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SI - Infections urinaires masculines Guidelines (invitation only)

Updated guidelines for management of community-acquired urinary tract infections in adult men by the French infectious disease society (SPILF)

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ABSTRACT

These guidelines address acute community-acquired urinary tract infections (UTIs) in adult men. The following situations are not covered: pediatric UTIs, UTIs in immunocompromised patients, catheter-associated UTIs (vesical, ureteral, or nephrostomy), neurogenic bladder, nosocomial UTIs, chronic and recurrent UTIs. This update defines nosological entities, including confirmation of the existence of cystitis in men. Definitions are provided in the first chapter. Epidemiological and bacterial resistance data specific to male UTIs—previously scarce and fragmented—are presented in the second chapter. Pharmacokinetic and pharmacodynamic data for antibiotics used in male UTIs are comprehensively reviewed and summarized in the third section. Treatment recommendations for each entity are detailed in the fourth chapter. The final chapter outlines investigations to be considered after UTI in men and situations requiring urological referral.
This document presents a concise text, and brief supporting arguments regarding key points have been added. Four clinical vignettes summarizing the diagnosis and management of cystitis, pyelonephritis, and epididymo-orchitis are presented at the end of this recommendation (Figs. 1, 2, 3 and 4).

Comprehensive texts are co-published alongside these guidelines and constitute an extended rationale.

1. Methodology

1.1. Study design

These guidelines were developed using the RAND/UCLA Appropriateness Method [1]. Work was organized into five thematic groups: 1) nosology and diagnosis, 2) bacteriological epidemiology; 3) pharmacodynamics and pharmacokinetics; 4) antibiotic therapy; and 5) additional investigations. Only sections 1, 4, and 5 were subjected to the RAND/UCLA consensus process.

1.2. Literature review and expert panel

A multidisciplinary expert panel was convened in coordination with the participating scientific societies (in alphabetical order: Association Française d'Urologie, AFU; Collège National des Généralistes Enseignants, CNGE; Société Française de Gériatrie et Gérontologie, SFGG; Société Française de Microbiologie, SFM; Société Française de Médecine d'Urgence, SFMU; Société Française de Pharmacologie et Thérapeutique, SFPT; Société Nationale Française de Médecine Interne, SNFMI; Société de Pathologie Infectieuse de Langue Française, SPILF). Each group conducted a literature review and produced working documents with proposed recommendations.

1.3. RAND/UCLA consensus process (table S1)

The RAND/UCLA method combines literature review and collective expert judgment through a two-round rating process [1].

Each proposal was rated individually by experts on a 1–9 scale (1 = inappropriate, 9 = appropriate), yielding three levels of appropriateness using the following definitions:

- Appropriate (A): panel median ≥ 7
- Uncertain (U): panel median of 4–6
- Inappropriate (I): panel median ≤ 3

In the RAND/UCLA method, the highest extreme value and the lowest extreme value are excluded.

The strengh of agreement was expressed as strong (+) and weak (−). For each item, agreement was assessed based on the position of the interval defined by the minimum and maximum ratings on the scale:

- Strong agreement (+) was assigned if the entire range of ratings fell within the predefined bounds (e.g., 1–3 for “inappropriate” or 7–9 for “appropriate”).
- Weak agreement (−) was assigned if the rating interval spanned multiple categories (e.g., 1–4 or 6–8), indicating divergent or ambiguous panel opinions.

Disagreement was defined as $\geq$3 experts rating in opposite extremes (1–3 and 7–9).

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The successive rating rounds were carried out using the following procedure:

- First round: Anonymous, independent rating for initial arbitration.
- Plenary discussion: Presentation of results and structured discussion of uncertain or opposed proposals, followed by reformulation.
- Second round: *Re*-rating after modifications to produce the final text.

