

**ORIGINAL PAPER**

General practitioners' clinical practice on the management of cystitis in Normandy, France: A clinical vignettes-based study

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Abstract

Rationale, aims, and objectives: The objective was to measure the quality of clinical practice for the management of cystitis in adult women in general practice by collaborating with quality circles and the regional centre for antibiotic counsel.

Method: This descriptive cross-sectional study was performed in 2018 in Normandy, France. A questionnaire composed of clinical vignettes was used to evaluate practices of general practitioners (GPs) with regard to cystitis classified into four categories: simple, at risk of complication, recurrent, and caused by multidrug-resistant bacteria. The 2017 French Infectious Diseases Society's guidelines were used as a reference.

Results: A total of 142 GPs participated in the study (45.5% of the solicited). Fosfomycin-trometamol and pivmecillinam were cited as first-line treatments for simple cystitis by 134 (94%) and 38 (27%) participants, respectively. For at risk of complication cystitis, the treatments cited were cefixime by 64 participants (45%), ofloxacin by 50 (35%), pivmecillinam by 49 (35%), fosfomycin-trometamol by 38 (27%), nitrofurantoin by 36 (25%), and amoxicillin-clavulanic acid by 28 (20%). Mean compliance rates were 85% for simple cystitis, 39% for at risk of complication cystitis, 60% for recurrent cystitis and 14% for cystitis caused by multidrug-resistant bacteria. Two criteria had less than 10% of the compliant answers: comprehensive knowledge of cystitis complication risk factors (9%) and positivity thresholds of urine cultures (10%).

Conclusions: In this study, diagnostic means, follow-up testing, and simple cystitis treatment (with fosfomycin predominantly mentioned) were broadly compliant. The use of critical antibiotics was too frequent for at risk of complication cystitis. There may be a need to improve the knowledge of professionals on antibiotic resistance and appropriate antibiotic use.

KEYWORDS

antibiotic resistance, clinical vignettes, general practice, measures of clinical practice, urinary tract infections

1 | INTRODUCTION

In France, similar to in other countries, bacterial resistance to antibiotics has become, in the last decade, a preoccupying evolution, particularly for *Enterobacteriaceae* isolated in the community. France remains a country with a high consumption of antibiotics, ranking third after Greece and Cyprus, according to the latest European data available (2016).¹ The consumption of antibiotics in the community has increased by 8.6% between 2006 and 2016² and represents 90% of the total consumption.³ To break the vicious circle between the overuse of antibiotics and the increase in the rate of antibiotic resistance observed both individually and collectively,⁴⁻⁶ the concept of critical antibiotics notably generating antibiotic resistance appeared. The use of some types of antibiotics, in particular, amoxicillin-clavulanic acid, cephalosporins, and fluoroquinolones (FQs), should be as limited as possible.⁷

In this regard, cystitis is a priority target for action, since it represents an important volume of prescriptions for antibiotics in the community (16.4% of volume in France in 2016, ranking third after ear, nose and throat infections (43.8%) and lower respiratory tract infections (22.7%)³ and is predominantly caused by *Enterobacteria*, with the opportunity (in this case) to prescribe “non-critical” antibiotics spared from the escalating antibiotic resistance rates: fosfomicin, pivmecillinam, nitrofurantoin.⁸

In 2017, the 2015 French national guidelines on the management of community urinary tract infections (UTIs) in adults were updated. These guidelines are issued by the French Infectious Diseases Society (French acronym SPILF), in collaboration with scientific societies to which its members are affiliated (French Urological Association, French Microbiology Society, French National College of Teachers in General Practice, French Radiology Society, French Gynaecology Society, French Infectious Diseases Group of the French Paediatrics Society, French Geriatrics and Gerontology Society). FQs and third-generation cephalosporins (3GCs) have been removed from the list of first-line antibiotics for the treatment of cystitis.^{9,10}

The improvement of quality of care in general practice is promoted by the development of peer review groups and quality circles (QCs), which have been expanding in European countries for many years.¹¹ In France, at the initiative of the regional unions of private practice physicians (French acronym URML) in collaboration with the regional unions of French health insurance funds and the regional health agencies, QCs were created (Groupes qualité, French acronym GQ). The objectives of GQs are to promote the exchange of practices between general practitioners (GPs) working in identical geographic areas to assess and improve the quality of patient care. In 2018, these GQs existed in six of the 13 regions.¹² Furthermore, Regional Centers for Antibiotic Counsel (French acronym CRCA) were developed under the aegis of health authorities in various French regions. Ever since the pilot experiences in Lorraine (Antibior) and Pays de Loire (MedQual) in 2003, their priority mission has been to support community physicians by means of case by case counsel, measures of clinical practices and target training. Western Normandy (known previously as “Basse-Normandie”) is among the French territories with both GQ

structures and a CRCA (“NormAntibio,” serving the entire Normandy region).

