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Knowledge, attitudes, and practice around urinary tract infections of general practitioners in the Netherlands: a cross sectional internet survey.

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Number of tables and figures: 4 + 3 appendices

Abstract

Objectives: Urinary tract infections (UTIs) are the most common reason for women to consult a general practitioner (GP). Current diagnostic tests are inadequate, complicating diagnosis and treatment decisions for GPs. To understand how the limited means available influence GPs in managing UTI, we aimed to determine GPs' knowledge, attitudes, and practices around UTI care.

Design: A cross-sectional internet-based survey.

Setting: General practice in the Netherlands between December 2021 and February 2022.

Participants: We distributed invitations to participate via e-mail to 126 practices. Additionally we distributed invitations via social media and newsletters.

Outcomes: The survey included 15 questions covering GPs' sociodemographic information, knowledge, attitude, and practices. Data analysis was based on frequencies and descriptive statistics.

Results: Among the 190 eligible respondents, 140 (73.7%) chose pollakisuria as a symptom that most likely indicates UTI in healthy women. One in three GPs would diagnose a UTI based on non-specific complaints with positive leukocyte and erythrocyte tests, which is in discordance with established guidelines. GPs indicated that better point-of-care diagnostics would help to improve antibiotic prescribing (72.6%) and would conserve time (60.0%). GPs considered a positive test result the most important factor to prescribe antibiotics while patient expectation was considered least important. Half of GPs indicated that the most urgent need in UTI care is improved diagnostics.

Conclusion: GPs often act in discordance with established guidelines and GPs rely on non-specific symptoms for the diagnosis of UTI. Additionally, GPs have little regard for patient preferences when deciding on treatment and seldom prescribe delayed antibiotics.

Key words: urinary tract infections, diagnosis, general practice, antibiotic stewardship, survey

Abbreviations: DA = doctor's assistant, GP = general practitioner, OOH = out-of-hours, SD = standard deviation, UTI = urinary tract infection

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Article summary

- This survey provides unique insights into the knowledge, attitudes, and practice of Dutch general practitioners around urinary tract infections.
- General practices in the Dutch province of Limburg were emailed directly to improve the number of responses to the survey.
- Therefore responses mainly originated from general practitioners in the south of the Netherlands, however their demographic data are comparable to Dutch general practitioners in general.

Introduction

Urinary tract infections (UTIs) are the most common reason for women to consult a general practitioner (GP). More than 75% of women will have at least one episode of UTI during their lifetime(1, 2). One in eight female patients consult their GP due to a UTI every year (1). In female patients over 60 years of age, this number increases up to one in five every year (3, 4).

The diagnosis of UTI in general practice and out-of-hours (OOH) in the Netherlands care relies mainly on urinary dipstick testing together with medical history-taking (5). Customarily, patients with urinary symptoms contact the general practice by phone, by which they first speak with a doctor's assistant (DA), who takes the patient's medical history and decides whether they should come by to hand in a urine sample. The DA tests the sample using the urinary dipstick test, and subsequently relays the result of the test together with the patient's medical history to the general practitioner, who decides on the course of action according to the decision algorithm shown in figure 1.

The result of the urinary dipstick carries significant weight in the diagnosis of UTI in the Netherlands. However, the urinary dipstick is suboptimal in both its sensitivity and specificity (3, 6, 7). Furthermore, urinary culture, the diagnostic golden standard, is laborious, costly, takes two to three days, and requires samples to be analysed at a clinical laboratory. Moreover, urinary culture is unable to distinguish between an actual UTI and asymptomatic bacteriuria. Therefore, the results of a urinary culture need to be interpreted with patient symptoms in mind, lest the physician prescribes antibiotics for the relatively benign condition of bacteriuria (8). Furthermore, while the sensitivity of the urinary culture is definitely one of its strengths, it also means that that it is susceptible to contamination.

Because of the drawbacks of urinary culture, most UTI treatment decisions in general practice are based on patient symptoms, urinary dipstick results, and empiric antibiotics (9-12). Because of this, GPs' knowledge of urinary symptoms related to UTIs, and the DAs' ability to take the relevant patient history, are of the utmost importance to avoid overtreatment. Overtreatment with antibiotics is a burden to both the patient and society as

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a whole. The patient is exposed to the side effects of antibiotics without reaping the benefits, while society is faced with increasing health care costs due to rising of antibiotic resistance (13, 14). Overtreatment is a problem in the out-of-hours setting especially, where physicians generally do not have access to patients' previous urine culture results or prior UTI symptoms, which causes them to opt for the prescription of antibiotics sooner (5).

GPs divert from UTI guidelines in half of the patients and most UTIs are treated with empiric antibiotic prescriptions, even though the disease is known to be self-limiting in 50% of otherwise healthy women (15,16). To improve the appropriateness of prescribed antibiotics, more insight is needed into the factors that may influence GPs decisions around the diagnosis and management of UTIs.

Research towards the knowledge and experiences of GPs managing UTIs is limited (17). Having an understanding of GPs' experiences is crucial when designing and implementing effective interventions and potential new diagnostic tests. This study therefore aims to investigate the knowledge, attitudes, and practices of Dutch GPs towards UTIs during regular and out-of-hours care.

Methods

We conducted a cross-sectional internet-based survey among Dutch GPs between December 2021 and February 2022. We used Qualtrics software (Qualtrics May 2020, Provo, UT, USA) to obtain responses. We sent emails to all GPs with publicly available email addresses in the Dutch province of Limburg (n=126). To enhance the response rate, we created a website that underlined the affiliation with Maastricht University and linking to the survey proper. Here the respondents were informed, after which they could consent to participation. Additionally, we distributed invitations on multiple social media platforms, including LinkedIn (Microsoft Corporation), Twitter Inc., Facebook (Meta Inc.), and WhatsApp (Meta Inc.), as well as via newsletters of multiple GPs' networks in Limburg (HOZL, Cohesie, ZIO and Meditta).

Setting and subjects

Fully trained GPs registered at the Dutch registry of health care professionals were eligible for participation. Participants were excluded if they were not actively working as GPs. Participants did not receive any incentive to participate in the study. While the focus of our recruitment was in the providence of Limburg, we did not exclude responses from the rest of the Netherlands.

Sample size

Based on an estimated population of 12,766 active GPs in the Netherlands during the conduction of this survey and a confidence interval of 95% and a margin of error between 5 to 10%, we considered a sample size of 96 to 373 sufficient to ensure generalizability (18).

Survey contents

The survey included 15 questions, of which 3 questions had 3-9 sub questions (Supplementary 1). These questions covered knowledge, attitude, practices and

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sociodemographic information. Answer possibilities within the survey were Likert-scale statements, right-wrong-don't know questions, listing priorities, regular multiple-choice question, an open-ended questions to explore the needs of GPs and an open-ended question to allow respondents to explain their answers or to notify the research group of survey difficulties, if any.

Data collection

The content of the questionnaire was derived from previous qualitative and quantitative research and expert opinion. Face validity and readability was tested after a consensus was reached within the research group about the quantity and quality of the compiled questions. A pilot sample of 7 individuals verified the face validity and readability of the questionnaire. Among these individuals were 1 active GP, 1 retired GP, 1 project manager, 3 medical students and 1 non-medically educated individual. All multiple-choice questions required a human interaction to the answer possibilities or required a data entry before the survey would continue to the next question. Subitems within questions were shuffled randomly among respondents. To prevent Ballot Box Stuffing, the survey software placed a local browser based cookie if not disagreed to by the user. The respondents IP address was also logged during completion of the survey allowing the research group to identify possible fraudulent enrollment to the survey.

Data Analysis

Respondents' answers were automatically entered into a data file and analysed using SPSS Version 27.0 (IBM Corp; Armonk, NY). We used descriptive statistics to analyse the demographic data. Analysis was based on frequencies and cross tables of pre-selected variables. The open-ended questions were categorised yielding frequencies and cross tables.

Patient and public involvement

Patients or other public were not involved in the design, conduct, reporting, or dissemination of the research.

Results

Population characteristics

We received 233 responses over the course of 3 months. After exclusion of partial responses (n=32), responses from physicians in training (n=10), and a response which was submitted by a DA (n=1), 190 responses remained eligible for analysis.

Table 1 summarises the characteristics of the included GPs. GPs had a mean age of 44.3 (standard deviation (SD)=9.4), ranging from 29 to 69 years. Among the participating GPs 129 (68%) were female. On average GPs had been practicing their profession for 13.4 years (SD=9.5), worked 14.6 days per month (SD=6.0) during regular hours and worked 2.6 days per month (SD=2.2) in OOH care centers.

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General practitioners' knowledge

UTI symptoms

We asked GPs to choose two symptoms out of a possible nine that they considered most likely to indicate a UTI in women (Table 2). According to the guidelines of the Dutch College of General Practitioners, the symptoms most indicative of a UTI in healthy, non-pregnant women are dysuria and the absence of vaginal complaints (4). Almost all GPs (n=172, 90.5%) correctly chose *dysuria* as most indicative of a UTI, and eight GPs (4.2%) chose *absence of vaginal complaints*. *Pollakisuria* was the second most frequently picked answer possibility with 140 (73.7%) responses (19,20).

> **Box 1: High risk UTI patients**
> UTI patients at a higher risk for a complicated course of disease according to Dutch guidelines:
> - Women who:
>   - Are pregnant
>   - Are diagnosed with diabetes mellitus
>   - Are immunocompromised
>   - Have abnormalities to the kidneys or urinary tract
>   - Have a neurogenic bladder
> - Men

To further evaluate GPs' knowledge, multiple statements involving the diagnosis and management of UTIs were presented within the survey (Supplementary 2). More than 4 out of 5 respondents answered the questions regarding the use of urinary culture in risk patients correctly (Box 1). Fewer respondents were able to correctly answer the question with regards to patients with signs of tissue invasion: 151 in regular hours (79.5%) and 131 in OOH (68.9%).

UTI in elderly patients

When asked about whether a urinary culture is required in an elderly patient with a positive nitrite test without micturition complaints, a likely case of asymptomatic bacteriuria, 109 respondents (57.4%) answered correctly that this was not the case. In a similar vein, 144 respondents (75.8%) answered correctly that a urinary culture was not indicated in the case of a catheterised patient with odorous or turbid urine.

Uncomplicated UTI

Respondents' knowledge on the diagnosis of uncomplicated UTI was tested with the statement: "In the case of non-specific complaints with a negative nitrite test, a UTI can be diagnosed with a positive leukocyte and erythrocyte test". Of all respondents, 135 (71.1%) correctly disagreed with the statement. Almost all respondents (n=184, 96.8%) correctly agreed with the statement that a cystitis can resolve by drinking sufficiently and with the possible addition of painkillers.

General practitioners' attitudes

Supplementary 3 shows the answer distributions to the Likert-scale questions regarding GPs' attitudes around UTI care. Almost two thirds of GPs participating in the survey (65.3%)

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would not disregard the result of a urinalysis when a urine sample is submitted from a patient with symptoms that do not suggest a urinary tract infection. Most GPs agree that better point-of-care tests are needed for the diagnosis of UTI (54.2%), that these new tests will aid them in prescribing antibiotics more accurately (72.6%), and that better point-of-care tests will likely save them time during their activities as an GP (60.0%).

We asked respondents what they thought were the most important features to consider of any potential newly developed test, what they thought were the most important considerations before prescribing an antibiotic, and what they thought were the most important reasons for patients to consult an GP (table 3). Among the respondents, 75.8% considered *diagnostic accuracy* the most important feature of a diagnostic test. Furthermore, GPs deemed patient expectation least important (86.8%) when considering an antibiotic prescription. According to our respondents, most patients with urinary symptoms visit the family practice with the expectation of *obtaining antibiotics* (37.5%), followed by *symptom relieve* (31.1%).

General practitioners' practice

Most GPs (46.3%) indicated that they *sometimes* prescribe a delayed antibiotic prescription when diagnosing a urinary tract infection in a healthy woman. Moreover, a combined 43.7% indicated that they *never* or *rarely* employed delayed prescriptions.

Discussion

Summary

GPs seem to overvalue pollakisuria as a symptom most indicative of a UTI. Furthermore, less than 6 out of 10 GPs chose the correct course of action for an elderly patient with asymptomatic bacteriuria. When deciding on whether to prescribe antibiotics for a UTI, GPs indicated that patient expectation carries little weight. Almost half of responding GPs indicated to never or rarely prescribe delayed antibiotics for a UTI. When asked about their highest need in UTI care, GPs indicated that diagnostic improvements have the highest urgency.

Strengths and limitations

A limitation of this study is the presence of possible selection bias, since respondents are likely more interested in the subject and therefore more up to date with the latest guidelines. Additionally, GPs who think that UTI care should be improved are more likely to participate. Another limitation of this study is the presence of possible response bias, since respondents could have answered in a socially desired manner.

