



Cystitis: antibiotic prescribing, consultation, attitudes and opinions

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Received May 26 2013; revised October 8 2013; Accepted November 3 2013.

Background. Despite stable overall antibiotic use between 2007 and 2011 in The Netherlands, use of nitrofurantoin and trimethoprim increased by 32%. The background of this increased antibiotic use against uropathogens is unknown.

Objectives. To determine whether increased use of urinary tract infection antibiotics is caused by changes in patients' consultation or physicians' prescribing behaviour and to investigate attitudes and opinions of women with respect to cystitis management and antibiotics.

Methods. Consultation and prescribing for International Classification of Primary Care (ICPC) codes U01 (dysuria), U02 (frequency), U05 (other urination problems), U70 (pyelonephritis) and U71 (cystitis) were determined from 2007 to 2010, using routinely collected primary health care data. Separately, behaviour of women with respect to managing cystitis, consultation and opinions towards (delayed) antibiotic treatment were studied using questionnaires in 2012.

Results. Consultation for U02 and U71 significantly increased from 93 to 114/1000 patient-years from 2007 to 2010; proportion of episodes in which an antibiotic was prescribed remained constant. Questionnaires revealed that urination problems and pain were dominant complaints of cystitis; pain medication, however, was not adequately used. One-third of women directly consult upon first symptoms, whereas the majority awaits an average of 4 days. Sixty-six per cent of women report to be willing to postpone antibiotic use.

Conclusion. Increased use of urinary tract infection antibiotics may be caused by increased consultation for cystitis in primary care. Future research should focus on the outcomes of adequate pain medication, enhanced diagnostic procedures and of delaying antibiotic use in cystitis management.

Keywords: Antibiotics, attitudes, consultation, cystitis, prescribing, primary health care.

Introduction

Despite an overall stable use of antibiotics in The Netherlands, a 32% increase in use of antibiotics specifically used for urinary tract infections was observed in the community from 2007 to 2011 (1). We assume this increase in antibiotic use concerns treatment of uncomplicated lower urinary tract infection in primary care. Cystitis is among the most common acute presentations in primary care (2,3). Antibiotics are often prescribed to decrease duration and severity of symptoms or with the idea to prevent complications (4,5). The causative agent of cystitis, often *Escherichia coli*, responds

well to a 5-day course of nitrofurantoin. In The Netherlands, a diagnosis of uncomplicated cystitis is based on (i) anamnesis combined with the patient's recognition of symptoms from a previous episode or (ii) results of a nitrite dipstick and/or urine culture (dipslide), and if necessary, followed by analysis of leukocytes or urine sediment. Uncomplicated cystitis can be treated with nitrofurantoin or with trimethoprim as second choice. Additionally, drinking water and frequent urination is advised; urinary alkalinizing agents are not recommended (6).

Uncomplicated urinary tract infections are often self-limiting, with a favourable natural course of disease; 25–42% of women are free of symptoms, and 31–41% have a negative culture within 1 week (7–9). With respect to the effects of antibiotic therapy, favourable effects are seen on clinical success, cure and microbiological eradication (10). Furthermore, duration of moderately bad to severe symptoms decreases from 5.4 days without antibiotics to 3.3 days with treatment started upon consultation (11). With respect to prevention of complications, a meta-analysis shows a non-significant decrease in pyelonephritis incidence from 0.4–2.6% without antibiotics, to 0–0.15% with antibiotic treatment (10). Treatment with ibuprofen (3 daily doses, 400 mg) resulted in a clinical recovery of 75% within 1 week, whereas in the same trial, ciprofloxacin resulted in a recovery of 61% (12). A UK trial comparing different treatment strategies for cystitis concludes that delayed prescribing decreased antibiotic use for cystitis (13). These data indicate that antibiotic treatment is not always necessary and that adequate pain medication could suffice for a subset of women with cystitis.

Increasing use of antibiotics is worrisome because of costs, medicalization and resistance problems. In Germany and Poland, a decreasing sensitivity for nitrofurantoin is observed (14). Infection with resistant uropathogens is associated with more severe and delayed resolution of urinary tract symptoms and with decreased clinical cure rates (11,15,16). Possibilities to restrict the increasing use of antibiotics for urinary tract infections could be a change in diagnostic procedures, to watchful wait some days before deciding for antibiotics, and, or to advise adequate pain medication. To this aim, it is important to investigate whether the increased use of urinary tract antibiotics is caused by an increasing presentation of urinary tract infections in primary care, or by changing prescribing behaviour of GPs, and to obtain insight in attitudes and opinions of women with respect to their management of cystitis, antibiotics and delaying antibiotic treatment.