1.4. Grading of recommendations

Recommendations were graded according to the French National Authority for Health (HAS) classification [2]:

Grade	Level of Evidence
A	High-quality randomized trials, meta-analyses
B	Lower-quality randomized trials, cohort/case-control studies
C	Retrospective studies, case series, studies with bias
AE	Expert opinion in the absence of sufficient data

2. Diagnosis of acute community-acquired bacterial urinary tract infections in men

2.1. Definitions

2.1.1. *Urinary colonization*

- Defined by detection of one or more microorganisms on urinalysis (urine culture), regardless of concentration or leukocyturia, in the absence of UTI symptoms [AE, A+].
- Screening and treatment of **urinary colonization** is not indicated, except prior to certain urological procedures [AE, A+].
- Cloudy urine or foul-smelling urine alone are not clinical signs of UTI in men [AE, A+].
- Macroscopic hematuria or acute urinary retention alone are not clinical signs of UTI in men [AE, A+].
- In acute urinary retention without UTI signs or sepsis of unknown etiology, urgent urinary drainage is indicated, but treatment of **urinary colonization** is not recommended [AE, A-].

2.1.2. *Bacteriuria of indeterminate clinical significance*

- In the presence of documented bacteriuria associated with nonspecific systemic symptoms (altered mental status, confusion, acute dependence, sudden deterioration, organ decompensation, unsteady gait or tendency to fall) and in the absence of clinical signs of cystitis, it is proposed to use the term “bacteriuria of indeterminate clinical significance” [C, A+].

This situation is more frequently observed in individuals over 75 years of age [3].

- In the event of bacteriuria of indeterminate clinical significance and in the absence of sepsis, clinical monitoring without antibiotic treatment is recommended [AE, A+].
- In the event of bacteriuria of indeterminate clinical significance associated with predictive signs of sepsis, using a simple score predictive of sepsis*, differential diagnoses should be ruled out; if no other etiology explains the clinical picture, a potential diagnosis of urinary sepsis should be considered [AE, A+].

*Clinical score composed of 6 variables (1 point per variable)

- Age $>$ 65 years
- Temperature $>$ 38 °C
- Systolic blood pressure $\leq$ 110 mmHg
- Heart rate $>$ 110/min
- Peripheral oxygen saturation $\leq$ 95%
- Recent-onset altered mental status

If clinical score $\geq 3 = \geq$ 40% risk of progression to sepsis [4].

Distinguishing between colonization and infection can be challenging in elderly patients presenting with bacteriuria associated with nonspecific systemic signs or isolated fever [5]. In patients over 75 years of age, those with nonspecific systemic signs suggestive of urinary sepsis often lack local signs of urinary tract infection, and even in the presence of bacteremia, fever may be absent [3,6,7].

2.2. Urine dipstick

- Not recommended for diagnosing UTI [C, A-].

Urine dipsticks are unhelpful for clinical decision-making and their broad use of dipsticks may cause significant harms by promoting overdiagnosis [and occasional underdiagnosis) of UTI [8,9].

2.3. Urine culture (UC)

- Not recommended:
- In isolated acute urinary retention [AE, A-].
- In nonspecific systemic symptoms in the elderly without UTI signs, fever, or signs of sepsis [AE, A-].
- After a clinically successful antibiotic treatment [AE, A+].
- Recommended before initiating antibiotic therapy for any suspected UTI [AE, A+].
- Urine culture should be performed in accordance with the European Federation of Laboratory Medicine (EFLM) best practice guidelines (2023) [10].
- For midstream urine samples, the significant thresholds supporting a clinical suspicion of UTI in men are: leukocyturia $>30 \times 10^3$/mL and monobacterial bacteriuria $\geq 10^3$ CFU/mL for main uropathogens [10] [C, A+].
- Clinical signs of UTI take precedence over leukocyturia and bacteriuria thresholds [AE, A+].
- The clinical context must be specified on the urine culture request form [AE, A+].

2.4. Acute cystitis

- Cystitis in men exists [C, A+].

Cystitis in men has been depicted in a recent prospective study [11] and in many retrospective studies [12,13]. Molecules presumed to be ineffective in prostatitis treatment have demonstrated their effectiveness in treating afebrile men in retrospective studies conducted in primary care [14,15]. Male cystitis is now recognized in numerous international guidelines [16–18].

- The diagnosis of bacterial cystitis is based on the presence of acute local symptoms combined with a positive UC without chills, rigors, fever or sepsis [C, A+].
- The clinical presentation of bacterial cystitis typically involves a combination of the following symptoms: urethral burning during micturition, increased urinary frequency, urinary urgency, dysuria, nocturia, and suprapubic pain [19,20]; these symptoms may be accompanied by macroscopic hematuria [C, A+].
- Failure of appropriately conducted treatment for cystitis should prompt investigation for prostatitis or consideration of alternative urological diagnoses **[AE, A+]**.

