

# Treatment of uncomplicated cystitis: analysis of prescribing in New Zealand

Natalie J Gauld, Irene SL Zeng, Rosemary B Ikram, Mark G Thomas, Stephen A Buetow

## ABSTRACT

**AIMS:** To describe prescribing for women with suspected urinary tract infections, including suspected uncomplicated cystitis, in New Zealand.

**METHODS:** Randomly selected community pharmacies participated in the study. Women attending the pharmacy in a 2-week period in 2012 for prescribed or non-prescription treatment of symptoms suggesting a urinary tract infection, or prophylaxis of a urinary tract infection, were invited to self-complete a questionnaire. Analysis focused on prescribing for women with symptoms of cystitis without complicating features.

**RESULTS:** Valid questionnaires arising from a prescription treatment were received from 789 patients from 139 pharmacies. Questionnaire data indicated that 17% of women had symptoms of cystitis without complicating features. Most prescribing was for a first-line agent, trimethoprim (59%) or nitrofurantoin (14%), but norfloxacin was also common (21%). Women with self-reported antibiotic use for suspected cystitis in the past 6 months were more likely to be prescribed norfloxacin than those with no such use. Many prescriptions were for a dose or duration outside those recommended in New Zealand guidelines.

**CONCLUSIONS:** While use of first-line agents is generally high, norfloxacin use could be reduced further. There is scope to understand clinical practice that deviates from guideline use regarding dose and duration.

One of the most common reasons for medical visits by young women is acute lower urinary tract infection (UTI), or cystitis.<sup>1</sup> UTIs occur in 30–50%<sup>1,2</sup> of women at least once in their lifetime,<sup>1,2</sup> and suspected cystitis is the second most common reason for empirical antimicrobial treatment.<sup>1</sup> Therefore, appropriate treatment of women with suspected UTIs is important for women's health and antimicrobial stewardship. The 2011 and 2013 Best Practice Advocacy Centre (BPAC) guidelines for treating uncomplicated cystitis in non-pregnant women, recommend treatment with trimethoprim 300 mg once daily for 3 days, or nitrofurantoin 50 mg four-times-daily for 5 days first-line, with norfloxacin second-line.<sup>3,4</sup> In pregnant women, trimethoprim (except first trimester) or nitrofurantoin (except from week 36) have the same dosing but for 7 days, and norfloxacin is avoided. BPAC reported increasing use of ciprofloxacin and high

use of norfloxacin in New Zealand, despite “very few situations in general practice where a quinolone would be considered first-line treatment”.<sup>5</sup> Recent studies show cystitis in women is commonly treated with fluoroquinolones in France,<sup>6</sup> and with nitrofurantoin in the Netherlands.<sup>7</sup> General practice prescribing of trimethoprim for cystitis in England is commonly for longer than the recommended duration.<sup>8</sup> While adhering to guidelines on drug, dose and duration for infections benefit antimicrobial stewardship,<sup>9,10</sup> and potentially aids effectiveness and limit adverse effects, it is unknown how well New Zealand prescribers adhere to local guidelines for many infections including cystitis, and how often quinolone antibiotics (norfloxacin and ciprofloxacin in New Zealand) are used in suspected cystitis without complicating features. Additionally, although antimicrobial resistance for some agents including trimethoprim increases with recent prescribing of antibiotics,<sup>11,12</sup>

whether and how previous antibiotic use affects prescribing is unknown.

In November 2012, trimethoprim became available from specially trained pharmacists for women aged 16–65 years with symptoms of cystitis without any complicating features (such as pregnancy, treatment failure, frequent infections, or antibiotic use in the past 6 months). Therefore, this study aimed to provide information on prescribing and pharmacy supplies for UTIs in New Zealand before and after pharmacist supply. Changes in overall supply of antimicrobials are reported elsewhere. This paper focuses on prescribing in UTIs, specifically:

1. What treatment was prescribed to women presenting in a pharmacy with a prescription to treat a possible UTI or for prophylaxis of a UTI?
2. What treatment was prescribed to women with symptoms of cystitis without complicating features?
3. What treatment was prescribed to women with symptoms of cystitis without complicating features who self-report antibiotic use in the last 6 months.
4. What treatment was prescribed to pregnant women with presumed UTI?