In this context of evolving recommendations, our objective was to measure the quality of clinical practice for the management of cystitis in adult women in general practice in Western Normandy with the purpose to then guide corrective measures with the help of GQs and the CRCA.

2 | METHODS

2.1 | Study type

We performed a descriptive cross-sectional study of the clinical practice of GPs in Normandy, France, carried out by using a questionnaire based on clinical vignettes.

2.2 | Creating clinical vignettes

In September 2017, two general physicians (C. B., P. T.) and two infectious disease specialists (E. F., E. P.) developed a questionnaire to assess the management of cystitis in adult women, containing three clinical vignettes (Appendix 1). The clinical vignettes were composed of 16 questions in total: three concerning simple cystitis (C1-Q1 to Q3), seven at risk of complication cystitis (C2-Q1 to Q7), four recurrent cystitis (C1-Q4a and 4b, C3-Q1 and Q4) and two cystitis caused by multidrug-resistant bacteria (MDRB) (extended-spectrum β -lactamase *Enterobacteriaceae* [ESBL-E], C3-Q2 and 3). Among the 16 questions, four addressed diagnostic criteria for the different cystitis studied (C2-Q2 and Q4, C3-Q1 and Q2), five addressed the recommended tests for the initial diagnosis or follow-up (C1-Q1, Q3 and Q4a, C2-Q1 and Q7) and seven addressed the therapy (no treatment, diet and lifestyle advice, curative antibiotherapy or antibiotic prophylaxis; C1-Q2 and Q4b, C2-Q3, Q5 and Q6, C3-Q3 and Q4).

SPILF guidelines were used as a reference for the evaluation of responses.¹⁰ Considering these guidelines, 16 criteria were defined to assess the management of cystitis. Expected antibiotics were as follows: for simple cystitis, fosfomicin and pivmecillinam; for cystitis at risk of complication (empirical treatment), fosfomicin, nitrofurantoin; and for MDRB cystitis, nitrofurantoin, fosfomicin, and pivmecillinam. The treatment was considered as compliant if at least one of the recommended molecules was cited. If one nonrecommended molecule was mentioned, the treatment was considered as noncompliant, regardless of any other molecule stated.

A preliminary version of the questionnaire was tested between September 2017 and December 2017 by 27 GPs involved in three of the 31 GQs in the studied region. GQs remarks allowed the situations to be more adapted to general practice and more realistic.

In addition to the clinical vignettes, the questionnaire also included items regarding participant demographics (age category, sex), type of practice (rural, semirural, urban) and average number of consultations per day. We also asked the GP if he/she had used external

resources to complete the clinical vignettes. The questionnaires were anonymous, and the sociodemographic and activity variables were exploited by categorized classes to reduce the chance of identification.

2.3 | Study population and questionnaire broadcast

The finalized version of the questionnaire was broadcast in January 2018 by postal mail via the URML with an explicative letter; the first participants were the 278 GPs of the 28 GQs based in Western Normandy who had not participated in the test. The last training on the management of UTIs received by the GPs as part of their participation in the GQ was held in 2014. As a second step (April 2018), the totality of the 34 GPs practicing in a sampled geographic area (chosen at our convenience) and not participating in the GQ were solicited by a phone call to take part in the study; then, the questionnaire was given to them by hand. This second panel was established to ensure the acceptability of clinical vignettes among non-GQ GPs.

2.4 | Statistical analysis

For every criterion, the total number of compliant answers and the percentage in relation to the totality of responses were computed. The results of the subgroups established according to the sociodemographic and activity characteristics were analysed using the Chi² test or Fisher exact test, when necessary. For every type of cystitis and every field studied (diagnostic criteria, recommended tests for initial, and follow-up diagnosis, therapy), the percentage of correct answers was measured for every participant. The mean value of this percentage and its 95% confidence interval were calculated. Thus, the mean values obtained in each subgroup were compared using the Wilcoxon nonparametric test.

A value of $P < .05$ was considered significant. All the statistical analyses were done using the SAS v9.4 software.