Methods

Physicians' prescribing and patients' consultation for urinary tract symptomatology was investigated by analysis of Urinary International Classification of Primary Care (ICPC) codes of relevance in a large primary health care database. Questionnaires for women presenting with cystitis complaints were used to obtain insight in their attitudes and opinions towards cystitis management and treatment.

Prescription and consultation for urinary tract symptomatology

Contact data were obtained from the 'Julius General Practitioners' Network database', containing anonymous routine health care

data from digital patient records of 45 general practices (160 GPs, full-time and part-time) in Utrecht and its vicinity (office hours, week days). Practice assistants are employed in every practice; their main roles are telephone triage and small medical interventions, including urine testing. Participating practices are localized in a typical Western European (sub)urban region, in the city of Utrecht and in surrounding villages; single-, two-, three-handed practices, as well as primary care centres participate. We regard this group of physicians with their patient population as a representative Dutch sample. Practitioners have been trained in correct ICPC coding and have experience in electronic medical records use and coding for >10 years (17). Every consultation is coded with one ICPC code. All contacts with an ICPC code for which an antibiotic could possibly be prescribed were extracted from 2007 to 2010. Contacts with the same ICPC codes within a pre-set timeframe were combined into a disease episode, giving the infectious disease database. For U01 (dysuria, painful urination), U02 (urinary frequency, urgency), U05 (other urination problems) and U71 (cystitis), a timeframe of 2 weeks from the first contact was used, and for U70 (pyelonephritis, pyelitis), 3 weeks. For these ICPC codes, the five most often prescribed antibiotics were determined, as well as the prescribing percentage: the percentage of episodes in which at least one antibiotic course was prescribed.

The dataset was supplemented with non-ICPC-coded contacts in which an antibiotic was prescribed (~10–15% of prescriptions) to analyse trends in the number of antibiotic and subgroup prescriptions per 1000 patient-years (py). To obtain accurate consultation measures, non-ICPC-coded antibiotic prescriptions were distributed over the individual ICPC codes using the same proportion as determined from the ICPC-coded prescriptions. Consultation incidences were determined by adding the number of ICPC-coded episodes to the number of episodes calculated from non-ICPC-coded prescriptions adjusted with prescription percentages and related to the number of patient-years. SPSS 17.0 and Excel 2003 were used in the analyses and calculations.

Questionnaires

Questions were based on clinical experience, relevant topics and, for comparability, on a questionnaire used in other studies (Table 1) (18,19). It was pilot tested with physicians and patients for presentation, clarity, variety in answers and missing items in answers; small adaptations were made before distributing. As the questionnaire was developed for this study, its validity and reliability were not assessed.

The questionnaire was delivered by the practice assistant to female patients presenting with symptoms of cystitis—in the vast majority of cases at the moment when they had their urine investigated—in 28 primary care practices (10 per practice).

Table 1. Attitude and opinions of women with respect to cystitis and antibiotic use (*n* = 231)

	Mean (SD)	%
Cystitis (general)	40.2 (16.9)	
What is your age (years)?		
How often did you have cystitis in the past year?		
>3x/year		19
2–3x/year		29
≤1x/year		37
First episode		15
Which symptom(s) do you experience during cystitis? ^a		
Frequent urination		79
Painful/burning urination		78
Urgency (small amount urination)		71
Pain in lower abdomen and/or back		57
Cloudy, strong-smelling urine		37
Haematuria		17
Changing fluor vaginalis		9
Fever		7
When do you consult your GP with symptoms of cystitis? ^b		
Presence of pain		57
After <i>x</i> days		54
<i>x</i> in days	3.9 (2.3)	
Directly upon first complaints		34
Presence of fever		10
What do you do when you think you have cystitis? ^a		
Bringing urine for investigation		88
Drinking a lot of water		87
Using home remedies (i.e. vitamin C, cranberries)		54
Contacting the practice assistant		33
Using pain medication		29
Consulting the GP		11
Do you need advice about pain medication during cystitis? (yes)		57
Cystitis (antibiotics)		
Who proposes antibiotic use for cystitis? ^b		
Physician		67
Practice assistant		48
Myself		22
When do you use antibiotics for cystitis? ^b		
Directly upon first complains after urine investigation		66
After several days		41
Directly upon first complains without urine investigation		9
Never		7
For what reason(s) do you use antibiotics for cystitis? ^a		
Bacteria must be combatted		68
To speed up recovery		66
To prevent complications		47
To reduce pain		47
Prescribed by physician		31
Common practice		5
Are you aware of the potential self-limiting course of cystitis? (yes)		50
Are you aware of disadvantages of antibiotic use? (yes)		88
Would you be willing to postpone antibiotic use (to wait some days—if necessary with pain medication—to see whether symptoms disappear without treatment)? (yes)		66

Patients were asked to indicate a maximum of the four^a or two^b most important answers.