Given the greater quantity of data in the baseline phase (2012), and minimal change in prescribing from the baseline phase to the second phase, this paper reports the 2012 data.

## Patients and methods

Ethics committee approval was not required because the study was an observational investigation collecting no identifiable patient details, with written confirmation provided in the on-line process by the Health and Disability Ethics Committee (4 September 2012).

Questionnaire data and observational data were collected over a 14-day period (24 September to 7 October 2012) before pharmacists could supply trimethoprim without a prescription.

Following a 1-week pilot phase in 10 pharmacies, 170 community pharmacies were randomly selected and invited to participate in the study. Random numbers were generated using Stat Trek (stattrek.com) for the 947 New Zealand community pharmacies listed in the Pharmacy Guild's

directory (October 2010). Pharmacy staff provided eligible women with written information explaining the study, and invited them to self-complete a two-page questionnaire in the pharmacy.

Women were considered eligible to enter the study if they were: aged 16 years or over and had been dispensed a prescribed treatment for a suspected UTI (including an antibiotic and/or a urinary alkaliniser); had purchased a relevant non-prescription remedy (including urinary alkaliniser, cranberry or methenamine hippurate); or had consulted a pharmacy staff member about a suspected UTI. Women living in a rest home were excluded. No patient identifying information was collected, other than the patient initials to match questionnaire data with the dispensing recording sheet (see below). Questionnaire completion was taken as consent to participate.

Pharmacy staff were asked to record all dispensings for norfloxacin, ciprofloxacin, nitrofurantoin or trimethoprim (regardless of reason for use), or other prescribed treatments possibly for a suspected UTI (from patient discussion). In this 'dispensing log', staff recorded the date, patient initials, medicine, quantity dispensed, whether the questionnaire was completed, and reasons for non-supply of the questionnaire (ie, male, age under 16 years, use for an indication other than a UTI, or living in a residential care home). The dispensing log indicated the proportion of supplies without a questionnaire, and reasons for non-completion (including ineligibility). This log also aided questionnaire accuracy with respect to medicine and quantity, where the study team matched the dispensing log and questionnaire by date and patient initials.

Women were asked about their symptoms, medical history, treatment received that day, previous treatment for this current infection, and demographics. They were instructed to ask the pharmacist for help if necessary. Pharmacy staff had been asked by the researchers to help the participant list the medication prescribed.

Women were considered to have suspected cystitis if they reported in the questionnaire: burning or pain on urination; pain in the lower abdomen just above the genital area; and/or the need to urinate often or urgently.

**Table 1:** Demographic and presenting features of the participants.

	All women who provided questionnaires (%)
Total	949
<b>Ethnicity*</b>	
European	745 (78.5)
Māori	118 (12.4)
Pacific	53 (5.6)
Indian	22 (2.3)
Chinese	15 (1.6)
Other	41 (4.3)
Unknown	19 (2.0)
<b>Age</b>	
16–20	86 (9.1)
21–30	164 (17.3)
31–40	130 (13.7)
41–50	149 (15.7)
51–60	138 (14.5)
61–65	57 (6.0)
>65	195 (20.5)
unknown	30 (3.2)

\* respondents could indicate multiple ethnicities so total proportion is more than 100%.

Women were excluded from the suspected cystitis group if they had possible symptoms of pyelonephritis, defined as: pain in the lower back or kidney area, or fever, or chills. Suspected cystitis was considered to have no complicating features if the woman reported none of the following: having an abnormal urinary tract; previous kidney problems other than an infection; recent presence of a urinary catheter; being pregnant or diabetic; having had more than three UTIs in the past 12 months; failure of an antibiotic for their current suspected UTI; a hospital admission in the preceding month; treatment with an antibiotic in the previous 6 months; or age under 16 years or over 65 years.