Some questions in the survey might be prone to misinterpretation leading to inaccurate results. In addition, multiple-choice questions might not offer all answer possibilities, leading to response bias as well. Furthermore, due to our inclusion strategy, almost half of our respondents resided in Limburg, the southernmost province of the

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Netherlands with 6-7% of the nation's inhabitants. However, our study population has a similar average age, average amount of working days a month, and share of practice holders compared to the total population of GPs in the Netherlands (18).

The main strength of this study is that this is the first quantitative survey among GPs in the Netherlands investigating their knowledge, attitude and practices towards UTI care. Therefore this study gives a unique insight into where UTI care can be improved in Dutch family medicine.

Comparison with current literature

The results of our study show that most GPs would treat a patient based on a urinary dipstick result, even when the patient does not have specific symptoms. However, UTI guidelines indicate that a cystitis is the correct diagnosis when a positive urinalysis is accompanied by patient symptoms (18). This indicates that GPs might rely on diagnostics too much, while not paying enough attention to patients symptoms (21).

Curiously, almost half of the GPs indicated that they felt the dipstick test is inadequate for the diagnosis of a UTI. This is probably a reflection of the poor accuracy of the urinary dipstick (3,6,7). Moreover, almost half of GPs think that the most pressing need in UTI care is the need for better diagnostics. We believe that until better diagnostics become available, the decision to test a urine sample should be much more conscious in order to improve current UTI management in general practice, something which was also proven to be effective in previous studies where health care professionals were trained in recognizing urinary tract infections (22).

As our results show, GPs have trouble identifying the symptoms that most likely constitute a UTI. The guidelines of the Dutch College of General Practitioners indicate that dysuria and the absence of vaginal complaints are the most indicative symptoms for UTI in otherwise healthy women. While dysuria was almost unanimously recognised, GPs failed to include the absence of vaginal complaints when asked about the strongest predictors for the presence of UTI (23-25). Furthermore, pollakisuria was often chosen as a symptom indicative of UTI. While pollakisuria is indeed a symptom associated with UTI, previous studies have shown that it is hardly a symptom specific for UTI (19,20).

Implications for practice

This study shows that while GPs think that they have sufficient knowledge around the diagnosis and treatment of UTI, this is not always the case. GPs rely heavily on urinalysis for the diagnosis of a UTI and seem to have trouble identifying the symptoms indicative of UTI and even indicate they disregard symptoms as a whole when a dipstick test turns out positive for nitrite. This may lead to overdiagnosis and –treatment of patients with asymptomatic bacteriuria. Moreover, this could lead to GPs overlooking alternative diagnoses, leading to increased morbidity. GPs should be made aware of these issues to improve UTI care.

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Moreover, GPs in our study indicated that they pay little heed towards patients' wishes when deciding to prescribe antibiotics. Therefore, GPs need to change their approach during consultations with urinary patients, since they primarily want to be free of symptoms and want to have the feeling that they are taken seriously (26,27). However, in the Dutch health care system GPs often do not get to see patients with urinary symptoms themselves. When patients contact the family practice, they first speak to a DA, who asks for symptoms, performs the urine test, and in some cases also already writes a prescription, which only needs to be signed by the GP. Therefore, it is imperative that DAs are also sufficiently informed about which symptoms to look out for in case of a UTI. We therefore recommend for further research to look into the knowledge, attitudes, and practices of DAs around UTIs.

Conclusion

In this cross-sectional survey study, we show that GPs have trouble identifying specific symptoms of UTI. They often act in discordance with established guidelines, especially when determining in which cases urinalysis needs to be performed. Furthermore, GPs overvalue pollakisuria as an indication of UTI. Additionally, GPs have little regard for patient preferences when deciding on which treatment will be prescribed and seldom make use of delayed antibiotic prescriptions.

Disclosure statement

Ethics

No ethical approval was necessary for this study. Respondents provided informed consent before enrollment in the study

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Conflict of interest statement

The authors report there are no competing interests to declare.

Author contributions

All authors meet the 4 criteria that form the basis of authorship as stated by the ICMJE. SC, WG, and EdB made the concept of and designed the work. SC and WG acquired and analysed the data. SC, WG, TP, JC, and EdB interpreted the data.

Data sharing

Data are available upon reasonable request.

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Tables

Table 1 Population characteristics

Characteristics	General practitioners (n = 190)
Age, mean years (SD)	44.3 (9.4)
Female, n (%)	129 (67.9)
Work experience, mean years (SD)	13.4 (9.5)
Work during regular hours, mean days/month (SD)	14.6 (6.0)
Work during OOH, mean days/month (SD)	2.6 (2.2)
Practice holder, n (%)	108 (56.8)
Resident educator, n (%)	19 (10.0)
Practice holder and resident educator, n (%)	15 (7.9)

OOH = out-of-hours, SD = standard deviation

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Table 2. Symptoms believed by general practitioners to indicate a UTI.

Symptom(s)	Respondents (%)
Dysuria	172 (90.5)
Pollakisuria	140 (73.7)
Malodorous or turbid urine	27 (14.2)
Urge to urinate on empty bladder	15 (7.9)
Absence of vaginal complains	8 (4.2)
Hematuria	8 (4.2)
Fever	6 (3.2)
Lower abdominal pain	4 (2.1)
Shivers	0 (0.0)

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Table 3 Most and least important features of new diagnostic tests, considerations before prescribing an antibiotic, and patient reasons for consultation according to general practitioners.

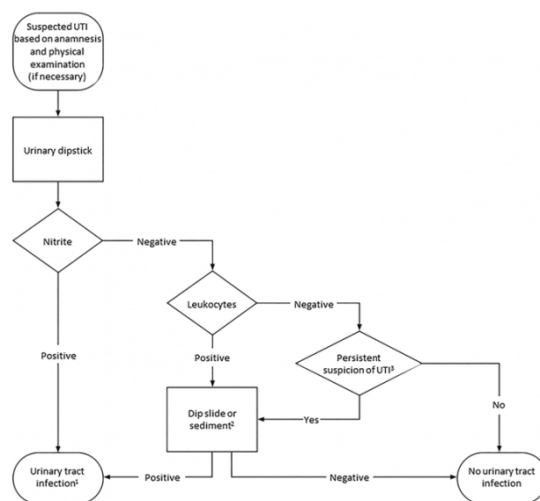| Most important (%)		Least important (%)
	Test feature	
75.8	Diagnostic accuracy	1.1
10.0	Time-to-result	7.4
9.5	Ease-of-use	14.2
2.6	Patient discomfort	24.2
2.1	Cost	53.2
	Consideration before prescribing an antibiotic	
57.4	Positive urine culture	2.1
26.8	Symptom recognition by patient	2.6
12.1	Symptom recognition by GP	8.4
3.7	Patient expectation	86.8
	Patient reasons for consultation	
37.5	Obtaining antibiotics	4.7
31.1	Symptom relief	5.3
22.1	Diagnosis	5.3
7.4	Additional examination	58.4
2.6	Reassurance	26.3

GP = general practitioner

14

Figure 1 Diagnostic algorithm for UTI in family practice in the Netherlands. 1Perform a urinary culture with antibiotic susceptibility testing in case of two time treatment failure for cystitis in healthy non-pregnant women, treatment failure for cystitis in vulnerable elderly patients, cystitis in patients taking antibiotic prophylaxis because of recurring UTI, cystitis in risk patients, cystitis in children younger than 12 years of age, or UTI with signs of tissue invasion. 2Only perform a sediment in patients older than 12 years of age. 3Perform a urinary culture with antibiotic susceptibility testing in case of a persisting suspicion of UTI, despite a negative dipstick and dip slide or sediment result. Image adapted from the UTI guidelines of the Dutch College of General Practitioners (4). UTI = urinary tract infection.

338x190mm (96 x 96 DPI)

Supplementary figures

Supplementary 1. Survey on general practitioners' knowledge, attitudes, practice, and needs around UTI care.

Dear general practitioner, this questionnaire is about your opinion, knowledge, and attitudes on UTIs.

*Do not concern yourself with answering the questions in this questionnaire "correctly", but only with your **personal opinion.** This is very important to us!*

1.   **Please indicate the extent to which you agree with the following statements about the diagnosis and treatment of urinary tract infections.**

	Completely disagree	Somewhat disagree	Neutral	Somewhat agree	Completely agree
If urine is handed in for symptoms **not** indicating a urinary tract infection, then I ignore the results of the urinalysis.	0	0	0	0	0
With the current dipstick at the out-of-hours center I can diagnose a urinary tract infection with sufficient certainty.	0	0	0	0	0
I am less likely to initiate a urine culture at the **out-of-hours center** than at the regular hours center because I do not have access to the patient's complete record.	0	0	0	0	0
I am less likely to initiate a urine culture at the **out-of-hours center** than at the regular hours center because I am unable to follow-up with the patient.	0	0	0	0	0
Point-of-care tests better than the current dipstick test are needed for diagnosing urinary symptoms.	0	0	0	0	0
Better point-of-care tests for urinary tract infections may help me to prescribe in a more targeted way.	0	0	0	0	0

Better point-of-care tests for urinary tract infections could save time in my daily work.	0	0	0	0	0
Physician assistants have sufficient knowledge on UTIs.	0	0	0	0	0
General practitioners have sufficient knowledge on UTIs.	0	0	0	0	0

2. In the list below, please indicate which **combination of 2 symptoms** make the diagnosis of **urinary tract infection most** likely in healthy women.:
*Select **2** symptoms from this list:*

0 Dysuria

0 Lower abdominal pain

0 Pollakisuria

0 Malodorous or turbid urine

0 Urge to urinate on empty bladder

0 Hematuria

0 Fever

0 Shivers

0 Absence of vaginal complaints

3. Statements about your handling of urinary tract infections:

	Never	Rarely	Sometimes	Often
When I diagnose a urinary tract infection in a healthy woman, I prescribe a delayed prescription.	0	0	0	0
I am less likely to order a urinary culture at the **out-of-hours center**.	0	0	0	0
I am more likely to prescribe an antibiotic to unknown patients at the **out-of-hours center**.	0	0	0	0
I refer patients with mictional complaints to www.thuisarts.nl.	0	0	0	0

4. For the following statements, could you indicate whather, in your opinion, they are true or false?

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I am able to apply a urine culture at an out-of-hours center.

0 Correct   0 Incorrect   0 I don't know

A cystitis can resolve by drinking sufficiently and with the possible addition of painkillers.

0 Correct   0 Incorrect   0 I don't know

A urine culture is indicated in the case of a positive nitrite test in an elderly patient without micturition complaints.

0 Correct   0 Incorrect   0 I don't know

In patients with an indwelling catheter, changed odor or consistency of urine is a reason to perform diagnostics.

0 Correct   0 Incorrect   0 I don't know

In the case of non-specific complaints with a negative nitrite test, a UTI can be diagnosed with a positive leukocyte and erythrocyte test.

0 Correct   0 Incorrect   0 I don't know

At an out-of-hours center, a urine culture needs to be applied in patients with a positive nitrite test and signs of tissue invasion.

0 Correct   0 Incorrect   0 I don't know

At a regular hours center a urine culture needs to applied in a patient with a positive nitrite test and signs of tissue invasion.

0 Correct   0 Incorrect   0 I don't know

At a regular hours clinic, a urine culture needs to be applied in a risk patient* with a positive nitrite test.
*(patients with kidney or urinary tract abnormalities, bladder function disorders, men, children <12y/o, and pregnant women)

0 Correct   0 Incorrect   0 I don't know

At an out-of-hours center a urine culture needs to be applied in a risk patient* with a positive nitrite test.
*(patients with kidney or urinary tract abnormalities, bladder function disorders, men, children <12y/o, and pregnant women)

0 Correct   0 Incorrect   0 I don't know

5. **If a new diagnostic test for urinary tract infections were to be developed, what would be the most important requirements according to you?**

   Please prioritize by numbering 1 to 5, 1 indicating most important and 5 indicating least important. You can use each number only once.

   ☐ Ease of use for the physician/physician assistant

   ☐ Limiting patient discomfort

   ☐ Time-to-result

   ☐ Diagnostic accuracy

   ☐ Cost

6. **In case of a suspected UTI at the out-of-hours center, which factors are most important for forming your decision to prescribe antibiotics?**

   Please prioritize by numbering 1 to 4, 1 indicating most important and 4 indicating least important. You can use each number only once.

   ☐ Symptom recognition by patient

   ☐ Symptom recognition by physician

   ☐ Patient expectation

   ☐ Positive urine culture

7. **With which expectations do you think patients most often consult a physician when suspecting a UTI?**

   Please prioritize by numbering 1 to 5, 1 indicating most important and 5 indicating least important. You can use each number only once.