A total of 256 questionnaires were returned anonymously; 25 were excluded as they were from children, pregnant women or women with serious comorbidity. Percentages of given answers were calculated.

Factors related to 'unwillingness to postpone antibiotic treatment' were investigated using multivariate logistic regression analysis (backward stepwise) on determinants with a P value <0.2 (χ^2 test), with a cut-off value of 0.05 for expulsion from the model. Differences in the lengths of symptoms prior to presentation for women willing and unwilling to delay treatment was tested using the Students t -test (SPSS 17.0).

Results

Urinary tract infection: antibiotic prescription and patient consultation

The infectious disease database contained a total of 845 756 disease episodes in the period 2007–2010, with 236 725 antibiotic prescriptions, belonging to 806 490 py. Total use of antibiotics was relatively stable between 2007 and 2010 (Table 2), in analogy with total Dutch figures. With respect to antibiotics used for uncomplicated urinary tract infection, use of nitrofurantoin and trimethoprim, however, increased with 26% (Table 2): caused by an increase in nitrofurantoin use. This increase corresponded to an increased incidence of patients consulting for U02 and U71, respectively, from 15 to 20.2/1000 py and from 78.1 to 93.4/1000 py. Numbers of patients consulting for U01, U05 and U70, the other ICPC codes for which nitrofurantoin and trimethoprim are prescribed, did not markedly increase in this period. With respect to physician's prescribing policy for urinary tract infections and symptoms, prescription percentages for the mentioned ICPC codes were relatively stable between 2007 and 2010, with a prescription percentage for cystitis of ~60%. In the choice of antibiotic, a trend was observed from prescribing trimethoprim and/or sulfamethoxazole/trimethoprim to prescribing nitrofurantoin for ICPC codes U01, U02, U05 and U71. Prescription of quinolones and amoxicillin/clavulanic acid was stable for cystitis. Decreases in quinolone prescription rates were seen for U01, U02 and U05. For pyelonephritis, mainly amoxicillin/clavulanic acid and quinolones were prescribed.

Questionnaires: attitude and opinions toward cystitis and antibiotics

The results of the questionnaire are shown in Table 1. The mean age of the patients was 40 years, and 48% indicated to have had more than one episode of cystitis in the past year. The most dominant symptoms were frequent urination, a painful/burning sensation and urgency. Pain in the lower abdomen and/or back was experienced by 57% of women, and pain was an important reason to visit the physician. Nevertheless, only 29% of patients

used pain mediation (paracetamol and/or ibuprofen), and 57% indicated to need physician's advice with respect to pain management. Over 50% of women often waited for some days before consulting the physician, with an average of 4 days. Upon suspecting cystitis, 88% of women brought urine to the practice for testing, and the advice to drink a lot of water was well followed.

The vast majority of patients felt that the physician or practice assistant took the initiative for antibiotic use and that they received antibiotics after urine investigation or after complaints for several days. Only 9% of women ever received a prompt antibiotic course without investigation. The most important reasons for women to use antibiotics were: to combat bacteria, to speed up recovery, to prevent complications and to reduce pain.

Willingness to postpone antibiotic use

Half of the questioned women were aware of a possible self-limiting course of cystitis. The majority knew about disadvantages of antibiotic use and 66% indicated to be willing to postpone antibiotic use for cystitis. Patients willing to delay treatment already wait longer before consulting, with an average of 4.4 days, compared to women not willing to delay, with an average of 3.3 days ($P = 0.03$). To obtain insight in the reasons of unwillingness to postpone antibiotic treatment, women responding to be willing to delay were compared to women indicating that this is not an option for them. Patients consulting their physician directly upon first complaints were less willing to delay treatment [odds ratio (OR): 3.2, 95% confidence interval (CI): 1.7–6.3, $P < 0.001$], as were women receiving antibiotics without testing [OR: 3.3, 95% CI: 1.1–10, $P = 0.04$]. Pain as dominant complaint, unawareness of self-limitedness and unawareness of disadvantages of antibiotics were not associated with unwillingness to delay treatment.