Pharmacies and women participating in the study received no payment, but \$1(NZD) was donated from the study funds to the Women's Refuge for each questionnaire completed.

Questionnaire data were entered into Excel spreadsheets, and analysis was conducted using Statistical Analysis System (SAS) 9.3, SAS Institute, Cary, NC, US.

The Chi-squared test ( $\chi^2$ ), or Fisher exact test, was used to assess associations between categorical variables; the Kolmogorov-Smirnov two-sample test was used to test the cumulative distribution of continuous variables between groups. A non-linear mixed effect model was used for nominal survey responses for medicines supplied. A covariance test was used for the prescriptions in a nonlinear mixed-effect model. In the analysis of women eligible for pharmacist supply of trimethoprim, cluster analysis was not used because the observations for most pharmacies numbered less than three. Showing no statistically significant variation in severity or duration of symptoms between pharmacies, the analysis from the complete data set was computed at the patient level.

## Results

Completed materials were returned to the study centre by 139 pharmacies, 81.8% of those invited to participate. Prescription data recorded by pharmacy staff dispensing

**Table 2:** Prescribed treatment in respondents, and the subgroup of women aged 16–65 years with suspected cystitis without complicating features.

Medicine	All respondents receiving a prescription (%)	Prescription management in participants with suspected cystitis without complicating features (%)
Trimethoprim	418 (53.0)	74 (58.7)
Norfloxacin	194 (24.6)	26 (20.6)
Nitrofurantoin	129 (16.3)	17 (13.5)
Ciprofloxacin	14 (1.8)	0 (0.0)
Co-trimoxazole	9 (1.1)	4 (3.2)
Amoxicillin + clavulanic acid	8 (1.0)	1 (0.8)
Cefaclor	6 (0.8)	1 (0.8)
Other/unspecified antibiotic	9 (1.1)	2 (1.6)
Non-antibiotic treatment	21 (1.8)	1 (0.8)
Total number of questionnaires*	789†	126

\* Where two antibiotics were supplied, both are counted; †missing data four questionnaires

logs during the study period comprised 1,783 patient entries. Four hundred and forty-four (24.9%) met the exclusion criteria for the study (eg, male, child, rest home patient, or indication other than UTI). Of the 1,339 patients eligible or possibly eligible for the study, the 789 valid questionnaires arising from prescription supply represented a 55.6% response rate, assuming the dispensing logs were accurate. Questionnaires from 958 patients were returned, and after nine exclusions, 949 were included in the study. An average of 6.8 questionnaires per pharmacy (range 0–32), were available for analysis.

### Demographic and presenting features for women respondents

Most women were of European ethnicity, with approximately 12% Māori, and Pacific peoples and other ethnicities providing a small minority of those surveyed (Table 1).

Of the valid questionnaires, most (789, 82.1%) arose from prescription dispensing. The most commonly-prescribed treatments to all participants receiving a prescription were trimethoprim, norfloxacin and nitrofurantoin (Table 2). Women aged 16–65 years with suspected cystitis without complicating features also were most likely to receive these same three medicines.