   ☐ Obtaining a diagnosis

   ☐ Obtaining reassurance

   ☐ Obtaining an antibiotic prescription

   ☐ Obtaining additional examination

   ☐ Obtaining symptom relief

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3   **8.** Name one aspect of UTI care that you feel could be improved.
4   *Enter the most important aspect here, or leave the question unanswered if you feel the care cannot be improved:.*
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7   *Finally, a few brief questions about your background.*
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9   **9. What is your age?**
10   **10. Wat is your gender?**
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12   **11. What is your work situation?**
13   o Practice owner
14   o Locum
15   o General practitioner in training
16   o General practitioner and researcher in training
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18   **12. How many years of working experience as a general practitioner do you have?**
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20   **13. On average, how many days per week do you work at a regular or out-of-hours center?**
21   **14. On average, how many shifts do you work at an out-of-hours center per year?**
22   **15. In which region do you currently spend most of your time working as a general**
23   **practitioner?**
24
25
26   **If you have any other comments please post them here:**
27
28   **Thank you for your cooperation!**
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33   **Supplementary 2.** General practitioners' knowledge about UTI care

Statement	Correct n (%)	Incorrect n (%)	Didn't know n (%)
The use of urinary culture			
I am able to apply a urine culture at an out-of-hours center	176 (92.6)	9 (4.7)	5 (2.6)
At a regular hours clinic, a urine culture needs to be applied in a risk patient with a positive nitrite test	177 (93.2)	12 (6.3)	1 (0.5)
At an out-of-hours center a urine culture needs to be applied in a risk patient with a positive nitrite test	159 (83.7)	27 (14.2)	4 (2.1)
At a regular hours center a urine culture needs to be applied in a patient with a positive nitrite test and signs of tissue invasion	151 (79.5)	35 (18.4)	4 (2.1)
At an out-of-hours center, a urine culture needs to be applied in patients with a positive nitrite test and signs of tissue invasion	131 (68.9)	48 (25.3)	11 (5.8)
UTI in elderly patients			
A urine culture is indicated in the case of a positive nitrite test in an elderly patient without micturition complaints	109 (57.4)	61 (32.1)	20 (10.5)
In patients with an indwelling catheter, changed odor or consistency of urine is a reason to perform diagnostics	144 (75.8)	33 (17.4)	13 (6.8)

Uncomplicated UTI			
In the case of non-specific complaints with a negative nitrite test, a UTI can be diagnosed with a positive leukocyte and erythrocyte test.	135 (71.1)	47 (24.7)	8 (4.2)
A cystitis can resolve by drinking sufficiently and with the possible addition of painkillers	184 (96.8)	4 (2.1)	2 (1.1)

Supplementary 3. GPs' opinions about UTI care

Statement	Agree n (%)	Neutral n (%)	Disagree n (%)
Knowledge			
General practitioners have enough knowledge in regards to urinary tract infections.	144 (75.8)	26 (13.7)	20 (10.5)
Doctors' assistants have enough knowledge in regards to urinary tract infections.	105 (55.3)	38 (20.0)	47 (24.7)
Point-of-care tests			
Better point of care tests will be able to aid me to prescribe antibiotics more accurately.	138 (72.6)	21 (11.1)	31 (16.3)
Better point of care tests will be able to save time during my daily work in the management of urinary tract infections.	114 (60.0)	40 (21.1)	36 (18.9)
With the current dipstick test at an out of hours center, I will be able to diagnose an urinary tract infection with enough certainty.	103 (54.2)	25 (13.2)	62 (32.6)
Better point of care tests, other than the current dipstick, are needed for urinary tract infections.	103 (54.2)	39 (20.5)	48 (25.3)
I disregard the result of a urinalysis when an urine sample is submitted with symptoms that are not fitting a urinary tract infection.	47 (24.7)	19 (10.0)	124 (65.3)
Urinary culture			
At an out-of-hours center, I'm less likely to submit a urine culture compared to the regular hours center because I do not have access to the full medical file.	72 (37.9)	13 (6.8)	105 (55.3)
At an out-of-hours center, I'm less likely to submit a urine culture compared to the regular hours center because I'm unable to follow up on the patient.	53 (27.9)	12 (6.3)	125 (65.8)

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of	4

recruitment, exposure, follow-up, and data collection

Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	4
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	5
Bias	#9	Describe any efforts to address potential sources of bias	n/a
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	5
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	5
Statistical methods	#12c	Explain how missing data were addressed	n/a
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	n/a
Statistical methods	#12e	Describe any sensitivity analyses	n/a

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	5
Participants	#13b	Give reasons for non-participation at each stage	n/a
Participants	#13c	Consider use of a flow diagram	n/a

Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.		5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest		n/a
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.		5-7
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included		5-7
Main results	#16b	Report category boundaries when continuous variables were categorized		n/a
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses		n/a

Discussion

Key results	#18	Summarise key results with reference to study objectives		7
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.		7-8
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.		7-8
Generalisability	#21	Discuss the generalisability (external validity) of the study results		8-9

Other Information

Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based		9

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This checklist was completed on 15. December 2023 using https://www.goodreports.org/, a tool made by the

EQUATOR Network in collaboration with Penelope.ai

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Knowledge, attitudes, and practice around urinary tract infections of general practitioners in the Netherlands: a cross sectional internet survey.

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Word count: 3460

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3   1   Number of tables and figures: 4 + 3 appendices
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5   2
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7   3   ## Abstract

8   4   **Objectives:** Urinary tract infections (UTIs) are the most common reason for women to
9   5   consult a general practitioner (GP). Current diagnostic tests are inadequate, complicating
10   6   diagnosis and treatment decisions for GPs. To understand how this influences GPs in
11   7   managing UTI, we aimed to determine GPs' knowledge, attitudes, and practices around UTI
12   8   care.
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14   9   **Design:** Cross-sectional internet-based survey.
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16   10   **Setting:** General practice in the Netherlands between December 2021 and February 2022.
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18   11   **Participants:** We distributed invitations to participate via e-mail to 126 practices.
19   12   Additionally we distributed invitations via social media and newsletters.
20
21   13   **Outcomes:** The survey included 15 questions covering GPs' sociodemographic information,
22   14   knowledge, attitude, and practices. Data analysis was based on frequencies and descriptive
23   15   statistics.
24
25   16   **Results:** Among the 190 eligible respondents, 172 (90.5%) chose dysuria and 140 (73.7%)
26   17   chose urinary frequency as a symptom likely indicating UTI in healthy women. One in three
27   18   GPs would diagnose a UTI based on non-specific complaints with positive leukocyte and
28   19   erythrocyte tests, discordant with established guidelines. GPs indicated that better point-of-
29   20   care diagnostics would help to improve antibiotic prescribing (72.6%) and would conserve
30   21   time (60.0%). GPs considered a positive test result the most important factor to prescribe
31   22   antibiotics while patient expectation was considered least important. Half of GPs indicated
32   23   that the most urgent need in UTI care is improved diagnostics.
33
34   24   **Conclusion:** GPs often act in discordance with established guidelines, rely on nonspecific
35   25   symptoms for the diagnosis of UTI, and rank patient expectation as less important in
36   26   comparison to symptom recognition and culture result when deciding on antibiotic
37   27   treatment.
38
39   28   **Key words:** urinary tract infections, diagnosis, general practice, antibiotic stewardship,
40   29   survey
41
42   30   **Abbreviations:** DA = doctor's assistant, GP = general practitioner, OOH = out-of-hours, SD =
43   31   standard deviation, UTI = urinary tract infection

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Strengths and limitations

- This survey provides unique insights into the knowledge, attitudes, and practice of Dutch general practitioners around urinary tract infections.
- General practices in the Dutch province of Limburg were emailed directly to improve the number of responses to the survey.
- Therefore responses mainly originated from general practitioners in the south of the Netherlands, however their demographic data are comparable to Dutch general practitioners in general.

Introduction

Urinary tract infections (UTIs) are the most common reason for women to consult a general practitioner (GP). More than 75% of women will have at least one episode of UTI during their lifetime (1, 2). One in eight female patients consult their GP due to a UTI every year (1). In female patients over 60 years of age, this number increases up to one in five every year (3, 4).

The diagnosis of UTI in general practice and out-of-hours (OOH) in the Netherlands relies mainly on urinary dipstick testing together with medical history-taking (4, 5). Customarily, patients with urinary symptoms contact the general practice by phone, by which they first speak with a doctor's assistant (DA), who takes the patient's medical history and decides whether they should submit a urine for diagnostic testing. The DA tests the sample using the urinary dipstick test, and subsequently relays the result of the test together with the patient's medical history to the general practitioner, who decides on the course of action according to the decision algorithm shown in figure 1.

The result of the urinary dipstick carries significant weight in the diagnosis of UTI in the Netherlands. However, the urinary dipstick is suboptimal in both its sensitivity and specificity (3, 6, 7). Furthermore, urinary culture, the diagnostic golden standard, is laborious, costly, takes two to three days, and requires samples to be analysed at a clinical laboratory. Moreover, urinary culture is unable to distinguish between an actual UTI and asymptomatic bacteriuria. Therefore, the results of a urinary culture need to be interpreted with patient symptoms in mind, lest the physician prescribes antibiotics for the relatively benign condition of bacteriuria (8). Furthermore, while the sensitivity of the urinary culture is definitely one of its strengths, it also means that that it is susceptible to contamination.

Because of the drawbacks of urinary culture, most UTI treatment decisions in general practice are based on patient symptoms, urinary dipstick results, and empiric antibiotics (9-12). Because of this, GPs' knowledge of urinary symptoms related to UTIs, and the DAs' ability to take the relevant patient history, are of the utmost importance to avoid overtreatment. Overtreatment with antibiotics is a burden to both the patient and society as a whole. The patient is exposed to the side effects of antibiotics without reaping the benefits, while society is faced with increasing health care costs due to rising of antibiotic resistance (13, 14). Overtreatment is a problem in the out-of-hours setting especially, where

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3   1   physicians generally do not have access to patients' previous urine culture results or prior
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5   2   UTI symptoms, which causes them to opt for the prescription of antibiotics sooner (5).
6   3   GPs divert from UTI guidelines in half of the patients and most UTIs are treated with
7   4   empiric antibiotic prescriptions, even though the disease is known to be self-limiting in 50%
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9   5   of otherwise healthy women (15,16). To improve the appropriateness of prescribed
10   6   antibiotics, more insight is needed into the factors that may influence GPs decisions around
11   7   the diagnosis and management of UTIs.
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13   8   Research towards the knowledge and experiences of GPs managing UTIs is limited
14   9   (17). Having an understanding of GPs' experiences is crucial when designing and
15   10   implementing effective interventions and potential new diagnostic tests. This study
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17   11   therefore aims to investigate the knowledge, attitudes, and practices of Dutch GPs towards
18   12   UTIs during regular and out-of-hours care.
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Methods

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23   15   We conducted a cross-sectional internet-based survey among Dutch GPs between December
24   16   2021 and February 2022. We used Qualtrics software (Qualtrics May 2020, Provo, UT, USA)
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26   17   to obtain responses. We sent emails to all GPs with publicly available email addresses in the
27   18   Dutch province of Limburg (n=126). To enhance the response rate, we created a website that
28   19   underlined the affiliation with Maastricht University and linking to the survey proper. Here
29   20   the respondents were informed about the study, after which they could consent to
30
31   21   participation. Additionally, we distributed invitations on multiple social media platforms,
32   22   including LinkedIn (Microsoft Corporation), Twitter Inc., Facebook (Meta Inc.), and
33   23   WhatsApp (Meta Inc.), as well as via newsletters of multiple GPs' networks in Limburg
34   24   (HOZL, Cohesie, ZIO and Meditta).
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37   ### Setting and subjects
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39   26   Fully trained GPs registered at the Dutch registry of health care professionals were eligible
40   27   for participation. To have a selective overview of current practice, participants were
41   28   excluded if they were not actively working as GPs. Participants did not receive any incentive
42   29   to participate in the study. While the focus of our recruitment was in the providence of
43
44   30   Limburg, we did not exclude responses from the rest of the Netherlands.
45
46   ### Sample size
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48   32   Based on an estimated population of 12,766 active GPs in the Netherlands during the
49   33   conduction of this survey and a confidence interval of 95% and a margin of error between 5
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51   34   to 10%, we considered a sample size of 96 to 373 sufficient to ensure generalizability (18).
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53   ### Survey contents
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55   36   The survey included 15 questions, of which 3 questions had 3-9 sub questions
56   37   (Supplementary 1). These questions covered knowledge, attitude, practices and
57   38   sociodemographic information. Answer possibilities within the survey were Likert-scale
58   39   statements, right-wrong-don't know questions, listing priorities, regular multiple-choice
59   40   question, an open-ended questions to explore the needs of GPs and an open-ended question
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1 to allow respondents to explain their answers or to notify the research group of survey
2 difficulties, if any.