Discussion

Summary

The increased use of nitrofurantoin in recent years urges for investigation of causal factors and of possibilities to prevent increasing antibiotic use for uncomplicated urinary tract infection. Our study shows that this increase is associated with increased patient consultation for cystitis. Since 2005, the Dutch primary care guideline allows a cystitis diagnosis based on symptoms and previous experience of the patient (6). The knowledge that treatment is available upon communicating symptoms without the need to test could stimulate women to contact their practitioner earlier. Less rigid criteria for cystitis diagnosis and medicalization behaviour are therefore more likely explanations for increased patient consultation than an increasing incidence of urinary tract infections in the community. To our knowledge, steadily increasing use of urinary tract infection antibiotics has not been reported earlier.

Table 2. Trends in antibiotic use, prescription and consultation for urinary tract infections

	2007	2008	2009	2010
Antibiotic use (per 1000 py)				
Total	287	288	299	298
XE (nitrofurantoin)	34.3	38.1	41.9	46
EA (trimethoprim)	11	11.2	11.2	11
EE (sulfamethoxazole/trimethoprim)	7.5	7.1	6.5	6.4
Presentation (per 1000 py)				
U01 (dysuria, painful urination)	7.2	7.3	7.1	7.3
U02 (urinary frequency, urgency)	15	17.2	18.8	20.2
U05 (other urination problems)	10.3	10.2	11.6	11.4
U70 (pyelonephritis, pyelitis)	2.5	2.7	2.6	2.7
U71 (cystitis)	78.1	83.5	90.1	93.4
Prescription %				
U01	37.8	38.5	36.3	39.6
U02	20.8	20.4	19.5	20
U05	17.3	19.4	19	18
U70	52.3	51.8	49	48.5
U71	59.5	59.6	59.6	60.4
Antibiotics prescribed for U01 ^a				
XE	55.2	61.2	61.7	67.5
EA	16.1	16.1	10.7	11.5
CR	12.3	9.3	13.5	10.2
MA	9.2	7.6	9.2	6.9
EE	5.6	5	3.5	2.7
Antibiotics prescribed for U02 ^a				
XE	47	50.2	55.8	59.4
EA	21.6	16.9	14.2	10.8
MA	13.3	12.5	11.8	11
CR	10.8	11.6	11.6	12.4
EE	5.3	6.7	4.2	4.2
Antibiotics prescribed for U05 ^a				
XE	34.5	40.8	47.6	39.6
MA	25.2	22.5	19.7	19.8
CR	16.3	12.6	12.5	16.8
EA	11.6	10.3	11.8	12.3
EE	11.6	11.8	6.7	9.5
Antibiotics prescribed for U70 ^a				
CR	54.1	47.4	50	50.2
MA	16.8	18.4	19	18.1
XE	13.4	15.9	14.5	12.8
EE	8.1	11.4	9.9	11.8
EA	6.2	6.1	5.4	5.4
Antibiotics prescribed for U71 ^a				
XE	53	53.9	53.8	55.6
EA	15.5	15.2	14.7	13.9
MA	12.4	12.6	13.8	13.1
CR	12.1	11.6	11.9	12.3
EE	5.1	4.8	3.9	3.2

^aMA: quinolones, CR: amoxicillin/clavulanic acid, ~2% other antibiotics.

Given a favourable natural course of cystitis, together with indications that adequate use of pain medication could help limiting symptoms, the increasing use of antibiotics against uropathogens seems undesirable (18). Strategies to limit over-use

of antibiotics for cystitis could be (i) to improve diagnostic procedures, (ii) to delay the decision for antibiotic treatment and (iii) to advise adequate use of pain medication. To be able to choose a strategy, insight in women's management of cystitis

and opinions towards treatment is necessary. The most relevant questionnaire outcomes with respect to these strategies are: (i) 88% of women bring urine for investigation and 9% report to have had antibiotics without diagnostic procedures, (ii) two-thirds of women are willing to delay antibiotic use and half of the women already wait a couple of days before consulting and (iii) pain is experienced by 57% of patients, pain is a reason for consulting, and 47% of patients use antibiotics to reduce pain; interestingly, only 29% of women actually use pain medication.