### Prescription supplies in women with symptoms of cystitis without complicating features

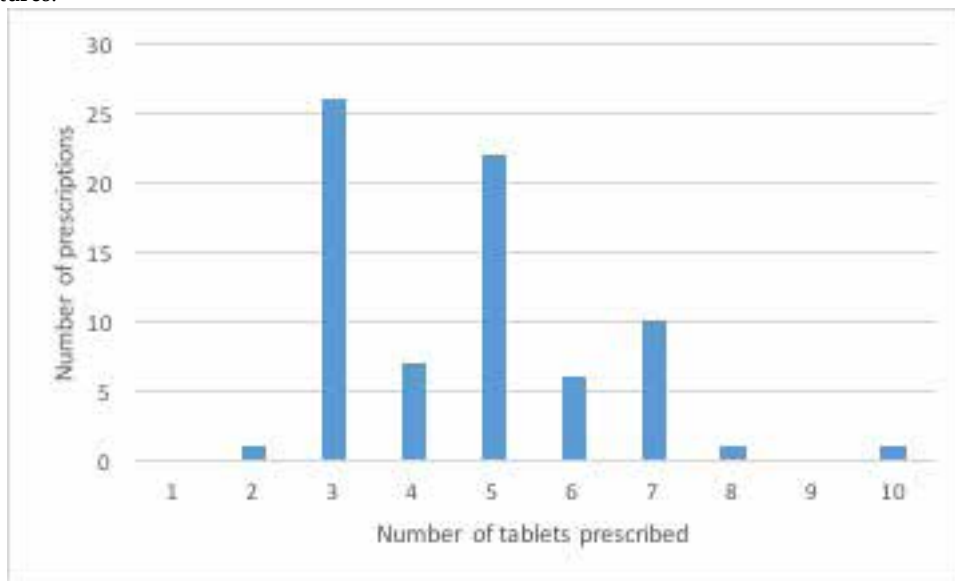
Approximately one-in-six (16%) of 789 participants reported symptoms of

cystitis and did not report any complicating features. In suspected cystitis with no complicating features, most prescriptions dispensed were for the first-line agents: trimethoprim or nitrofurantoin (n=91, 72.2% of questionnaires arising from prescriptions). A minority of prescriptions for this subgroup of women used the recommended dose and duration of a first-line agent in the New Zealand guidelines (20.6%).

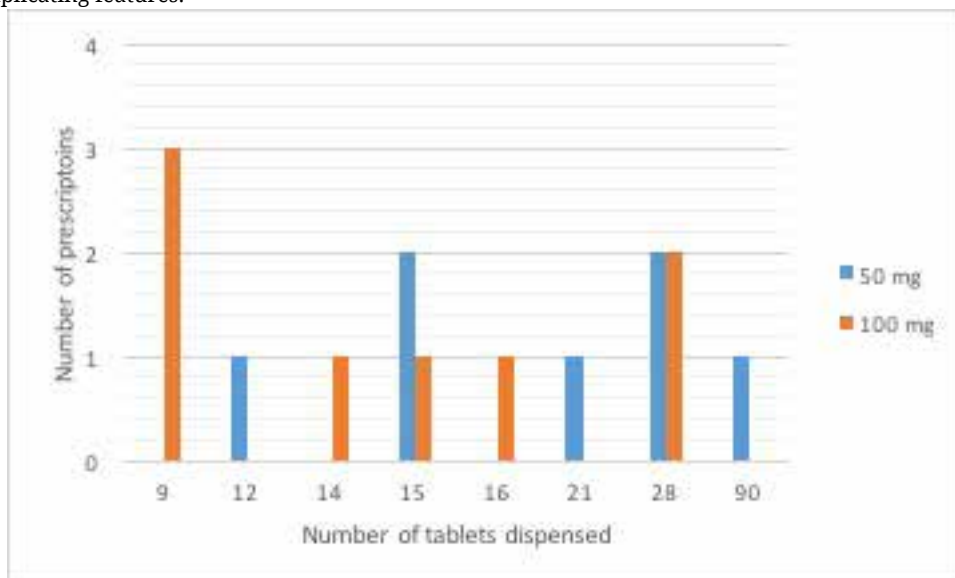
Around one-third of trimethoprim dispensings (35.1%) appeared to use the recommended duration of 3 days (Figure 1). Most trimethoprim treatments appeared longer than recommended with a median of five trimethoprim tablets prescribed. No nitrofurantoin supplies complied with the recommended dose and duration, with considerable variation observed (Figure 2). Norfloxacin was mostly prescribed in quantities of six tablets (consistent with recommended dosing of twice-daily dosing for 3 days, 72%), with 20% prescribed 10 tablets.

Previous antibiotic use was associated with some differences in antibiotics used (Table 3). Previous antibiotic use (for cystitis or for other uses) did not appear to affect the frequency with which nitrofurantoin was prescribed (12.8–15.8%). However, norfloxacin usage increased significantly in women who reported having cystitis in the last 6 months (33.3% vs 20.6%, respectively;  $\chi^2=4.95$ ,  $df=1$ ,  $p=0.026$ ).