3 | RESULTS

In total, 142 GPs participated in the study out of the 312 solicited (45.5%), including 120 of the 278 (43.2%) affiliated with a GQ. Despite the anonymity of the questionnaire, 12 GPs (8.5%) did not wish to give any sociodemographic or activity data related to them, a thirteenth did not give his/her practice environment and a fourteenth did not give the number of patients seen per day. The characteristics of the participating GPs were as follows: 84 (64.6%) men and 46 (35.4%) women, 51 (39.2%) aged under 45 years and 79 (60.8%) aged 45 years and over, 74 (57.4%) practicing in a rural or semirural area and 55 (42.6%) in an urban area, and 18 (13.9%) seeing less than 20 patients a day on average and 111 (86.1%) seeing 20 or more patients a day on average.

Table 1 describes the global answers according to the clinical form of cystitis concerning the diagnostic means, therapy and follow-up testing. For simple cystitis, fosfomycin was cited alone by 81 GPs (57.0%), pivmecillinam was cited by 31 GPs (21.8%) and another molecule was cited by 22 GPs (15.5%). The complication risk factors for UTIs mentioned were the following: age over 65 years with 3 frailty criteria or more by 110 GPs (77.5%), diabetes by 115 GPs (81.0%), severe chronic renal failure by 113 GPs (79.6%), single kidney by 104 GPs (73.2%), obesity by 46 GPs (32.4%), hypertension by 17 GPs (12.0%), and smoking by 14 GPs (9.9%). For the cytobacteriological examination of the urine (CBEU) interpretation criteria, 108 GPs (76.1%) mentioned a leukocyturia positivity threshold $\geq 10^4$, 66 GPs (46.5%) mentioned a bacteriuria threshold for *Escherichia coli* $\geq 10^3$, and 101 GPs (71.1%) mentioned a bacteriuria threshold for other bacteria $\geq 10^5$, whereas 66 GPs (46.5%) replied that clinical criteria take precedence over biological criteria if the results are ambiguous. Forty-seven participants (33.1%) indicated that they would delay antibiotic treatment pending CBEU results for at risk of complication cystitis and 126 (88.7%) declared they would do a reassessment with antimicrobial susceptibility test results in case of empirical treatment.

Tables 2 and 3 present the given responses compliance for the four types of cystitis studied in the case vignettes. The best results (>80% of compliant answers) were observed for the absence of urinalysis control for simple cystitis (100%), the reassessment of empirical treatment for at risk of complication cystitis based on the susceptibility test results (88.7%) and the simple cystitis antibiotic choice (81.7%). The results were under 10% for two criteria: the comprehensive knowledge of the complication risk factors for cystitis (8.5%) and of the positivity thresholds for CBEU (9.9%). We noticed few differences between the rate of compliant responses from the GPs based on their age category (<45 years, ≥ 45 years) or their type of practice (rural or semirural, urban). Younger GPs (< 45 years) prescribed significantly more initial CBEU ($P = .002$) and less often after treatment controls than older GPs in at risk of complication cystitis ($P = .0001$). In recurrent cystitis with less than an episode a month, the absence of prophylactic antibiotics was more frequently observed in GPs practicing in urban areas ($P = .007$). The rate of compliant answers did not differ according to belonging or not belonging to a GQ, the sex or the average number of consultations per day (data not presented).

The mean percentage of compliant responses varied from 13.7% for MDRB cystitis to 85.2% for simple cystitis (Table 4). Regardless of the type of cystitis, the best performances were observed in the conformity of diagnostic means and follow-up testing (76.5%). The compliance of treatment was on average 44.3% (95% CI 41.5-47.0).

Thirteen GPs (9.2%) declared having used external resources to complete the clinical vignettes. They had better scores for the management of at risk of complication cystitis (compliant answers: 58.2% vs 37.3%, $P = .0001$), the knowledge of diagnostic criteria (36.5% vs 25.4%, $P = .03$) and the conformity of antibiotic choice (58.2% vs 42.9%, $P = .001$). The 22 GPs not affiliated with a GQ declared that the clinical vignettes-based evaluation was relevant or fairly relevant 21 times (95.5%) and not relevant one time.