- UC is the only recommended test to confirm cystitis and guide antibiotic treatment [AE, A+].
- Routine blood sampling for diagnostic purposes (including PSA measurement, inflammatory markers, and blood cultures) is not recommended in men presenting with clinical signs of cystitis **[AE, A+]**.

2.5. Acute prostatitis

- The diagnosis of acute prostatitis is based on the presence of cystitis symptoms combined with fever or sepsis, and a positive UC [C, A+].
- A routine digital rectal examination is not recommended except in cases of diagnostic uncertainty between cystitis and prostatitis, or between pyelonephritis and prostatitis [AE, A-].

The clinical diagnosis of prostatitis may be difficult in patients with pauci-symptomatic forms, pre-existing voiding or storage dysfunction, cognitive impairment, etc. Pain at digital rectal examination may contribute to the diagnosis of prostatitis but is variable, having been reported in 39 to 70% of acute prostatitis [21].

- PSA measurement is not recommended for the diagnosis of acute prostatitis or for deciding on antibiotic treatment or monitoring patients receiving antibiotics for this infection [C, A+].

In the context of acute prostatitis, elevated PSA levels are observed variably (in 30% to 60% of cases [22–25]. PSA elevation does not correlate with the presence or severity of clinical signs of prostatitis [24,25].

- Renal function assessment is not recommended for men with acute prostatitis managed in an outpatient setting, provided that there are no risk factors for acute renal failure (such as chronic kidney disease, urological history, dehydration, or high-risk medications including diuretics, Angiotensin-Converting Enzyme (ACE) inhibitors, *non*-steroidal anti-*inflammatory* drugs (NAIDs), aminoglycosides, etc.) [AE, A+].
- Measurement of inflammatory markers and blood cultures are not recommended for men with acute prostatitis managed in an outpatient setting [C, A+].

While blood cultures are positive in 16–22% of hospitalized men with febrile urinary tract infections, they contribute to the microbiological diagnosis in only about 5% of cases [21,26–28].

- Imaging is recommended in the following situations:

  - In emergency settings:

- **If sepsis or septic shock is present:** Perform an abdominal-pelvic CT scan with and without contrast, ideally including a delayed phase (use of contrast should be carefully considered in cases of acute renal failure) **[AE, A+]**.
  - **If acute urinary retention is suspected:** Use a bladder scanner or suprapubic ultrasound; if urinary retention is confirmed, proceed with urgent urinary drainage **[AE, A+]**.

- In case of poor clinical response after 72 h of appropriate antibiotic therapy:

defined by persistent fever or worsening urinary symptoms,

imaging is recommended to investigate a potential prostatic abscess (using preferentially contrast-enhanced MRI or CT scan, or transrectal prostate ultrasound, depending on availability) **[AE, A+]**.

During febrile urinary tract infections in men, acute urinary retention is reported in 10–25% of hospitalized patients [27].

2.6. Acute pyelonephritis

- The diagnosis of acute pyelonephritis is based on the presence of fever or sepsis, spontaneous or percussion-induced lumbar pain, symptoms of cystitis and a positive UC.
- Symptoms of cystitis may be absent [29] [C, A+].
- A first-line abdominal-pelvic CT scan with and without contrast, including a delayed phase, is systematically recommended (use of contrast should be carefully considered in cases of acute renal failure) [AE, A-].

This imaging should be performed [AE, A+]:

- Systematically within 48–72 h to check for uropathy.
- While awaiting CT imaging, if acute urinary retention is suspected, a bladder scan or suprapubic ultrasound should be performed urgently to confirm retention and proceed if necessary with urinary drainage [AE, A+].
- **In emergency settings**:

- sepsis or septic shock
- uncontrolled pain
- suspicion of urinary tract obstruction (by stone, tumor…)
- *endo*-ureteral material
- acute renal failure

Pyelonephritis is rare in men and may more commonly reveal underlying urinary tract disorders [30] [AE, A+].

- Routine renal function assessment is not recommended for men with acute pyelonephritis managed in an outpatient setting, provided there are no risk factors for acute renal failure (chronic kidney disease, urological history, dehydration, or high-risk medications including diuretics, ACE inhibitors, NSAIDs, aminoglycosides, or indication of urgent abdominal-pelvic CT-scan…) [AE, A-].