**Figure 1:** Trimethoprim quantity prescribed to women with suspected cystitis without complicating features.



**Figure 2:** Nitrofurantoin strength and quantity prescribed to women with suspected cystitis without complicating features.



**Table 3:** Antibiotic prescribing in women with suspected cystitis without complicating features, according to previous antibiotic use.

	<b>Subgroup except no self-reported antibiotic use in the last 6 months</b>	<b>Antibiotics for cystitis in last 6 months but otherwise matching subgroup criteria</b>	<b>Antibiotics for reasons other than cystitis in last 6 months but otherwise matching subgroup criteria</b>
Trimethoprim	74 (58.7%)	27 (50.0%)	27 (69.2%)
Nitrofurantoin	17 (13.5%)	8 (15.8%)	5 (12.8%)
Norfloxacin	26 (20.6%)	18 (33.3%)	5 (12.8%)
Other antibiotic	8 (6.4%)	1 (1.9%)	2 (5.2%)
Totals	125	54	39

Pregnant women with symptoms of cystitis also had variable antibiotic prescribing. Most received nitrofurantoin (n=16), or trimethoprim (n=6), with one woman receiving amoxicillin-clavulanic acid. Half of the women received a quantity indicative of the recommended 7-day treatment (although not always at the recommended strength for nitrofurantoin). Most other women received fewer tablets than recommended, eg, 3–6 trimethoprim tablets.

## Discussion

This study provides insight into prescribing for suspected UTIs prior to pharmacist supply of trimethoprim. The paper concentrates specifically on women with symptoms of cystitis without any complicating features, for which guideline-adherent treatment would usually be appropriate. These prescribers would have been doctors in all or almost all cases, as few nurses have prescribing rights.<sup>13</sup> For pregnant women with symptoms of cystitis, prescribers were midwives or doctors.

Most women with suspected UTIs were prescribed medicines recommended in New Zealand guidelines as first-line for cystitis (trimethoprim and nitrofurantoin). For women with symptoms of cystitis and no complicating features, nearly three-quarters were prescribed a first-line agent according to New Zealand guidelines, mainly trimethoprim. In 2011, New Zealand's BPAC expressed concern about ciprofloxacin and norfloxacin use.<sup>5</sup> We found a low level of ciprofloxacin use by women with UTIs, and no ciprofloxacin use in women without complicating features, but about one-fifth of such women treated through prescription received norfloxacin. This quinolone usage is considerably lower than in France<sup>6</sup> and Switzerland,<sup>14</sup> but higher than the Netherlands.<sup>7</sup> In New Zealand, fosfomycin and pivmecillinam are not licenced, or generally funded on prescription.

Further research over an extended period would reveal change over time, and whether national messages on antibiotic use are working. In 2014, funding restrictions on norfloxacin were implemented to reduce first-line use, so a repeat survey may be warranted to ascertain the effect of this policy. Additionally, the reclassification of trimethoprim may alter prescribing in the

long-term. A repeat of this survey would indicate further changes.

Nitrofurantoin had low use, despite being recommended first-line in New Zealand for suspected cystitis,<sup>4</sup> and having low rates of resistance.<sup>15,16</sup> The variable dosing we found could contribute to treatment failure from insufficient dosing or duration, or expose the patient and commensal bacteria to a longer duration than necessary. Some countries have higher nitrofurantoin use in uncomplicated cystitis, eg, the Netherlands (56–67%)<sup>7</sup> and Canada (27%).<sup>17</sup> In New Zealand, the four-times-daily dosing may be discouraging for prescribers (and patients), hard for prescribers to remember, or may be deliberately ignored given the inconvenience or difficulty of four-times-a-day dosing. A slow-release formulation (currently not available in New Zealand) with twice-daily dosing may simplify dosing, improving guideline adherence. It is unclear whether guideline non-adherence reflects lack of knowledge of the guidelines, lack of confidence in the guidelines, or a decision responding to individual patient circumstances. The guidelines differ from manufacturer product information for nitrofurantoin, which may create confusion. New Zealand guidelines could be reviewed to aid simplicity; for example, Scottish<sup>18</sup> and Belgian<sup>19</sup> guidelines recommend nitrofurantoin for 3 days in uncomplicated cystitis, which may limit adverse effects and aid compliance, although Dutch guidelines are for 5 days' treatment.<sup>20</sup>