Data collection

4 The content of the questionnaire was derived from previous qualitative and quantitative
5 research and expert opinion (4,19-21). Face validity (the degree to which the survey appears
6 effective in terms of its stated aims) and readability was tested after a consensus was
7 reached within the research group about the quantity and quality of the compiled questions.
8 A pilot sample of 7 individuals verified the face validity and readability of the questionnaire.
9 Among these individuals were 1 active GP, 1 retired GP, 1 project manager, 3 medical
10 students and 1 non-medically educated individual. All multiple-choice questions required a
11 human interaction to the answer possibilities or required a data entry before the survey
12 would continue to the next question. Subitems within questions were shuffled randomly
13 among respondents. To prevent Ballot Box Stuffing, the survey software placed a local
14 browser based cookie if not disagreed to by the user. The respondent's IP address was also
15 logged during completion of the survey allowing the research group to identify possible
16 fraudulent enrollment to the survey.

Data Analysis

18 Respondents' answers were automatically entered into a data file and analysed using SPSS
19 Version 27.0 (IBM Corp; Armonk, NY). We used descriptive statistics to analyse the
20 demographic data. Analysis was based on frequencies and cross tables of pre-selected
21 variables. The open-ended questions were categorised yielding frequencies and cross tables.

Patient and public involvement

23 Patients or other public were not involved in the design, conduct, reporting, or dissemination of the
24 research.

Results

Population characteristics

27 We received 233 responses over the course of 3 months. After exclusion of partial responses
28 (n=32), responses from physicians in training (n=10), and a response which was submitted by
29 a DA (n=1), 190 responses remained eligible for analysis.

30   Table 1 summarises the characteristics of the included GPs. GPs had a mean age of
31 44.3 (standard deviation (SD)=9.4), ranging from 29 to 69 years. Among the participating GPs
32 129 (68%) were female. On average GPs had been practicing their profession for 13.4 years
33 (SD=9.5), worked 14.6 days per month (SD=6.0) during regular hours and worked 2.6 days
34 per month (SD=2.2) in OOH care centers.

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General practitioners' knowledge

UTI symptoms

We asked GPs to choose two symptoms out of a possible nine that they considered most likely to indicate a UTI in women (Table 2). We chose these nine symptoms because they were listed in the guidelines of the Dutch College of General Practitioners as possible symptoms of UTI. According to the guidelines, the symptoms most indicative of a UTI in healthy, non-pregnant women are dysuria and the absence of vaginal complaints (4). Almost all GPs (n=172, 90.5%) correctly chose *dysuria* as most indicative of a UTI, and eight GPs (4.2%) chose *absence of vaginal complaints*. *Urinary frequency* was the second most frequently picked answer possibility with 140 (73.7%) responses (22,23).

> **Box 1: High risk UTI patients**
> UTI patients at a higher risk for a complicated course of disease according to Dutch guidelines:
> - Women who:
>   - Are pregnant
>   - Are diagnosed with diabetes mellitus
>   - Are immunocompromised
>   - Have abnormalities to the kidneys or urinary tract
>   - Have a neurogenic bladder
> - Men

To further evaluate GPs' knowledge, multiple statements involving the diagnosis and management of UTIs were presented within the survey (Supplementary 2). More than 4 out of 5 respondents answered the questions regarding the use of urinary culture in risk patients correctly (Box 1). Fewer respondents were able to correctly answer the question with regards to patients with signs of tissue invasion (fever, shivers, signs of sepsis, etc.): 151 in regular hours (79.5%) and 131 in OOH (68.9%).

UTI in elderly patients

When asked about whether a urinary culture is required in an elderly patient with a positive nitrite test without micturition complaints (a likely case of asymptomatic bacteriuria), 109 respondents (57.4%) answered correctly that this was not the case. In a similar vein, 144 respondents (75.8%) answered correctly that a urinary culture was not indicated in the case of a catheterised patient with odorous or turbid urine.

Uncomplicated UTI

Respondents' knowledge on the diagnosis of uncomplicated UTI was tested with the statement: "In the case of non-specific complaints with a negative nitrite test, a UTI can be diagnosed with a positive leukocyte and erythrocyte test". Of all respondents, 135 (71.1%) correctly disagreed with the statement. Almost all respondents (n=184, 96.8%) correctly agreed with the statement that a cystitis can resolve by drinking sufficiently and with the possible addition of painkillers.

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General practitioners' attitudes

Supplementary 3 shows the answer distributions to the Likert-scale questions regarding GPs' attitudes around UTI care. Almost two thirds of GPs participating in the survey (65.3%) would not disregard the result of a urinalysis when a urine sample is submitted from a patient with symptoms that do not suggest a urinary tract infection. Most GPs agree that better point-of-care tests are needed for the diagnosis of UTI (54.2%), that these new tests will aid them in prescribing antibiotics more accurately (72.6%), and that better point-of-care tests will likely save them time during their activities as an GP (60.0%).

We asked respondents what they thought were the most important features to consider of any potential newly developed test, what they thought were the most important considerations before prescribing an antibiotic, and what they thought were the most important reasons for patients to consult a GP (table 3). Among the respondents, 75.8% considered *diagnostic accuracy* the most important feature of a diagnostic test. Furthermore, when asked to rank considerations for prescribing an antibiotic from least to most important, most GPs (86.8%) ranked patient expectation least important (the other options being a positive urine culture, symptom recognition by the patient, and symptom recognition by the GP). According to our respondents, most patients with urinary symptoms visit the family practice with the expectation of *obtaining antibiotics* (37.5%), followed by *symptom relief* (31.1%).

General practitioners' practice

Most GPs (46.3%) indicated that they *sometimes* prescribe a delayed antibiotic prescription when diagnosing a urinary tract infection in a healthy woman. Moreover, 43.7% indicated that they *never* or *rarely* employed delayed prescriptions.

Discussion

Summary

GPs seem to overvalue urinary frequency as a symptom most indicative of a UTI. Furthermore, fewer than 6 out of 10 GPs chose the correct course of action for an elderly patient with asymptomatic bacteriuria. When deciding on whether to prescribe antibiotics for a UTI, GPs deemed symptom recognition or the urinary culture result more important than patient expectation. Almost half of responding GPs indicated to never or rarely prescribe delayed antibiotics for a UTI. When asked about their highest need in UTI care, GPs indicated that diagnostic improvements have the highest urgency.

A limitation of this study is the presence of possible selection bias, since respondents are likely more interested in the subject and therefore more up to date with the latest guidelines. Additionally, GPs who think that UTI care should be improved are more likely to participate. Another limitation of this study is the presence of possible response bias, since respondents could have answered in a socially desired manner.

1 Some questions in the survey might be prone to misinterpretation leading to inaccurate
2 results. In addition, multiple-choice questions might not offer all answer possibilities, leading
3 to response bias as well. Furthermore, due to our inclusion strategy, almost half of our
4 respondents resided in Limburg, the southernmost province of the Netherlands with 6-7% of
5 the nation's inhabitants. However, our study population has a similar average age, average
6 amount of working days a month, and share of practice holders compared to the total
7 population of GPs in the Netherlands (18). Still, the relatively small sample size combined
8 with the limited spread of respondents throughout the Netherlands might limit the
9 generalisability of our findings. Nonetheless, this study highlights points of improvement for
10 UTI care in the Netherlands in general, since we hypothesise that most if not all points raised
11 are applicable to GPs throughout the country.

12 The main strength of this study is that this is the first quantitative survey among GPs
13 in the Netherlands investigating their knowledge, attitude and practices towards UTI care.
14 Therefore this study gives a unique insight into where UTI care can be improved in Dutch
15 family medicine.

16 ## Comparison with current literature

17 The results of our study show that most GPs would treat a patient based on a urinary
18 dipstick result, even when the patient does not have specific symptoms. However, UTI
19 guidelines indicate that a cystitis is the correct diagnosis when a positive urinalysis is
20 accompanied by patient symptoms (4,18). This indicates that GPs might rely on diagnostics
21 too much, while not paying enough attention to patients symptoms (24).

22 Curiously, almost half of the GPs indicated that they felt the dipstick test is
23 inadequate for the diagnosis of a UTI. This is probably a reflection of the poor accuracy of
24 the urinary dipstick (3,6,7). In view of its poor accuracy, the use of urinary dipsticks is not
25 always recommended for the diagnosis of cystitis in otherwise healthy, pre-menopausal,
26 non-pregnant women in other countries. International guidelines from Belgium, Germany,
27 Sweden, Norway, and the UK suggest to diagnose these patients with a UTI if the symptoms
28 point to this diagnosis, while ensuring the absence of symptoms that could point to other
29 diagnoses (such as vaginal complaints) (25-29). In North-Western Europe, only the French,
30 Danish, and Dutch guidelines recommend the routine use of urinary dipsticks for the
31 diagnosis of UTI in otherwise healthy women in addition to asking for symptoms (4,30,31).
32 Previous versions of the Dutch guidelines included the recommendation to diagnose based
33 only on patient symptoms. However, previous research has shown that 15-20% of patients
34 presenting with symptoms suggestive of a UTI did not have a microbiological cause for their
35 symptoms (32). Additionally, an increase in the amount of GP visits and antibiotic
36 prescriptions due to UTIs in the Netherlands was seen, which was believed to be caused by
37 GPs diagnosing solely based on symptoms (10). These findings combined led to the inclusion
38 of the urinary dipstick in the diagnostic algorithm. In order to account for the dipstick's
39 relatively poor accuracy when performed in isolation, the revised guidelines recommends to
40 perform the urinary dipstick test only under the condition that the patient's symptoms
41 already suggest a UTI. In this manner both the dipstick and the patient's symptoms act as a

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control for each other. However, as our results show, Dutch GPs often forgo this condition and perform a urinary dipstick test whether patient symptoms suggest a UTI or not. Therefore, it is imperative that GPs are made aware of the conditions under which they should perform a urinary dipstick by offering continuing education on UTI guidelines.

An inclusion in such continuing education could be the recognition of the symptoms most indicative of a UTI. The guidelines of the Dutch College of General Practitioners indicate that dysuria and the absence of vaginal complaints are the most indicative symptoms for UTI in otherwise healthy women. While dysuria was almost unanimously recognised, GPs failed to include the absence of vaginal complaints when asked about the strongest predictors for the presence of UTI (33). Furthermore, urinary frequency was often chosen as a symptom indicative of UTI. While urinary frequency is indeed a symptom associated with UTI, previous studies have shown that it is a symptom with limited specificity for UTI (22, 23). However, as is the case in most international guidelines, the Dutch guidelines still recommend GPs to ask patients about frequency of urination. Therefore, we do not mean to suggest that looking out for urinary frequency is wrong, only that the combination of dysuria and an absence of vaginal symptoms is the most predictive. This is also recognised internationally, since most international guideline we consulted suggests to forgo the diagnosis of UTI when vaginal symptoms are present (25,26,29). It is therefore critical that GPs pay close attention to their presence and adjust their diagnosis accordingly.

Moreover, almost half of GPs think that the most pressing need in UTI care is the need for better diagnostics. We believe that until better diagnostics become available, the decision to test a urine sample should be much more conscious in order to improve current UTI management in general practice, something which was also proven to be effective in previous studies where health care professionals were trained in recognizing urinary tract infections (34).

Implications for practice

This study shows that while GPs think that they have sufficient knowledge around the diagnosis and treatment of UTI, this is not always the case. GPs rely heavily on urinalysis for the diagnosis of a UTI and seem to have trouble identifying the symptoms indicative of UTI and even indicate they disregard symptoms as a whole when a dipstick test turns out positive for nitrite. This may lead to overdiagnosis and –treatment of patients with asymptomatic bacteriuria. Moreover, this could lead to GPs overlooking alternative diagnoses, leading to increased morbidity. This overreliance on the urinary dipstick could be an unintended side effect of the revision of the Dutch guidelines mentioned above, since it created a central role for the urinary dipstick in diagnosing UTI in otherwise healthy women. Creating awareness among GPs of the urinary dipstick's limited accuracy and teaching them to only employ the urinary dipstick when the patient's symptoms call for it is critical in reducing the current overreliance on the urinary dipstick.

Moreover, GPs in our study indicated that they value a positive urine culture and symptom recognition by either the patient or the GP over patients' wishes when

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deciding to prescribe antibiotics. We think this is partly due to GPs interpreting the question with each option in isolation. We can imagine that GPs would not want to describe antibiotics to a patient when anamnesis and diagnostics ruled out a UTI, no matter the patient's desire to obtain antibiotics. In this context it is understandable that GPs might not take the patient's wishes into account when deciding on treatment. This is supported by previous research that has shown that GPs think that patients with urinary symptoms primarily visit a GP to obtain antibiotics, also underlined by results in our current study (35). However, patients primarily want to be free of symptoms and want to have the feeling that they are taken seriously during consultation (36,37). Therefore we think that UTI care can be improved by incorporating the patient's wishes into the treatment decision. However, this warrants supplying the patient with the necessary information, since the patient's knowledge on UTIs might be lacking.

