)	195 (8%)	
	Referral ordered	No	369 (95%)	2427 (99%)	<0.001
		Yes	20 (5%)	34 (1%)	
	Consultation duration	mean (SD)	21 (11)	18 (8)	<0.001
	Number of problems	mean (SD)	2 (1)	2 (1)	<0.001

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