With the low resistance profile for *Escherichia coli* to nitrofurantoin, we expected greater use of nitrofurantoin in women with previous antibiotic use, but it did not occur. Women who reported using antibiotics for cystitis in the last 6 months were more likely to get norfloxacin, a second-line agent. Why this shift occurred is unknown; possibly it arises from patient demand by women who regularly get these infections. Education may be required on resistance patterns with previous antibiotic use.

To reduce resistance, antibiotic prescribing should provide the "right drug at the right time at the right dose for the right duration".<sup>10,21</sup> Additionally, prescribing should be according to national guidelines, avoiding broad-spectrum agents, and using the shortest antibiotic course

likely to be effective.<sup>10</sup> We found prescribed trimethoprim use was often longer than the recommended 3 days for uncomplicated cystitis, nitrofurantoin dosing was highly variable, and some broad-spectrum agent use occurred. Duration is not often reported, but our results are consistent with data from England published in 2007, which indicated that most trimethoprim supplies exceeded the recommended duration.<sup>8</sup> In a later, small Scottish study, 56% of general practice prescriptions for cystitis were for the recommended duration.<sup>22</sup>

Other New Zealand research has found higher consumption of antimicrobials, and lower usage of narrow-spectrum penicillin than in some other countries.<sup>9</sup> Further research is required to investigate why antimicrobial prescribing in New Zealand is not more reflective of national guidelines or in-line with countries elsewhere. Routine laboratory urine data on rates of bacterial resistance may differ from rates of bacterial resistance in women with uncomplicated infections.<sup>23</sup> Therefore ongoing surveillance is needed to show bacterial resistance in such women to help inform local prescribing decisions and show what, if any, changes are associated with policy changes.

## Strengths and limitations

Our research relied on self-reported information, with potential for recall errors. Diagnosis of cystitis typically relies on self-reported symptoms, but medical examination might have been more accurate. For example, low back pain may occur with cystitis,<sup>24</sup> and not indicate pyelonephritis. Around one-third of our questionnaires had possible symptoms of pyelonephritis (data not shown). This prevalence is likely to be an over-estimation, given that in adult women in primary care, cystitis is over 20 times more frequent than pyelonephritis.<sup>25</sup> Women who reported kidney problems were all considered 'complicated', but some might not have been. We could not identify whether women who reported having had kidney stones had them currently, and therefore we did not include such women in the complicated group. The limited medical history we asked excluded some history, such as medication intolerance,

non-response with a medication, or immunosuppression, which may alter prescribing. Accuracy of medication recorded on the questionnaire was likely given the pharmacist's help in some cases, and the research team used the dispensing log for medication and quantity where necessary.

Entries in the dispensing log might have been missed, although checks against dispensary computer records often occurred to minimise missing data. Checks were indicated by the provision of computer records in some cases, how the pharmacy recorded the information, or anecdotal feedback when questioned about possible missing data. Thus, our denominator data may be under-stated. However, we have concentrated primarily on the questionnaire data, and prescribing data from the Ministry of Health indicates that our prescription questionnaires reflected around 40% of the expected prescriptions for trimethoprim. Women can receive trimethoprim and co-trimoxazole directly from their medical clinic, family planning, or sexual health clinics, under practitioner supply orders for emergency supply, but this is likely to be a small proportion of overall usage of these agents.

Usage of broad-spectrum agents other than norfloxacin and ciprofloxacin might have been under represented, as pharmacy staff were specifically asked to enquire on all trimethoprim, nitrofurantoin, norfloxacin and ciprofloxacin supplies, and where other antibiotics were used for a suspected UTI. Pharmacy staff therefore might have focused on the named agents.