It is imperative that GPs not only change their own behavior, but that they change the culture around testing and antibiotic prescriptions throughout their whole practice. In the Dutch health care system patients with urinary symptoms are not always seen by GPs. Instead the patient contact is performed entirely by a doctor's assistant (DA). Therefore, it is imperative that DAs are also sufficiently informed by GPs about which symptoms to look out for in case of a suspected UTI. Little research has been done towards DA's knowledge, attitudes, and practices around UTIs and we therefore recommend to repeat this study in that population.

Conclusion

In this cross-sectional survey study, we show that GPs have trouble identifying specific symptoms of UTI. They often act in discordance with established guidelines, especially when determining in which cases urinalysis needs to be performed. Furthermore, GPs overvalue urinary frequency as an indication of UTI. Additionally, GPs value a positive urine culture and the recognition of UTI symptoms by either the patient or the GP over patient preference when deciding on whether antibiotics should be prescribed. GPs seldom make use of delayed antibiotic prescriptions.

Disclosure statement

Ethics

Funding

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1 ## Conflict of interest statement

2 The authors report there are no competing interests to declare.

3 ## Author contributions

4 All authors meet the 4 criteria that form the basis of authorship as stated by the ICMJE. SC, WG, and
5 EdB made the concept of and designed the work. SC and WG acquired and analysed the data. SC,
6 WG, TP, JC, and EdB interpreted the data. SC is responsible for the overall content as guarantor.

7 ## Data sharing

8 Data are available upon reasonable request.

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Figure legend

Figure 1 - Diagnostic algorithm for UTI in family practice in the Netherlands. [1]Perform a urinary culture with antibiotic susceptibility testing in case of two time treatment failure for cystitis in healthy non-pregnant women, treatment failure for cystitis in vulnerable elderly patients, cystitis in patients taking antibiotic prophylaxis because of recurring UTI, cystitis in risk patients, cystitis in children younger than 12 years of age, or UTI with signs of tissue invasion. [2]Only perform a sediment in patients older than 12 years of age. [3]Perform a urinary culture with antibiotic susceptibility testing in case of a persisting suspicion of UTI, despite a negative dipstick and dip slide or sediment result. Image adapted from the UTI guidelines of the Dutch College of General Practitioners (4). UTI = urinary tract infection.

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14   6   **Table 1** Population characteristics

Characteristics	General practitioners (n = 190)
Age, mean years (SD)	44.3 (9.4)
Female, n (%)	129 (67.9)
Work experience, mean years (SD)	13.4 (9.5)
Work during regular hours, mean days/month (SD)	14.6 (6.0)
Work during OOH, mean days/month (SD)	2.6 (2.2)
Practice holder, n (%)	108 (56.8)
Resident educator, n (%)	19 (10.0)
Practice holder and resident educator, n (%)	15 (7.9)

14   *OOH = out-of-hours, SD = standard deviation*

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Table 2. Symptoms believed by general practitioners to indicate a UTI in healthy women.

Symptom(s)	Respondents (%)
Dysuria	172 (90.5)
Urinary frequency	140 (73.7)
Malodorous or turbid urine	27 (14.2)
Urge to urinate on empty bladder	15 (7.9)
Absence of vaginal complaints	8 (4.2)
Hematuria	8 (4.2)
Fever	6 (3.2)
Lower abdominal pain	4 (2.1)
Shivers	0 (0.0)

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12   5   **Table 3** Most and least important features of new diagnostic tests, considerations before prescribing
13   6   an antibiotic, and patient reasons for consultation according to general practitioners.

Most important (%)		Least important (%)
	Test feature	
75.8	Diagnostic accuracy	1.1
10.0	Time-to-result	7.4
9.5	Ease-of-use	14.2
2.6	Patient discomfort	24.2
2.1	Cost	53.2
	Consideration before prescribing an antibiotic	
57.4	Positive urine culture	2.1
26.8	Symptom recognition by patient	2.6
12.1	Symptom recognition by GP	8.4
3.7	Patient expectation	86.8
	Patient reasons for consultation	
37.5	Obtaining antibiotics	4.7
31.1	Symptom relief	5.3
22.1	Diagnosis	5.3
7.4	Additional examination	58.4
2.6	Reassurance	26.3

7   GP = general practitioner

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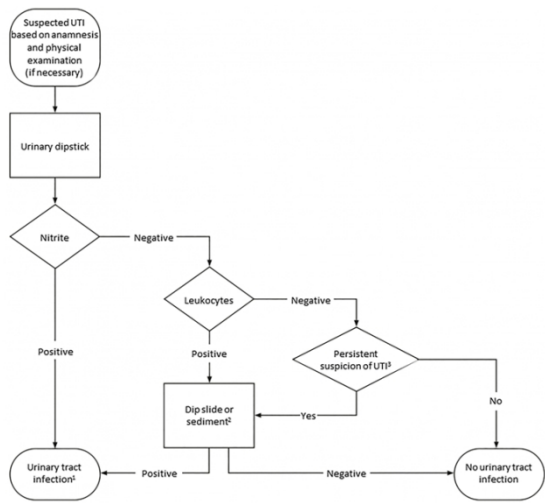44
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Figure 1 - Diagnostic algorithm for UTI in family practice in the Netherlands.

338x190mm (96 x 96 DPI)

Supplementary figures

Supplementary 1. Survey on general practitioners' knowledge, attitudes, practice, and needs around UTI care.

Dear general practitioner, this questionnaire is about your opinion, knowledge, and attitudes on UTIs.

*Do not concern yourself with answering the questions in this questionnaire "correctly", but only with your **personal opinion.** This is very important to us!*

1.   **Please indicate the extent to which you agree with the following statements about the diagnosis and treatment of urinary tract infections.**

	Completely disagree	Somewhat disagree	Neutral	Somewhat agree	Completely agree
If urine is handed in for symptoms **not** indicating a urinary tract infection, then I ignore the results of the urinalysis.	0	0	0	0	0
With the current dipstick at the out-of-hours center I can diagnose a urinary tract infection with sufficient certainty.	0	0	0	0	0
I am less likely to initiate a urine culture at the **out-of-hours center** than at the regular hours center because I do not have access to the patient's complete record.	0	0	0	0	0
I am less likely to initiate a urine culture at the **out-of-hours center** than at the regular hours center because I am unable to follow-up with the patient.	0	0	0	0	0
Point-of-care tests better than the current dipstick test are needed for diagnosing urinary symptoms.	0	0	0	0	0
Better point-of-care tests for urinary tract infections may help me to prescribe in a more targeted way.	0	0	0	0	0

Better point-of-care tests for urinary tract infections could save time in my daily work.	0	0	0	0	0
Physician assistants have sufficient knowledge on UTIs.	0	0	0	0	0
General practitioners have sufficient knowledge on UTIs.	0	0	0	0	0

2. In the list below, please indicate which **combination of 2 symptoms** make the diagnosis of **urinary tract infection most** likely in healthy women.:
*Select **2** symptoms from this list:*

0 Dysuria

0 Lower abdominal pain

0 Pollakisuria

0 Malodorous or turbid urine

0 Urge to urinate on empty bladder

0 Hematuria

0 Fever

0 Shivers

0 Absence of vaginal complaints

3. Statements about your handling of urinary tract infections:

	Never	Rarely	Sometimes	Often
When I diagnose a urinary tract infection in a healthy woman, I prescribe a delayed prescription.	0	0	0	0
I am less likely to order a urinary culture at the **out-of-hours center**.	0	0	0	0
I am more likely to prescribe an antibiotic to unknown patients at the **out-of-hours center**.	0	0	0	0
I refer patients with mictional complaints to www.thuisarts.nl.	0	0	0	0

4. For the following statements, could you indicate whather, in your opinion, they are true or false?

I am able to apply a urine culture at an out-of-hours center.

0 Correct   0 Incorrect   0 I don't know

A cystitis can resolve by drinking sufficiently and with the possible addition of painkillers.

0 Correct   0 Incorrect   0 I don't know

A urine culture is indicated in the case of a positive nitrite test in an elderly patient without micturition

complaints.

0 Correct   0 Incorrect   0 I don't know

In patients with an indwelling catheter, changed odor or consistency of urine is a reason to perform
diagnostics.

0 Correct   0 Incorrect   0 I don't know

In the case of non-specific complaints with a negative nitrite test, a UTI can be diagnosed with a

positive leukocyte and erythrocyte test.

0 Correct   0 Incorrect   0 I don't know

At an out-of-hours center, a urine culture needs to be applied in patients with a positive nitrite test
and signs of tissue invasion.

0 Correct   0 Incorrect   0 I don't know

At a regular hours center a urine culture needs to be applied in a patient with a positive nitrite test
and signs of tissue invasion.

0 Correct   0 Incorrect   0 I don't know

At a regular hours clinic, a urine culture needs to be applied in a risk patient* with a positive nitrite
test.
*(patients with kidney or urinary tract abnormalities, bladder function disorders, men, children <12y/o, and pregnant women)

0 Correct   0 Incorrect   0 I don't know

At an out-of-hours center a urine culture needs to be applied in a risk patient* with a positive nitrite
test.
*(patients with kidney or urinary tract abnormalities, bladder function disorders, men, children <12y/o, and pregnant women)

0 Correct   0 Incorrect   0 I don't know

5. **If a new diagnostic test for urinary tract infections were to be developed, what would be the most important requirements according to you?**
    Please prioritize by numbering 1 to 5, 1 indicating most important and 5 indicating least important. You can use each number only once.

☐ Ease of use for the physician/physician assistant

☐ Limiting patient discomfort

☐ Time-to-result

☐ Diagnostic accuracy

☐ Cost

6. **In case of a suspected UTI at the out-of-hours center, which factors are most important for forming your decision to prescribe antibiotics?**
    Please prioritize by numbering 1 to 4, 1 indicating most important and 4 indicating least important. You can use each number only once.

☐ Symptom recognition by patient

☐ Symptom recognition by physician

☐ Patient expectation

☐ Positive urine culture

7. **With which expectations do you think patients most often consult a physician when suspecting a UTI?**
    Please prioritize by numbering 1 to 5, 1 indicating most important and 5 indicating least important. You can use each number only once.

☐ Obtaining a diagnosis

☐ Obtaining reassurance

☐ Obtaining an antibiotic prescription

☐ Obtaining additional examination

☐ Obtaining symptom relief

8. Name one aspect of UTI care that you feel could be improved.
Enter the most important aspect here, or leave the question unanswered if you feel the care cannot be improved:.

Finally, a few brief questions about your background.

9. What is your age?

10. Wat is your gender?

11. What is your work situation?
  o Practice owner
  o Locum
  o General practitioner in training
  o General practitioner and researcher in training

12. How many years of working experience as a general practitioner do you have?

13. On average, how many days per week do you work at a regular or out-of-hours center?

14. On average, how many shifts do you work at an out-of-hours center per year?

15. In which region do you currently spend most of your time working as a general practitioner?

If you have any other comments please post them here:

Thank you for your cooperation!