TABLE 1 Strategy evaluation on the management of cystitis in general practice by clinical vignettes: global responses according to the clinical context

Question	Simple cystitis, N (%)	At risk of complication cystitis, N (%)	Cystitis caused by multi-drug-resistant bacteria, N (%)
<i>Diagnostic means</i>			
Urine test strips	110 (77.5)	22 (15.5)	NR
CBEU	17 (12.0)	136 (95.8)	NR
Urinary tract ultrasound	0 (0)	19 (13.4)	NR
Blood test	0 (0)	45 (31.7)	NR
Urinary tract CT scan	NR	0 (0)	NR
Urodynamic testing	NR	NR	NR
No test	9 (6.3)	0 (0)	NR
<i>Antibiotics mentioned^a</i>			
Fosfomycin-trometamol	134 (94.4)	38 (26.8)	27 (19.0)
Pivmecillinam	45 (31.7)	49 (34.5)	54 (38.0)
Nitrofurantoin	18 (12.7)	36 (25.4)	56 (39.4)
Ceftriaxone	1 (0.7)	NR	32 (22.5)
Cefixime	NR	64 (45.1)	48 (33.8)
Ofloxacin	5 (3.5)	50 (35.2)	52 (36.6)
Amoxicillin-clavulanic acid	1 (0.7)	28 (19.7)	35 (24.6)
Cotrimoxazole	0 (0)	NR	NR
<i>Therapy in recurrent cystitis</i>			
Diet and lifestyle advice	131 (92.3)	NR	92 (64.8)
Antibiotic prophylaxis (<1 episode a month)	18 (12.7)	NR	6 (4.2)
Antibiotic prophylaxis (≥1 episode a month)	NR	NR	75 (52.8)
<i>Follow-up testing (if favourable outcome)</i>			
No CBEU	142 (100)	85 (59.9)	NR

Abbreviations: CBEU, cytobacteriological examination of the urine; NR, not required.

^aSimple cystitis: first-line empirical antibiotics/at risk of complication cystitis: empirical treatment—the sum of the percentages is greater than 100 considering the possibility of multiple responses.

4 | DISCUSSION

In this study, we have highlighted contrasting results in the assessment of the adherence to national guidelines for the management of community UTIs in adults visiting GPs in Normandy. Diagnostic means, follow-up testing and simple cystitis treatment (particularly the use of fosfomycin, predominantly mentioned) were broadly compliant. However, some criteria were insufficiently followed, namely diagnostic criteria and antibiotic treatments for other cystitis.

Overall, the conformity of treatments in the management of cystitis was low, on average 44%, with little influence of sociodemographic or activity characteristics. Previous French studies have shown similar results—conformity rate for therapy guidelines of only 20% in 2010 in Limoges¹³ and 41% in 2012 in the Alpes-Maritimes.¹⁴ In Europe, the ascertainment was the same—in Spain, in 2009, the compliance rate for empirical treatments was 18%,¹⁵ in Germany the same year only 8%,¹⁶ and in Sweden in 2012 41%.¹⁷ A very positive point was that critical antibiotics⁷ (FQs, amoxicillin-clavulanic acid, and third-

generation cephalosporins) were rarely cited in simple cystitis in our study. However, they were often cited as first-line treatments for other cystitis. Prescriptions of these molecules have nonetheless decreased by half in France since 2010.^{2,3} On the other hand, we can worry about prescriptions cited in ESBL-E cystitis, with a compliance of only 16%. Once again, we expected first-line treatments as a response to this question, as they usually stay effective against ESBL-E, without any specified susceptibility test results. These results did not consider situations with acquired microbial resistance to those molecules. ESBL-E. *coli* maintains a high susceptibility to nitrofurantoin and fosfomycin (>98%) based on the National Observatory of Epidemiology of Bacterial Resistance to Antibiotics (French acronym ONERBA) report.⁸ These antibiotics should therefore be promoted as first-line treatments. Pivmecillinam is not yet mentioned in this report, but it has only been recommended as a first-line antibiotic for UTIs since 2015.⁹ This may explain the low proportion of its prescription in our study. In Scandinavia and Northern countries, it has been a first-choice molecule for many years, without any emerging

TABLE 2 Simple and at risk of complication cystitis global analysis, based on age categories and type of practice