We did not collect the exact prescribing information for the antibiotics, but used the quantity prescribed to ascertain compliance with guidelines.

The response rate shows that nearly half of eligible women did not complete the questionnaire. This finding could reflect a staff member forgetting the study, or lack of awareness of the study by a locum. However, it is possible that women with more severe symptoms did not participate, feeling too unwell to participate in the survey or attend the pharmacy in person. Minority ethnic groups might have been under-represented, possibly because of cultural sensitivity or language barriers,

precluding detection of variation by ethnicity. We do not know the ethnicity of those who did not participate.

The strengths of the research included the random selection of pharmacies and the high participation rate by pharmacies. Using the pharmacy meant that prescribers were probably unaware of the study. Dispensing logs helped to ensure the accuracy of the medicine/s supplied and their strengths and quantities, rather than rely on participant self-report.

## Conclusion

This research provides a baseline of New Zealand prescribing for women with suspected UTIs, and particularly women with suspected cystitis without complicating features. Further research is required to ascertain long-term effects on prescribing from policy changes, and understand reasons for deviation from guidelines in treating cystitis.

---

### Competing interests:

Natalie Gauld received funding from Pharmacybrands Ltd (now Green Cross Health) for work on the trimethoprim reclassification. Rosemary Ikram received funding for training and input into the trimethoprim reclassification. The other authors have no conflicts to report.

### Acknowledgements:

The efforts of pharmacy staff in New Zealand and the women who completed questionnaires for this project are gratefully acknowledged. Thanks to the Ministry of Health for Pharmaceutical Collection Data.

### Funding:

This work was supported by unrestricted grants from Pharmacybrands Ltd (now Green Cross Health); ProPharma; the Pharmacy Guild of New Zealand; and the Pharmaceutical Society of New Zealand. No funders had any decision-making role in the design, execution, analysis or reporting of the research.

### Author information:

Natalie J Gauld, Natalie Gauld Ltd, Auckland, and Honorary Research Fellow, Department of General Practice and Primary Health Care, University of Auckland, Auckland; Irene SL Zeng Honorary Research Fellow, Department of Statistics, University of Auckland, Auckland; Rosemary B Ikram, Independent consultant, Christchurch; Mark G Thomas, Associate Professor, Department of Molecular Medicine and Pathology, University of Auckland, Auckland; Stephen A Buetow, Associate Professor, Department of General Practice and Primary Health Care, University of Auckland, Auckland, New Zealand.

### Corresponding author:

Natalie Gauld, PO Box 9349, Newmarket, Auckland 1149.  
n.gauld@auckland.ac.nz

### URL:

[www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2016/vol-129-no-1437-1-july-2016/6933](http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2016/vol-129-no-1437-1-july-2016/6933)

---

### REFERENCES:

- Zalmanovici Trestioreanu A, Green H, Paul M, et al. Antimicrobial agents for treating uncomplicated urinary tract infection in women. The Cochrane Library. 2010: CD007182.
- ACOG Practice Bulletin No. 91: Treatment of Urinary Tract Infections in Nonpregnant Women. *Obstet Gynecol.* 2008;111:785-94.
- Antibiotics: choices for common infections. *Best Practice Journal.* 2011;(35):Supplement.
- Antibiotics: choices for common infections. *Best Practice Journal.* 2013: Available from: [http://www.bpac.org.nz/Supplement/2013/July/docs/Antibioitcs\\_guide\\_2013.pdf](http://www.bpac.org.nz/Supplement/2013/July/docs/Antibioitcs_guide_2013.pdf).
- Quinolone antibiotics - limit use. *Best Practice Journal.* 2011;(35). Available from: <http://www.bpac.org.nz/magazine/2011/april/quinolone.asp>.
- Denes E, Prouzergue J, Ducroix-Roubertou S, et al. Antibiotic prescription by general practitioners for urinary tract infections in outpatients. *Eur*