Supplementary 2. General practitioners' knowledge about UTI care

Statement	Correct n (%)	Incorrect n (%)	Didn't know n (%)
The use of urinary culture			
I am able to apply a urine culture at an out-of-hours center	176 (92.6)	9 (4.7)	5 (2.6)
At a regular hours clinic, a urine culture needs to be applied in a risk patient with a positive nitrite test	177 (93.2)	12 (6.3)	1 (0.5)
At an out-of-hours center a urine culture needs to be applied in a risk patient with a positive nitrite test	159 (83.7)	27 (14.2)	4 (2.1)
At a regular hours center a urine culture needs to be applied in a patient with a positive nitrite test and signs of tissue invasion	151 (79.5)	35 (18.4)	4 (2.1)
At an out-of-hours center, a urine culture needs to be applied in patients with a positive nitrite test and signs of tissue invasion	131 (68.9)	48 (25.3)	11 (5.8)
UTI in elderly patients			
A urine culture is indicated in the case of a positive nitrite test in an elderly patient without micturition complaints	109 (57.4)	61 (32.1)	20 (10.5)
In patients with an indwelling catheter, changed odor or consistency of urine is a reason to perform diagnostics	144 (75.8)	33 (17.4)	13 (6.8)

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Uncomplicated UTI			
In the case of non-specific complaints with a negative nitrite test, a UTI can be diagnosed with a positive leukocyte and erythrocyte test.	135 (71.1)	47 (24.7)	8 (4.2)
A cystitis can resolve by drinking sufficiently and with the possible addition of painkillers	184 (96.8)	4 (2.1)	2 (1.1)

Supplementary 3. GPs' opinions about UTI care

Statement	Agree n (%)	Neutral n (%)	Disagree n (%)
Knowledge			
General practitioners have enough knowledge in regards to urinary tract infections.	144 (75.8)	26 (13.7)	20 (10.5)
Doctors' assistants have enough knowledge in regards to urinary tract infections.	105 (55.3)	38 (20.0)	47 (24.7)
Point-of-care tests			
Better point of care tests will be able to aid me to prescribe antibiotics more accurately.	138 (72.6)	21 (11.1)	31 (16.3)
Better point of care tests will be able to save time during my daily work in the management of urinary tract infections.	114 (60.0)	40 (21.1)	36 (18.9)
With the current dipstick test at an out of hours center, I will be able to diagnose an urinary tract infection with enough certainty.	103 (54.2)	25 (13.2)	62 (32.6)
Better point of care tests, other than the current dipstick, are needed for urinary tract infections.	103 (54.2)	39 (20.5)	48 (25.3)
I disregard the result of a urinalysis when an urine sample is submitted with symptoms that are not fitting a urinary tract infection.	47 (24.7)	19 (10.0)	124 (65.3)
Urinary culture			
At an out-of-hours center, I'm less likely to submit a urine culture compared to the regular hours center because I do not have access to the full medical file.	72 (37.9)	13 (6.8)	105 (55.3)
At an out-of-hours center, I'm less likely to submit a urine culture compared to the regular hours center because I'm unable to follow up on the patient.	53 (27.9)	12 (6.3)	125 (65.8)

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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of	4

recruitment, exposure, follow-up, and data collection

Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	4
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	5
Bias	#9	Describe any efforts to address potential sources of bias	n/a
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	5
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	5
Statistical methods	#12c	Explain how missing data were addressed	n/a
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	n/a
Statistical methods	#12e	Describe any sensitivity analyses	n/a

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	5
Participants	#13b	Give reasons for non-participation at each stage	n/a
Participants	#13c	Consider use of a flow diagram	n/a

Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	5-7
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	5-7
Main results	#16b	Report category boundaries when continuous variables were categorized	n/a
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	n/a

Discussion

Key results	#18	Summarise key results with reference to study objectives	7
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	7-8
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	7-8
Generalisability	#21	Discuss the generalisability (external validity) of the study results	8-9

Other Information

Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	9

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Knowledge, attitudes, and practice around urinary tract infections of general practitioners in the Netherlands: a cross sectional internet survey.

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Word count: 3487

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3 1 Number of tables and figures: 4 + 3 appendices
4 2
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7 3 ## Abstract

8
9 4 **Objectives:** Urinary tract infections (UTIs) are the most common reason for women to
10 5 consult a general practitioner (GP). Current diagnostic tests are inadequate, complicating
11 6 diagnosis and treatment decisions for GPs. To understand how this influences GPs in
12 7 managing UTI, we aimed to determine GPs' knowledge, attitudes, and practices around UTI
13 8 care.
14
15 9 **Design:** Cross-sectional internet-based survey.
16
17 10 **Setting:** General practice in the Netherlands between December 2021 and February 2022.
18
19 11 **Participants:** We distributed invitations to participate via e-mail to 126 practices.
20 12 Additionally we distributed invitations via social media and newsletters.
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23 13 **Outcomes:** The survey included 15 questions covering GPs' sociodemographic information,
24 14 knowledge, attitude, and practices. Data analysis was based on frequencies and descriptive
25 15 statistics.
26
27 16 **Results:** Among the 190 eligible respondents, 172 (90.5%) chose dysuria and 140 (73.7%)
28 17 chose urinary frequency as a symptom likely indicating UTI in healthy women. One in three
29 18 GPs would diagnose a UTI based on non-specific complaints with positive leukocyte and
30 19 erythrocyte tests, discordant with established guidelines. GPs indicated that better point-of-
31 20 care diagnostics would help to improve antibiotic prescribing (72.6%) and would conserve
32 21 time (60.0%). GPs considered a positive test result the most important factor to prescribe
33 22 antibiotics while patient expectation was considered least important. Half of GPs indicated
34 23 that the most urgent need in UTI care is improved diagnostics.

35
36 24 **Conclusion:** GPs often act in discordance with established guidelines, rely on nonspecific
37 25 symptoms for the diagnosis of UTI, and rank patient expectation as less important in
38 26 comparison to symptom recognition and culture result when deciding on antibiotic
39 27 treatment.
40
41 28 **Key words:** urinary tract infections, diagnosis, general practice, antibiotic stewardship,
42 29 survey
43
44 30 **Abbreviations:** DA = doctor's assistant, GP = general practitioner, OOH = out-of-hours, SD =
45 31 standard deviation, UTI = urinary tract infection

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Strengths and limitations

- Involvement of general practitioners as well as persons not among our target audience during construction of the survey ensured its readability and face validity.
- General practices in the Dutch province of Limburg were emailed directly to improve the number of responses to the survey.
- Responses from general practitioners from the rest of the Netherlands were obtained by distributing the survey via multiple social media platforms (LinkedIn, Twitter, Facebook, Instagram).

Introduction

Urinary tract infections (UTIs) are the most common reason for women to consult a general practitioner (GP). More than 75% of women will have at least one episode of UTI during their lifetime (1, 2). One in eight female patients consult their GP due to a UTI every year (1). In female patients over 60 years of age, this number increases up to one in five every year (3, 4).

The diagnosis of UTI in general practice and out-of-hours (OOH) in the Netherlands relies mainly on urinary dipstick testing together with medical history-taking (4, 5). Customarily, patients with urinary symptoms contact the general practice by phone, by which they first speak with a doctor's assistant (DA), who takes the patient's medical history and decides whether they should submit a urine for diagnostic testing. The DA tests the sample using the urinary dipstick test, and subsequently relays the result of the test together with the patient's medical history to the general practitioner, who decides on the course of action according to the decision algorithm shown in figure 1.

The result of the urinary dipstick carries significant weight in the diagnosis of UTI in the Netherlands. However, the urinary dipstick is suboptimal in both its sensitivity and specificity (3, 6, 7). Furthermore, urinary culture, the diagnostic golden standard, is laborious, costly, takes two to three days, and requires samples to be analysed at a clinical laboratory. Moreover, urinary culture is unable to distinguish between an actual UTI and asymptomatic bacteriuria. Therefore, the results of a urinary culture need to be interpreted with patient symptoms in mind, lest the physician prescribes antibiotics for the relatively benign condition of bacteriuria (8). Furthermore, while the sensitivity of the urinary culture is definitely one of its strengths, it also means that that it is susceptible to contamination.

Because of the drawbacks of urinary culture, most UTI treatment decisions in general practice are based on patient symptoms, urinary dipstick results, and empiric antibiotics (9-12). Because of this, GPs' knowledge of urinary symptoms related to UTIs, and the DAs' ability to take the relevant patient history, are of the utmost importance to avoid overtreatment. Overtreatment with antibiotics is a burden to both the patient and society as a whole. The patient is exposed to the side effects of antibiotics without reaping the benefits, while society is faced with increasing health care costs due to rising of antibiotic resistance (13, 14). Overtreatment is a problem in the out-of-hours setting especially, where

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physicians generally do not have access to patients' previous urine culture results or prior UTI symptoms, which causes them to opt for the prescription of antibiotics sooner (5).

GPs divert from UTI guidelines in half of the patients and most UTIs are treated with empiric antibiotic prescriptions, even though the disease is known to be self-limiting in 50% of otherwise healthy women (15,16). To improve the appropriateness of prescribed antibiotics, more insight is needed into the factors that may influence GPs decisions around the diagnosis and management of UTIs.

Research towards the knowledge and experiences of GPs managing UTIs is limited (17). Having an understanding of GPs' experiences is crucial when designing and implementing effective interventions and potential new diagnostic tests. This study therefore aims to investigate the knowledge, attitudes, and practices of Dutch GPs towards UTIs during regular and out-of-hours care.

Methods

We conducted a cross-sectional internet-based survey among Dutch GPs between December 2021 and February 2022. We used Qualtrics software (Qualtrics May 2020, Provo, UT, USA) to obtain responses. We sent emails to all GPs with publicly available email addresses in the Dutch province of Limburg (n=126). To enhance the response rate, we created a website that underlined the affiliation with Maastricht University and linking to the survey proper. Here the respondents were informed about the study, after which they could consent to participation. Additionally, we distributed invitations on multiple social media platforms, including LinkedIn (Microsoft Corporation), Twitter Inc., Facebook (Meta Inc.), and WhatsApp (Meta Inc.), as well as via newsletters of multiple GPs' networks in Limburg (HOZL, Cohesie, ZIO and Meditta).

Setting and subjects

Fully trained GPs registered at the Dutch registry of health care professionals were eligible for participation. To have a selective overview of current practice, participants were excluded if they were not actively working as GPs. Participants did not receive any incentive to participate in the study. While the focus of our recruitment was in the providence of Limburg, we did not exclude responses from the rest of the Netherlands.

Sample size

Based on an estimated population of 12,766 active GPs in the Netherlands during the conduction of this survey and a confidence interval of 95% and a margin of error between 5 to 10%, we considered a sample size of 96 to 373 sufficient to ensure generalizability (18).

Survey contents

The survey included 15 questions, of which 3 questions had 3-9 sub questions (Supplementary 1). These questions covered knowledge, attitude, practices and sociodemographic information. Answer possibilities within the survey were Likert-scale statements, right-wrong-don't know questions, listing priorities, regular multiple-choice question, an open-ended questions to explore the needs of GPs and an open-ended question

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1 to allow respondents to explain their answers or to notify the research group of survey
2 difficulties, if any.

Data collection

4 The content of the questionnaire was derived from previous qualitative and quantitative
5 research and expert opinion (4,19-21). Face validity (the degree to which the survey appears
6 effective in terms of its stated aims) and readability was tested after a consensus was
7 reached within the research group about the quantity and quality of the compiled questions.
8 A pilot sample of 7 individuals verified the face validity and readability of the questionnaire.
9 Among these individuals were 1 active GP, 1 retired GP, 1 project manager, 3 medical
10 students and 1 non-medically educated individual. All multiple-choice questions required a
11 human interaction to the answer possibilities or required a data entry before the survey
12 would continue to the next question. Subitems within questions were shuffled randomly
13 among respondents. To prevent Ballot Box Stuffing, the survey software placed a local
14 browser based cookie if not disagreed to by the user. The respondent's IP address was also
15 logged during completion of the survey allowing the research group to identify possible
16 fraudulent enrollment to the survey.

Data Analysis

18 Respondents' answers were automatically entered into a data file and analysed using SPSS
19 Version 27.0 (IBM Corp; Armonk, NY). We used descriptive statistics to analyse the
20 demographic data. Analysis was based on frequencies and cross tables of pre-selected
21 variables. The open-ended questions were categorised yielding frequencies and cross tables.

Patient and public involvement

23 Patients or other public were not involved in the design, conduct, reporting, or dissemination of the
24 research.

Results

Population characteristics

27 We received 233 responses over the course of 3 months. After exclusion of partial responses
28 (n=32), responses from physicians in training (n=10), and a response which was submitted by
29 a DA (n=1), 190 responses remained eligible for analysis.

30 Table 1 summarises the characteristics of the included GPs. GPs had a mean age of
31 44.3 (standard deviation (SD)=9.4), ranging from 29 to 69 years. Among the participating GPs
32 129 (68%) were female. On average GPs had been practicing their profession for 13.4 years
33 (SD=9.5), worked 14.6 days per month (SD=6.0) during regular hours and worked 2.6 days
34 per month (SD=2.2) in OOH care centers.

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1 General practitioners' knowledge

2 UTI symptoms

3 We asked GPs to choose two symptoms out of a possible nine that they considered most
4 likely to indicate a UTI in women (Table 2). We chose these nine symptoms because they
5 were listed in the guidelines of the Dutch College of General Practitioners as possible
6 symptoms of UTI. According to the guidelines, the
7 symptoms most indicative of a UTI in healthy, non-
8 pregnant women are dysuria and the absence of
9 vaginal complaints (4). Almost all GPs (n=172,
10 90.5%) correctly chose *dysuria* as most indicative of
11 a UTI, and eight GPs (4.2%) chose *absence of*
12 *vaginal complaints*. *Urinary frequency* was the
13 second most frequently picked answer possibility
14 with 140 (73.7%) responses (22,23).