Strengths and limitations

With routine primary health care data of 45 primary care practices, we had reliable data to investigate antibiotic prescribing for urinary tract infections. The absolute increase in nitrofurantoin prescription from 2007 to 2010 ($\Delta 11.7/1000$ py) could largely be explained by increased consultation for U71—corrected for prescribing percentages—($\Delta 7/1000$ py)—and by the shifts from trimethoprim and quinolone prescribing towards nitrofurantoin for U01, 02 and 05 ($\Delta 1.6/1000$ py). Additionally, nitrofurantoin was increasingly prescribed as second course within a cystitis episode of 2 weeks, and also increasingly within episodes for other diseases, i.e. a patient consulting for sleeplessness and reporting cystitis complaints as well, and therefore receiving antibiotics (data not shown).

Although our data suggest a direct relation between increased consultation and increased antibiotic use, alternative explanations need to be considered and investigated. Physicians could increasingly use the label 'cystitis' to justify a prescription. For indications in other ICPC chapters were coding bias could play a role, this trend was not observed; in the same dataset, the number of registered consultations for bronchitis and tonsillitis were decreasing and remained constant for sinusitis, infectious diarrhoea and impetigo (data not shown). In, or just prior to the analysed time period, the Dutch guideline 'urinary tract infections', telephone triage or diagnostic testing procedures have not changed. It is, therefore, unlikely that changes in medical or organizational structure were responsible for increased registering of U71 or for the increased use of urinary tract infection antibiotics. A high percentage of women answered that the practice assistant proposes antibiotic use, probably suggested during a telephone call or during testing; in The Netherlands, only the GP actually prescribes.

Questionnaire research provided insight in management and attitudes of women visiting a primary care practice with complaints of cystitis, and not of symptomatic women managing at home. We feel this was justified, as particularly the women visiting the practice are part of the interplay of increased antibiotic use and are the subjects for a changing management strategy for cystitis. Some remarks of the survey should be acknowledged. As the vast majority of questionnaires were filled in during

urine testing, women could potentially suffer from other illness, i.e. a Chlamydia infection for younger patients. No questions related to perceived severity of symptoms, or impact on daily functioning, were included. Therefore, the influence of perceived symptom severity on willingness to delay treatment could not be analysed. As the survey was performed years after the increase in antibiotic use for cystitis initiated, a change in women's attitudes and opinions as possible drivers could not be investigated. Response bias could potentially have affected the outcomes. Ninety-two per cent of the questionnaires were returned and upon inquiry with the practice assistants, it appeared that the vast majority of women were willing to fill in the short questionnaire, and that it took the practices only 1–4 days to complete the 10 questionnaires. Furthermore, at forehand, it was unknown that part of the questions was about antibiotics. Given these reasons and the number of practices, we regard this sample as a representative sample of women consulting their physician with complaints of cystitis.

Comparison with existing literature

A qualitative study of interviews with 20 trial patients in the UK on the acceptability of alternative management strategies for urinary tract infection showed that women were open to approaches other than immediate antibiotics (19). With 256 questionnaires of women consulting for cystitis complaints, we were able to do quantitative analyses on reasons influencing acceptability of delayed prescribing. Similar results with respect to symptoms and time waited before consultation were obtained by the UK trial and in our study (20).

Implications for clinical practice

Our data suggest that increased consultation is the key driver of increased antibiotic use for cystitis. This steadily increasing antibiotic use might result in over-treatment of cystitis (18). We hypothesize that increased consultation for cystitis might be related to less rigid diagnostic procedures, unawareness of possible self-limitedness and a general tendency of medicalizing potentially self-limiting illness. We however found willingness among women to delay treatment, and furthermore there is evidence that adequate pain medication might be helpful (12).

With respect to alternative therapies than immediate antibiotics, literature indicates a strong need of explaining the rationale underlying such an approach (19). Proper information about the natural course and self-care, provision of adequate pain medication, no prescribing without urine investigation or delayed prescribing could help to rationalize antibiotic treatment of cystitis. Future research should focus on the effects of these (combined) strategies in cystitis management, on antibiotic use, patients' satisfaction, consultation and complications.

Acknowledgements

We thank the GPs, participating in the 'Julius General Practitioners' Network database', for sharing their anonymized electronic medical record data and the practice assistants and patients for participating in the questionnaire research.

Declaration

Funding: none.

Ethical approval: this study was approved by the Medical Ethics Committee of the University Medical Center Utrecht, The Netherlands.

Conflict of interest: none.