Clinical vignette topic and analysis criteria	Number of compliant answers (%)						
	All participants (N = 142)	<45 years (N = 51)	≥45 years (N = 79)	P	Rural or semi-rural (N = 74)	Urban (N = 55)	P
<i>Simple cystitis</i>							
Unaccompanied UTS for diagnosis	105 (73.9)	37 (72.6)	61 (77.2)	NS	55 (74.3)	42 (76.4)	NS
Treatment compliant to guidelines	116 (81.7)	44 (86.3)	64 (81.0)	NS	58 (78.4)	49 (89.1)	NS
No follow-up testing (UTS, CBEU)	142 (100)	51 (100)	79 (100)	–	74 (100)	55 (100)	–
<i>At risk of complication cystitis</i>							
Diagnostic by urine cultures (±UTS)	89 (62.7)	40 (78.4)	41 (51.9)	.002	41 (55.4)	39 (70.9)	NS
Complication risk factors are known	12 (8.5)	7 (13.7)	5 (6.3)	NS	8 (10.8)	4 (7.3)	NS
Leukocyturia and bacteriuria thresholds are known	14 (9.9)	6 (11.8)	7 (8.9)	NS	7 (9.5)	6 (10.9)	NS
Treatment is delayed if cystitis is well tolerated	46 (32.4)	14 (27.5)	30 (38.0)	NS	23 (31.1)	20 (36.4)	NS
In case of empirical treatment, antibiotics are compliant	18 (12.7)	6 (11.8)	12 (15.2)	NS	11 (14.9)	6 (10.9)	NS
In case of empirical treatment, a reassessment is made with urine cultures results	126 (88.7)	49 (96.1)	69 (87.3)	NS	67 (90.5)	50 (90.9)	NS
No follow-up testing (UTS, CBEU)	85 (59.9)	44 (86.3)	34 (43.0)	.0001	43 (58.1)	34 (61.8)	NS

Abbreviations: CBEU, cyto-bacteriological examination of the urine; NS, not significant; UTS, urine test strips.

TABLE 3 Recurrent cystitis and cystitis caused by multi-drug-resistant bacteria global analysis, by age categories and type of practice

Clinical vignette topic and analysis criteria	Number of compliant answers (%)						
	All participants (N = 142)	<45 years (N = 51)	≥45 years (N = 79)	P	Rural or semi-rural (N = 74)	Urban (N = 55)	P
<i>Recurrent cystitis</i>							
Diagnostic criteria known	108 (76.1)	39 (76.5)	59 (74.7)	NS	52 (70.3)	45 (81.8)	NS
CBEU for first recurrences	122 (85.9)	46 (90.2)	66 (83.5)	NS	67 (90.5)	44 (80.0)	NS
Less than one episode a month: diet and lifestyle advice and no antibiotic prophylaxis	75 (52.8)	30 (58.8)	39 (49.4)	NS	32 (43.2)	37 (67.3)	.007
More than one episode a month: diet and lifestyle advice and antibiotic prophylaxis	36 (25.4)	17 (33.3)	19 (24.1)	NS	18 (24.3)	18 (32.7)	NS
<i>Cystitis caused by multi-drug-resistant bacteria (ESBL Enterobacteriaceae)</i>							
Knowledge of ESBL <i>Enterobacteriaceae</i> risk factors	16 (11.3)	7 (13.7)	7 (8.9)	NS	10 (13.5)	4 (7.3)	NS
Treatment conformity	23 (16.2)	7 (13.7)	14 (17.7)	NS	10 (13.5)	11 (20.0)	NS

Abbreviations: CBEU, cyto-bacteriological examination of the urine; ESBL, extended-spectrum β -lactamase; NS, not significant; UTI, urinary tract infection; UTS, urine test strips.

antibiotic resistance and with remaining efficiency for the management of cystitis.^{18–20} It could be useful to continue education and physician training efforts on the use of this molecule, which provides effectiveness for treating cystitis (including the ones caused by ESBL-E).

Knowledge of diagnostic criteria and the use of diagnostic means also showed some gaps in our study. However, CBEU was widely prescribed in at risk of complication cystitis and never prescribed for follow-up testing in simple cystitis. In the literature, we noticed the sporadic use of urine test strips in France,^{14,21} an underuse of urine

TABLE 4 Number of compliant answers according to cystitis type and criteria evaluated

Clinical vignette topic and analysis criteria	Number of questions	Compliant answers	
		Range minimum-maximum	Mean percentage [CI 95]
<i>Type of cystitis</i>			
Simple cystitis	3	1–3	85.2 [81.9–88.5]
At risk of complication cystitis	7	0–5	39.2 [36.4–42.1]
Recurrent cystitis	4	0–4	60.0 [56.2–63.9]
Cystitis caused by multi-drug-resistant bacteria (ESBL-E)	2	0–2	13.7 [9.5–17.9]
<i>Evaluated criteria</i>			
Diagnostic criteria (cystitis classification)	4	0–3	26.4 [23.7–29.1]
Diagnostic means (UTS/CBEU) and follow-up testing	5	1–5	76.5 [73.1–79.8]
Antibiotic treatment	7	0–6	44.3 [41.5–47.0]