> **Box 1: High risk UTI patients**
> UTI patients at a higher risk for a
> complicated course of disease
> according to Dutch guidelines:
> - Women who:
>   o Are pregnant
>   o Are diagnosed with
>   diabetes mellitus
>   o Are
>   immunocompromised
>   o Have abnormalities to
>   the kidneys or urinary
>   tract
>   o Have a neurogenic
>   bladder
> - Men

15 To further evaluate GPs' knowledge,
16 multiple statements involving the diagnosis and
17 management of UTIs were presented within the
18 survey (Supplementary 2). More than 4 out of 5
19 respondents answered the questions regarding the
20 use of urinary culture in risk patients correctly (Box
21 1). Fewer respondents were able to correctly
22 answer the question with regards to patients with signs of tissue invasion (fever, shivers,
23 signs of sepsis, etc.): 151 in regular hours (79.5%) and 131 in OOH (68.9%).

24 UTI in elderly patients

25 When asked about whether a urinary culture is required in an elderly patient with a positive
26 nitrite test without micturition complaints (a likely case of asymptomatic bacteriuria), 109
27 respondents (57.4%) answered correctly that this was not the case. In a similar vein, 144
28 respondents (75.8%) answered correctly that a urinary culture was not indicated in the case
29 of a catheterised patient with odorous or turbid urine.

30 Uncomplicated UTI

31 Respondents' knowledge on the diagnosis of uncomplicated UTI was tested with the
32 statement: "In the case of non-specific complaints with a negative nitrite test, a UTI can be
33 diagnosed with a positive leukocyte and erythrocyte test". Of all respondents, 135 (71.1%)
34 correctly disagreed with the statement. Almost all respondents (n=184, 96.8%) correctly
35 agreed with the statement that a cystitis can resolve by drinking sufficiently and with the
36 possible addition of painkillers.

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General practitioners' attitudes

Supplementary 3 shows the answer distributions to the Likert-scale questions regarding GPs' attitudes around UTI care. Almost two thirds of GPs participating in the survey (65.3%) would not disregard the result of a urinalysis when a urine sample is submitted from a patient with symptoms that do not suggest a urinary tract infection. Most GPs agree that better point-of-care tests are needed for the diagnosis of UTI (54.2%), that these new tests will aid them in prescribing antibiotics more accurately (72.6%), and that better point-of-care tests will likely save them time during their activities as an GP (60.0%).

We asked respondents what they thought were the most important features to consider of any potential newly developed test, what they thought were the most important considerations before prescribing an antibiotic, and what they thought were the most important reasons for patients to consult a GP (table 3). Among the respondents, 75.8% considered *diagnostic accuracy* the most important feature of a diagnostic test. Furthermore, when asked to rank considerations for prescribing an antibiotic from least to most important, most GPs (86.8%) ranked patient expectation least important (the other options being a positive urine culture, symptom recognition by the patient, and symptom recognition by the GP). According to our respondents, most patients with urinary symptoms visit the family practice with the expectation of *obtaining antibiotics* (37.5%), followed by *symptom relief* (31.1%).

General practitioners' practice

Most GPs (46.3%) indicated that they *sometimes* prescribe a delayed antibiotic prescription when diagnosing a urinary tract infection in a healthy woman. Moreover, 43.7% indicated that they *never* or *rarely* employed delayed prescriptions.

Discussion

Summary

GPs seem to overvalue urinary frequency as a symptom most indicative of a UTI. Furthermore, fewer than 6 out of 10 GPs chose the correct course of action for an elderly patient with asymptomatic bacteriuria. When deciding on whether to prescribe antibiotics for a UTI, GPs deemed symptom recognition or the urinary culture result more important than patient expectation. Almost half of responding GPs indicated to never or rarely prescribe delayed antibiotics for a UTI. When asked about their highest need in UTI care, GPs indicated that diagnostic improvements have the highest urgency.

A limitation of this study is the presence of possible selection bias, since respondents are likely more interested in the subject and therefore more up to date with the latest guidelines. Additionally, GPs who think that UTI care should be improved are more likely to participate. Another limitation of this study is the presence of possible response bias, since respondents could have answered in a socially desired manner. Due to our recruitment

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3   1   strategy we were unable to calculate a response rate, since it was unknown to us how many
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5   2   potential respondents the survey invitation reached.
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7   3   Some questions in the survey might be prone to misinterpretation leading to inaccurate
8   4   results. In addition, multiple-choice questions might not offer all answer possibilities, leading
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10   5   to response bias as well. Furthermore, due to our inclusion strategy, almost half of our
11   6   respondents resided in Limburg, the southernmost province of the Netherlands with 6-7% of
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13   7   the nation's inhabitants. However, our study population has a similar average age, average
14   8   amount of working days a month, and share of practice holders compared to the total
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16   9   population of GPs in the Netherlands (18). Still, the relatively small sample size combined
17   10   with the limited spread of respondents throughout the Netherlands might limit the
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19   11   generalisability of our findings. Nonetheless, this study highlights points of improvement for
20   12   UTI care in the Netherlands in general, since we hypothesise that most if not all points raised
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22   13   are applicable to GPs throughout the country.
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24   14   The main strength of this study is that this is the first quantitative survey among GPs
25   15   in the Netherlands investigating their knowledge, attitude and practices towards UTI care.
26   16   Therefore this study gives a unique insight into where UTI care can be improved in Dutch
27   17   family medicine.
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29   18   ## Comparison with current literature
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31   19   The results of our study show that most GPs would treat a patient based on a urinary
32   20   dipstick result, even when the patient does not have specific symptoms. However, UTI
33   21   guidelines indicate that a cystitis is the correct diagnosis when a positive urinalysis is
34   22   accompanied by patient symptoms (4,18). This indicates that GPs might rely on diagnostics
35   23   too much, while not paying enough attention to patients symptoms (24).
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37   24   Curiously, almost half of the GPs indicated that they felt the dipstick test is
38   25   inadequate for the diagnosis of a UTI. This is probably a reflection of the poor accuracy of
39   26   the urinary dipstick (3,6,7). In view of its poor accuracy, the use of urinary dipsticks is not
40   27   always recommended for the diagnosis of cystitis in otherwise healthy, pre-menopausal,
41   28   non-pregnant women in other countries. International guidelines from Belgium, Germany,
42   29   Sweden, Norway, and the UK suggest to diagnose these patients with a UTI if the symptoms
43   30   point to this diagnosis, while ensuring the absence of symptoms that could point to other
44   31   diagnoses (such as vaginal complaints) (25-29). In North-Western Europe, only the French,
45   32   Danish, and Dutch guidelines recommend the routine use of urinary dipsticks for the
46   33   diagnosis of UTI in otherwise healthy women in addition to asking for symptoms (4,30,31).
47   34   Previous versions of the Dutch guidelines included the recommendation to diagnose based
48   35   only on patient symptoms. However, previous research has shown that 15-20% of patients
49   36   presenting with symptoms suggestive of a UTI did not have a microbiological cause for their
50   37   symptoms (32). Additionally, an increase in the amount of GP visits and antibiotic
51   38   prescriptions due to UTIs in the Netherlands was seen, which was believed to be caused by
52   39   GPs diagnosing solely based on symptoms (10). These findings combined led to the inclusion
53   40   of the urinary dipstick in the diagnostic algorithm. In order to account for the dipstick's
54   41   relatively poor accuracy when performed in isolation, the revised guidelines recommends to
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perform the urinary dipstick test only under the condition that the patient's symptoms already suggest a UTI. In this manner both the dipstick and the patient's symptoms act as a control for each other. However, as our results show, Dutch GPs often forgo this condition and perform a urinary dipstick test whether patient symptoms suggest a UTI or not. Therefore, it is imperative that GPs are made aware of the conditions under which they should perform a urinary dipstick by offering continuing education on UTI guidelines.

An inclusion in such continuing education could be the recognition of the symptoms most indicative of a UTI. The guidelines of the Dutch College of General Practitioners indicate that dysuria and the absence of vaginal complaints are the most indicative symptoms for UTI in otherwise healthy women. While dysuria was almost unanimously recognised, GPs failed to include the absence of vaginal complaints when asked about the strongest predictors for the presence of UTI (33). Furthermore, urinary frequency was often chosen as a symptom indicative of UTI. While urinary frequency is indeed a symptom associated with UTI, previous studies have shown that it is a symptom with limited specificity for UTI (22, 23). However, as is the case in most international guidelines, the Dutch guidelines still recommend GPs to ask patients about frequency of urination. Therefore, we do not mean to suggest that looking out for urinary frequency is wrong, only that the combination of dysuria and an absence of vaginal symptoms is the most predictive. This is also recognised internationally, since most international guideline we consulted suggests to forgo the diagnosis of UTI when vaginal symptoms are present (25,26,29). It is therefore critical that GPs pay close attention to their presence and adjust their diagnosis accordingly.

Moreover, almost half of GPs think that the most pressing need in UTI care is the need for better diagnostics. We believe that until better diagnostics become available, the decision to test a urine sample should be much more conscious in order to improve current UTI management in general practice, something which was also proven to be effective in previous studies where health care professionals were trained in recognizing urinary tract infections (34).

Implications for practice

This study shows that while GPs think that they have sufficient knowledge around the diagnosis and treatment of UTI, this is not always the case. GPs rely heavily on urinalysis for the diagnosis of a UTI and seem to have trouble identifying the symptoms indicative of UTI and even indicate they disregard symptoms as a whole when a dipstick test turns out positive for nitrite. This may lead to overdiagnosis and –treatment of patients with asymptomatic bacteriuria. Moreover, this could lead to GPs overlooking alternative diagnoses, leading to increased morbidity. This overreliance on the urinary dipstick could be an unintended side effect of the revision of the Dutch guidelines mentioned above, since it created a central role for the urinary dipstick in diagnosing UTI in otherwise healthy women. Creating awareness among GPs of the urinary dipstick's limited accuracy and teaching them to only employ the urinary dipstick when the patient's symptoms call for it is critical in reducing the current overreliance on the urinary dipstick.

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Moreover, GPs in our study indicated that they value a positive urine culture and symptom recognition by either the patient or the GP over patients' wishes when deciding to prescribe antibiotics. We think this is partly due to GPs interpreting the question with each option in isolation. We can imagine that GPs would not want to describe antibiotics to a patient when anamnesis and diagnostics ruled out a UTI, no matter the patient's desire to obtain antibiotics. In this context it is understandable that GPs might not take the patient's wishes into account when deciding on treatment. This is supported by previous research that has shown that GPs think that patients with urinary symptoms primarily visit a GP to obtain antibiotics, also underlined by results in our current study (35). However, patients primarily want to be free of symptoms and want to have the feeling that they are taken seriously during consultation (36,37). Therefore we think that UTI care can be improved by incorporating the patient's wishes into the treatment decision. However, this warrants supplying the patient with the necessary information, since the patient's knowledge on UTIs might be lacking.

It is imperative that GPs not only change their own behavior, but that they change the culture around testing and antibiotic prescriptions throughout their whole practice. In the Dutch health care system patients with urinary symptoms are not always seen by GPs. Instead the patient contact is performed entirely by a doctor's assistant (DA). Therefore, it is imperative that DAs are also sufficiently informed by GPs about which symptoms to look out for in case of a suspected UTI. Little research has been done towards DA's knowledge, attitudes, and practices around UTIs and we therefore recommend to repeat this study in that population.

Conclusion

In this cross-sectional survey study, we show that GPs have trouble identifying specific symptoms of UTI. They often act in discordance with established guidelines, especially when determining in which cases urinalysis needs to be performed. Furthermore, GPs overvalue urinary frequency as an indication of UTI. Additionally, GPs value a positive urine culture and the recognition of UTI symptoms by either the patient or the GP over patient preference when deciding on whether antibiotics should be prescribed. GPs seldom make use of delayed antibiotic prescriptions.

Disclosure statement

Ethics

Funding

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3   1   Conflict of interest statement
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5   2   The authors report there are no competing interests to declare.
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8   3   Author contributions
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10 4   All authors meet the 4 criteria that form the basis of authorship as stated by the ICMJE. SC, WG, and
11 5   EdB made the concept of and designed the work. SC and WG acquired and analysed the data. SC,
12 6   WG, TP, JC, and EdB interpreted the data. SC is responsible for the overall content as guarantor.
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15 7   Data sharing
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17 8   Data are available upon reasonable request. Interested parties can contact the corresponding author
18 9   with their inquiry.
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Figure legend

Figure 1 - Diagnostic algorithm for UTI in family practice in the Netherlands. [1]Perform a urinary culture with antibiotic susceptibility testing in case of two time treatment failure for cystitis in healthy non-pregnant women, treatment failure for cystitis in vulnerable elderly patients, cystitis in patients taking antibiotic prophylaxis because of recurring UTI, cystitis in risk patients, cystitis in children younger than 12 years of age, or UTI with signs of tissue invasion. [2]Only perform a sediment in patients older than 12 years of age. [3]Perform a urinary culture with antibiotic susceptibility testing in case of a persisting suspicion of UTI, despite a negative dipstick and dip slide or sediment result. Image adapted from the UTI guidelines of the Dutch College of General Practitioners (4). UTI = urinary tract infection.