References

1. Drug Information System of the Health Care Insurance Board (CVZ), GIP database. www.gip databank.nl (accessed on 22 November 2013).
2. Drekonja DM, Johnson JR. Urinary tract infections. *Prim Care* 2008; **35**: 345–67, vii.
3. Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. *Am J Med* 2002; **113** (suppl 1A): 5S–13S.
4. Zalmanovici Trestioreanu A, Green H, Paul M, Yaphe J, Leibovici L. Antimicrobial agents for treating uncomplicated urinary tract infection in women. *Cochrane Database Syst Rev* 2010; CD007182.
5. Hooton TM. Clinical practice. Uncomplicated urinary tract infection. *N Engl J Med* 2012; **366**: 1028–37.
6. Van Haarden KAM, Visser HS, Van Vliet S *et al.* NHG Standaard Urineweginfecties (M05). *Huisarts Wet* 2005; **7**: 341–52. <https://www.nhg.org/standaarden/samenvatting/urinegeweginfecties> (accessed on 22 November 2013).
7. Ferry SA, Holm SE, Stenlund H, Lundholm R, Monsen TJ. The natural course of uncomplicated lower urinary tract infection in women illustrated by a randomized placebo controlled study. *Scand J Infect Dis* 2004; **36**: 296–301.
8. Ferry SA, Holm SE, Stenlund H, Lundholm R, Monsen TJ. Clinical and bacteriological outcome of different doses and duration of piv-mecillinam compared with placebo therapy of uncomplicated lower urinary tract infection in women: the LUTIW project. *Scand J Prim Health Care* 2007; **25**: 49–57.
9. Christiaens TC, De Meyere M, Verschraegen G, Peersman W, Heytens S, De Maeseneer JM. Randomised controlled trial of nitrofurantoin versus placebo in the treatment of uncomplicated urinary tract infection in adult women. *Br J Gen Pract* 2002; **52**: 729–34.
10. Falagas ME, Kotsantis IK, Vouloumanou EK, Rafailidis PI. Antibiotics versus placebo in the treatment of women with uncomplicated cystitis: a meta-analysis of randomized controlled trials. *J Infect* 2009; **58**: 91–102.
11. Little P, Merriman R, Turner S *et al.* Presentation, pattern, and natural course of severe symptoms, and role of antibiotics and antibiotic resistance among patients presenting with suspected uncomplicated urinary tract infection in primary care: observational study. *BMJ* 2010; **340**: b5633.
12. Bleidorn J, Gágyor I, Kochen MM, Wegscheider K, Hummers-Pradier E. Symptomatic treatment (ibuprofen) or antibiotics (ciprofloxacin) for uncomplicated urinary tract infection?—results of a randomized controlled pilot trial. *BMC Med* 2010; **8**: 30.
13. Little P, Moore MV, Turner S *et al.* Effectiveness of five different approaches in management of urinary tract infection: randomised controlled trial. *BMJ* 2010; **340**: c199.
14. Schito GC, Naber KG, Botto H *et al.* The ARESC study: an international survey on the antimicrobial resistance of pathogens involved in uncomplicated urinary tract infections. *Int J Antimicrob Agents* 2009; **34**: 407–13.
15. McNulty CA, Richards J, Livermore DM *et al.* Clinical relevance of laboratory-reported antibiotic resistance in acute uncomplicated urinary tract infection in primary care. *J Antimicrob Chemother* 2006; **58**: 1000–8.
16. Abrahamian FM, Krishnadasan A, Mower WR, Moran GJ, Coker JR, Talan DA. The association of antimicrobial resistance with cure and quality of life among women with acute uncomplicated cystitis. *Infection* 2011; **39**: 507–14.
17. Grobbee DE, Hoes AW, Verheij TJ, Schrijvers AJ, van Ameijden EJ, Numans ME. The Utrecht Health Project: optimization of routine healthcare data for research. *Eur J Epidemiol* 2005; **20**: 285–7.
18. McIsaac WJ, Hunchak CL. Overestimation error and unnecessary antibiotic prescriptions for acute cystitis in adult women. *Med Decis Making* 2011; **31**: 405–11.
19. Leydon GM, Turner S, Smith H, Little P; UTIS team. Women's views about management and cause of urinary tract infection: qualitative interview study. *BMJ* 2010; **340**: c279.
20. Leydon GM, Turner S, Smith H, Little P; UTIS team. The journey from self-care to GP care: a qualitative interview study of women presenting with symptoms of urinary tract infection. *Br J Gen Pract* 2009; **59**: e219–25.