- J Clin Microbiol Infect Dis. 2012;31:3079-83.
7. Willems CSJ, van den Broek D'Obrenan J, Numans ME, et al. Cystitis: antibiotic prescribing, consultation, attitudes and opinions. *Fam Pract*. 2014;31:149-55.
  8. Reeves D. The 2005 Garrod Lecture: the changing access of patients to antibiotics—for better or worse? *J Antimicrob Chemother*. 2007;59:333-41.
  9. Thomas MG, Smith AJ, Tilyard MW. Rising antimicrobial resistance: a strong reason to reduce excessive antimicrobial consumption in New Zealand. *New Zealand Med J*. 2014;127:72-84.
  10. Dryden M, Johnson AP, Ashiru-Oredope D, et al. Using antibiotics responsibly: right drug, right time, right dose, right duration. *J Antimicrob Chemother*. 2011;66:2441-3.
  11. Donnan P, Wei L, Steinke D, et al. Presence of bacteriuria caused by trimethoprim resistant bacteria in patients prescribed antibiotics: multilevel model with practice and individual patient data. *BMJ*. 2004;328:1297.
  12. Costelloe C, Metcalfe C, Lovering A, et al. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. *BMJ*. 2010;340:c2096.
  13. The New Zealand Nursing Workforce 2012-2013. Wellington, New Zealand: The Nursing Council of New Zealand. 2014.
  14. Stuck AK, Tauber MG, Schabel M, et al. Determinants of quinolone versus trimethoprim-sulfamethoxazole use for outpatient urinary tract infection. *Antimicrob Agents Chemother*. 2012 Mar;56:1359-63.
  15. Horner CS, Abberley N, Denton M, et al. Surveillance of antibiotic susceptibility of Enterobacteriaceae isolated from urine samples collected from community patients in a large metropolitan area, 2010-2012. *Epidemiol Infect*. 2014;142:399-403.
  16. McIsaac WJ, Moineddin R, Meaney C, et al. Antibiotic-resistant *Escherichia coli* in women with acute cystitis in Canada. *Can J Infect Dis Med Microbiol*. 2013;24:143-9.
  17. McIsaac WJ, Prakash P, Ross S. The management of acute uncomplicated cystitis in adult women by family physicians in Canada. *Can J Infect Dis Med Microbiol*. 2008;19:287-93.
  18. Scottish Intercollegiate Guidelines Network. SIGN guideline 88: Management of suspected bacterial urinary tract infection in adults. 2012; Available from: <http://www.sign.ac.uk/pdf/sign88.pdf>.
  19. Willems L, Denckens P, Philips H, et al. Can we improve adherence to guidelines for the treatment of lower urinary tract infection? A simple, multifaceted intervention in out-of-hours services. *J Antimicrob Chemother*. 2012;67:2997-3000.
  20. den Heijer CDJ, Donker GA, Maes J, et al. Antibiotic susceptibility of unselected uropathogenic *Escherichia coli* from female Dutch general practice patients: A comparison of two surveys with a 5 year interval. *J Antimicrob Chemother*. 2010;65:2128-33.
  21. Dryden MS, Cook J, Davey P. Antibiotic stewardship - more education and regulation not more availability? *J Antimicrob Chemother*. 2009;64:885-8.
  22. Booth JL, Mullen AB, Thomson DAM, et al. Antibiotic treatment of urinary tract infection by community pharmacists: a cross-sectional study. *Br J Gen Pract*. 2013;63:e244-e9.
  23. Richards DA, Toop LJ, Chambers ST, et al. Antibiotic resistance in uncomplicated urinary tract infection: Problems with interpreting cumulative resistance rates from local community laboratories. *New Zealand Med J*. 2002;115(1146):12-4.
  24. Lane DR, Takhar SS. Diagnosis and Management of Urinary Tract Infection and Pyelonephritis. *Emerg Med Clin North Am*. 2011;29(3):539-52.
  25. Ikäheimo R, Siitonen A, Heiskanen T, et al. Recurrence of urinary tract infection in a primary care setting: Analysis of a 1-year follow-up of 179 women. *Clin Infect Dis*. 1996;22(1):91-9.