Abbreviations: CBEU, cytobacteriological examination of the urine; CI95, 95% confidence interval; UTS, urine test strips.

cultures in Ireland²² and, on the contrary, unnecessary CBEU in the United Kingdom.²³ Regarding the knowledge of complication risk factors for cystitis, we were able to notice that, despite the poor knowledge of the entire list, some major risk factors, which were independently evaluated, were sufficiently known. We observed that diabetes was still frequently listed, but it was only suppressed from this list in 2015.⁹ In a study carried out in the Netherlands and published in 2017, diabetes was also not a risk factor for antimicrobial resistance in UTIs.²⁴

In all countries, it is established that guidelines are not always sufficiently followed.^{13,14,21} In our study, the evolution of national recommendations with suppression of critical antibiotics in first-line treatments of cystitis was recent,⁹ and GPs may not have had enough time to integrate them. The assessment of clinical practices is an action lever for adherence to guidelines,^{25–27} and we hope that our case-vignettes can help to improve adherence. However, it has been shown that contextual factors can influence medical decisions, regardless of knowledge of the recommendations, especially among physicians with more experience.²⁸ Although the situations presented in the vignettes were relatively neutral, it would have been interesting to assess whether certain details of these clinical cases had motivated a different attitude from that proposed by the recommendations.

There was, in this study, a high participation rate for a questionnaire-based study carried out in a population of French GPs.²⁴ The participants were representative of the medical population in Western Normandy.²⁹ We found few differences in the different GP subgroup answers—some responses on diagnosis management were significantly better among the younger GPs and some responses on therapeutic management were significantly more compliant among GPs practicing in urban areas. Younger physicians probably receive more current guidelines in their training, and urban practice might promote better practice exchanges through the work in group medical practices and the involvement in peer review or in continuing medical education. We decided to question GPs that were members of QCs as a priority, who are used to measure and improve the quality of practice via their meetings in France, as well as at the European scale.¹¹ It

is important to notice that the GQ had not recently worked on UTIs prior to the study, which could have resulted in a selection bias and overestimated the conformity rates observed in the study. We compared the results obtained by the GQ to the ones obtained by the other GPs. The absence of a significant difference between the two subgroups' answers, despite a probable lack of statistical power, would suggest a potentially high external validity for our study. It was interesting to notice that GPs who used external resources had significantly higher scores than other GPs. This comforts the idea of enhancing the broadcast of guidelines to improve practices.

We used a clinical vignettes-based questionnaire in our study, with multiple choice questions, to facilitate better participation of GPs. The interest of case-vignettes resides in the opportunity to present written clinical situations that one could encounter in their usual practice in primary care to obtain real practice analysis. These clinical situations are usually brief to avoid impacting the working time of GPs and to facilitate quick responses. This method also has the advantage of being economical and achievable in every type of practice.^{30–32} Other methods used for measuring the quality of clinical practice do not allow enough involvement of GPs to obtain a full view of clinical care.^{23,24,33} Lack of time is often mentioned.^{15,33}

We identified a few limitations in our study. First, answers to the questionnaire were declarative and represented theoretical practice, but they could differ from real clinical practice. Second, closed questions in the questionnaire did not allow considering answers individually and nuances of the questioned physicians, but the free commentaries section overcame this bias. Last, some sociodemographic and activity data were missing, and we did not consider the possible participation in peer review or continuing medical education of GPs outside the GQ, resulting in a possible information bias.

In conclusion, our results suggest that there may be a need to improve the knowledge of professionals on antibiotic resistance and appropriate antibiotic use. Complementary training based on this evaluation to GQ and peer review groups could be proposed. The efficacy of feedback in the improvement of quality of care in QCs has been



demonstrated in the Netherlands.^{34,35} Some tools such as targeted susceptibility testing could be promoted.³⁶ In addition, qualitative studies could be carried out to better understand the reasons for non-adherence to recommendations, before a new measure of clinical practices.

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CONFLICT OF INTEREST

The authors declare that they have no competing interest.

AUTHOR CONTRIBUTIONS

Claire Beaurain, Pascal Thibon, Renaud Verdon, and Claude Magnani contributed to the conception and design of the study protocol. Claire Beaurain, Pascal Thibon, Elise Fiaux, and Emmanuel Piednoir designed the clinical vignettes. CB and CM acquired the data. Claire Beaurain and Pascal Thibon analysed the data and wrote the article. François Caron, Renaud Verdon, and Claude Magnani revised the article. All authors read and approved the final manuscript.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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