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10   4   Tables
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14   6   **Table 1** Population characteristics

Characteristics	General practitioners (n = 190)
Age, mean years (SD)	44.3 (9.4)
Female, n (%)	129 (67.9)
Work experience, mean years (SD)	13.4 (9.5)
Work during regular hours, mean days/month (SD)	14.6 (6.0)
Work during OOH, mean days/month (SD)	2.6 (2.2)
Practice holder, n (%)	108 (56.8)
Resident educator, n (%)	19 (10.0)
Practice holder and resident educator, n (%)	15 (7.9)

14   *OOH = out-of-hours, SD = standard deviation*

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Table 2. Symptoms believed by general practitioners to indicate a UTI in healthy women.

Symptom(s)	Respondents (%)
Dysuria	172 (90.5)
Urinary frequency	140 (73.7)
Malodorous or turbid urine	27 (14.2)
Urge to urinate on empty bladder	15 (7.9)
Absence of vaginal complaints	8 (4.2)
Hematuria	8 (4.2)
Fever	6 (3.2)
Lower abdominal pain	4 (2.1)
Shivers	0 (0.0)

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12   5   **Table 3** Most and least important features of new diagnostic tests, considerations before prescribing
13   6   an antibiotic, and patient reasons for consultation according to general practitioners.
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Most important (%)		Least important (%)
	Test feature	
75.8	Diagnostic accuracy	1.1
10.0	Time-to-result	7.4
9.5	Ease-of-use	14.2
2.6	Patient discomfort	24.2
2.1	Cost	53.2
	Consideration before prescribing an antibiotic	
57.4	Positive urine culture	2.1
26.8	Symptom recognition by patient	2.6
12.1	Symptom recognition by GP	8.4
3.7	Patient expectation	86.8
	Patient reasons for consultation	
37.5	Obtaining antibiotics	4.7
31.1	Symptom relief	5.3
22.1	Diagnosis	5.3
7.4	Additional examination	58.4
2.6	Reassurance	26.3

7   GP = general practitioner

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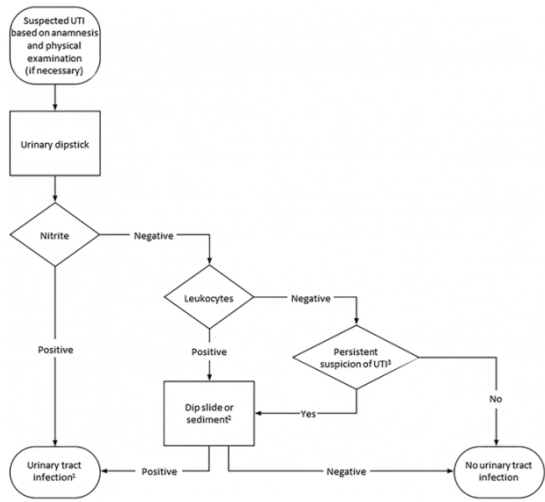50
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Figure 1 - Diagnostic algorithm for UTI in family practice in the Netherlands.

338x190mm (96 x 96 DPI)

Supplementary figures

Supplementary 1. Survey on general practitioners' knowledge, attitudes, practice, and needs around UTI care.

Dear general practitioner, this questionnaire is about your opinion, knowledge, and attitudes on UTIs.

*Do not concern yourself with answering the questions in this questionnaire "correctly", but only with your **personal opinion.** This is very important to us!*

1. **Please indicate the extent to which you agree with the following statements about the diagnosis and treatment of urinary tract infections.**

	Completely disagree	Somewhat disagree	Neutral	Somewhat agree	Completely agree
If urine is handed in for symptoms **not** indicating a urinary tract infection, then I ignore the results of the urinalysis.	0	0	0	0	0
With the current dipstick at the out-of-hours center I can diagnose a urinary tract infection with sufficient certainty.	0	0	0	0	0
I am less likely to initiate a urine culture at the **out-of-hours center** than at the regular hours center because I do not have access to the patient's complete record.	0	0	0	0	0
I am less likely to initiate a urine culture at the **out-of-hours center** than at the regular hours center because I am unable to follow-up with the patient.	0	0	0	0	0
Point-of-care tests better than the current dipstick test are needed for diagnosing urinary symptoms.	0	0	0	0	0
Better point-of-care tests for urinary tract infections may help me to prescribe in a more targeted way.	0	0	0	0	0

Better point-of-care tests for urinary tract infections could save time in my daily work.	0	0	0	0	0
Physician assistants have sufficient knowledge on UTIs.	0	0	0	0	0
General practitioners have sufficient knowledge on UTIs.	0	0	0	0	0

2. In the list below, please indicate which **combination of 2 symptoms** make the diagnosis of **urinary tract infection most** likely in healthy women.:

*Select **2** symptoms from this list:*

0 Dysuria

0 Lower abdominal pain

0 Pollakisuria

0 Malodorous or turbid urine

0 Urge to urinate on empty bladder

0 Hematuria

0 Fever

0 Shivers

0 Absence of vaginal complaints

3. Statements about your handling of urinary tract infections:

	Never	Rarely	Sometimes	Often
When I diagnose a urinary tract infection in a healthy woman, I prescribe a delayed prescription.	0	0	0	0
I am less likely to order a urinary culture at the **out-of-hours center**.	0	0	0	0
I am more likely to prescribe an antibiotic to unknown patients at the **out-of-hours center**.	0	0	0	0
I refer patients with mictional complaints to www.thuisarts.nl.	0	0	0	0

4. For the following statements, could you indicate whather, in your opinion, they are true or false?

I am able to apply a urine culture at an out-of-hours center.

0 Correct   0 Incorrect   0 I don't know

A cystitis can resolve by drinking sufficiently and with the possible addition of painkillers.

0 Correct   0 Incorrect   0 I don't know

A urine culture is indicated in the case of a positive nitrite test in an elderly patient without micturition complaints.

0 Correct   0 Incorrect   0 I don't know

In patients with an indwelling catheter, changed odor or consistency of urine is a reason to perform diagnostics.

0 Correct   0 Incorrect   0 I don't know

In the case of non-specific complaints with a negative nitrite test, a UTI can be diagnosed with a positive leukocyte and erythrocyte test.

0 Correct   0 Incorrect   0 I don't know

At an out-of-hours center, a urine culture needs to be applied in patients with a positive nitrite test and signs of tissue invasion.

0 Correct   0 Incorrect   0 I don't know

At a regular hours center a urine culture needs to be applied in a patient with a positive nitrite test and signs of tissue invasion.

0 Correct   0 Incorrect   0 I don't know

At a regular hours clinic, a urine culture needs to be applied in a risk patient* with a positive nitrite test.
*(patients with kidney or urinary tract abnormalities, bladder function disorders, men, children <12y/o, and pregnant women)

0 Correct   0 Incorrect   0 I don't know

At an out-of-hours center a urine culture needs to be applied in a risk patient* with a positive nitrite test.
*(patients with kidney or urinary tract abnormalities, bladder function disorders, men, children <12y/o, and pregnant women)

0 Correct   0 Incorrect   0 I don't know

5. If a new diagnostic test for urinary tract infections were to be developed, what would be the most important requirements according to you?

Please prioritize by numbering 1 to 5, 1 indicating most important and 5 indicating least important. You can use each number only once.

☐ Ease of use for the physician/physician assistant

☐ Limiting patient discomfort

☐ Time-to-result

☐ Diagnostic accuracy

☐ Cost

6. In case of a suspected UTI at the out-of-hours center, which factors are most important for forming your decision to prescribe antibiotics?

Please prioritize by numbering 1 to 4, 1 indicating most important and 4 indicating least important. You can use each number only once.

☐ Symptom recognition by patient

☐ Symptom recognition by physician

☐ Patient expectation

☐ Positive urine culture

7. With which expectations do you think patients most often consult a physician when suspecting a UTI?

Please prioritize by numbering 1 to 5, 1 indicating most important and 5 indicating least important. You can use each number only once.

☐ Obtaining a diagnosis

☐ Obtaining reassurance

☐ Obtaining an antibiotic prescription

☐ Obtaining additional examination

☐ Obtaining symptom relief

8. Name one aspect of UTI care that you feel could be improved.
Enter the most important aspect here, or leave the question unanswered if you feel the care cannot be improved:.

Finally, a few brief questions about your background.

9. What is your age?

10. Wat is your gender?

11. What is your work situation?
- o Practice owner
- o Locum
- o General practitioner in training
- o General practitioner and researcher in training

12. How many years of working experience as a general practitioner do you have?

13. On average, how many days per week do you work at a regular or out-of-hours center?

14. On average, how many shifts do you work at an out-of-hours center per year?

15. In which region do you currently spend most of your time working as a general practitioner?

If you have any other comments please post them here:

Thank you for your cooperation!

Supplementary 2. General practitioners' knowledge about UTI care

Statement	Correct n (%)	Incorrect n (%)	Didn't know n (%)
The use of urinary culture			
I am able to apply a urine culture at an out-of-hours center	176 (92.6)	9 (4.7)	5 (2.6)
At a regular hours clinic, a urine culture needs to be applied in a risk patient with a positive nitrite test	177 (93.2)	12 (6.3)	1 (0.5)
At an out-of-hours center a urine culture needs to be applied in a risk patient with a positive nitrite test	159 (83.7)	27 (14.2)	4 (2.1)
At a regular hours center a urine culture needs to be applied in a patient with a positive nitrite test and signs of tissue invasion	151 (79.5)	35 (18.4)	4 (2.1)
At an out-of-hours center, a urine culture needs to be applied in patients with a positive nitrite test and signs of tissue invasion	131 (68.9)	48 (25.3)	11 (5.8)
UTI in elderly patients			
A urine culture is indicated in the case of a positive nitrite test in an elderly patient without micturition complaints	109 (57.4)	61 (32.1)	20 (10.5)
In patients with an indwelling catheter, changed odor or consistency of urine is a reason to perform diagnostics	144 (75.8)	33 (17.4)	13 (6.8)

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Uncomplicated UTI			
In the case of non-specific complaints with a negative nitrite test, a UTI can be diagnosed with a positive leukocyte and erythrocyte test.	135 (71.1)	47 (24.7)	8 (4.2)
A cystitis can resolve by drinking sufficiently and with the possible addition of painkillers	184 (96.8)	4 (2.1)	2 (1.1)

Supplementary 3. GPs' opinions about UTI care

Statement	Agree n (%)	Neutral n (%)	Disagree n (%)
Knowledge			
General practitioners have enough knowledge in regards to urinary tract infections.	144 (75.8)	26 (13.7)	20 (10.5)
Doctors' assistants have enough knowledge in regards to urinary tract infections.	105 (55.3)	38 (20.0)	47 (24.7)
Point-of-care tests			
Better point of care tests will be able to aid me to prescribe antibiotics more accurately.	138 (72.6)	21 (11.1)	31 (16.3)
Better point of care tests will be able to save time during my daily work in the management of urinary tract infections.	114 (60.0)	40 (21.1)	36 (18.9)
With the current dipstick test at an out of hours center, I will be able to diagnose an urinary tract infection with enough certainty.	103 (54.2)	25 (13.2)	62 (32.6)
Better point of care tests, other than the current dipstick, are needed for urinary tract infections.	103 (54.2)	39 (20.5)	48 (25.3)
I disregard the result of a urinalysis when an urine sample is submitted with symptoms that are not fitting a urinary tract infection.	47 (24.7)	19 (10.0)	124 (65.3)
Urinary culture			
At an out-of-hours center, I'm less likely to submit a urine culture compared to the regular hours center because I do not have access to the full medical file.	72 (37.9)	13 (6.8)	105 (55.3)
At an out-of-hours center, I'm less likely to submit a urine culture compared to the regular hours center because I'm unable to follow up on the patient.	53 (27.9)	12 (6.3)	125 (65.8)

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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of	4

recruitment, exposure, follow-up, and data collection

Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	4
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	5
Bias	#9	Describe any efforts to address potential sources of bias	n/a
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	5
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	5
Statistical methods	#12c	Explain how missing data were addressed	n/a
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	n/a
Statistical methods	#12e	Describe any sensitivity analyses	n/a

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	5
Participants	#13b	Give reasons for non-participation at each stage	n/a
Participants	#13c	Consider use of a flow diagram	n/a

Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	5-7
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	5-7
Main results	#16b	Report category boundaries when continuous variables were categorized	n/a
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	n/a

Discussion

Key results	#18	Summarise key results with reference to study objectives	7
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	7-8
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	7-8
Generalisability	#21	Discuss the generalisability (external validity) of the study results	8-9

Other Information

| Funding | #22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 9 |

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