- Measurement of inflammatory markers and blood cultures is not recommended for community-acquired acute pyelonephritis managed in an outpatient setting [AE, A+].

2.7. Acute epididymitis/orchitis

- The diagnosis of epididymitis or orchitis is defined by the acute onset of swelling and spontaneous or palpation-induced pain in the epididymis or testis. The primary emergency differential diagnosis is testicular torsion [20] [C, A+].

  Other associated clinical signs may include: fever, hydrocele, scrotal erythema and edema, symptoms of cystitis, or urethral discharge [31].
- UC is systematically recommended [AE, A+].
- In sexually active men, regardless of age, a first-void urine sample for nucleic acid amplification testing (NAAT/PCR) to detect *Chlamydia trachomatis* and *Neisseria gonorrhoeae* is also recommended. A comprehensive sexually transmitted infection (STI) evaluation should be performed based on individual risk factors [C, A+] [31].
- Routine scrotal ultrasound is not recommended for acute epididymitis or orchitis [AE, A+].
- Scrotal ultrasound is recommended in the following situations [AE, A+]:
  - Diagnostic uncertainty.
  - Suspected abscess.
  - Persistent fever or worsening local symptoms after 72 h of appropriate antibiotic therapy [32].

Table 1
Epidemiology of bacterial species isolated from midstream UC in men with community-acquired infections in France, between 2019 and 2023.

Bacterial species	Hospital Centers* (Emergency Departments)	Private MBLs**
E. coli	15,322 (40.0%)	7952 (39.2%)
E. faecalis	5046 (13.2%)	2962 (14.6%)
K. pneumoniae	3001 (7.8%)	1265 (6.2%)
P. mirabilis	2208 (5.8%)	937 (4.6%)
Other Enterobacterales	5628 (14.7%)	3269 (16.1%)
Other Gram-positive cocci	4007 (10.5%)	2827 (13.9%)
Other Gram-negative bacilli (non-Enterobacterales)	2046 (5.3%)	926 (4.6%)
Other species***	1021 (2.7%)	157 (0.8%)
Total	**38,279 (100%)**	**20,295 (100%)**

* Aggregated data from bacteriology laboratories of university hospitals in Rennes, Nantes, Grenoble, Limoges, Tours, Caen, Besançon, Henri-Mondor, Kremlin-Bicêtre, general hospitals in Versailles, Suresnes, Saint-Joseph, Mantes-la-Jolie, Antibes, and the military teaching hospital Bégin.
** Aggregated data from the private MBL group Atoutbio.
*** Aggregated data for species with *frequency < 0.5%.*

3. Epidemiology of male urinary tract infections

- Only limited data specifically detail the epidemiology of male UTIs. The most recent available data come from a retrospective observational study conducted in Germany between 2015 and 2020. The most widely identified pathogenic bacteria in cultures were *Escherichia coli* (38.4%), *Enterococcus faecalis* (16.5%, predominantly in polymicrobial cultures), *Proteus mirabilis* (9.3%), and *Klebsiella pneumoniae* (7.7%) [33].
- No French data specifically detailing the epidemiology of community-acquired UTIs in men have been published over the past 10 years. As a result, retrospective data on the epidemiology of bacterial species isolated from midstream urine cultures in men with community-acquired infections were compiled from medical biology laboratory (MBL) data between 2019 and 2023 (drawn from three sources: emergency departments of 15 hospitals, private MBL group, and the national PRIMO mission), as well as from primary care data recorded in the AntibioClic antibiotic prescribing support tool between 2017 and 2024 [34–36].

3.1. Epidemiology of bacterial species isolated from midstream urine cultures in men with community-acquired infections in France

Analysis of data from both hospital and private laboratories confirms a predominance of *E. coli* **[39–40%)**, *E. faecalis* **(13–15%)**, *K. pneumoniae* **(6–8%)**, and *P. mirabilis* **(5–6%)** among the main bacterial species isolated from midstream urine cultures (ECBU) in men in France with community-acquired infections (Table 1).

3.2. Antibiotic resistance epidemiology of the four main bacterial species isolated from UC in men with community-acquired infections in France, between 2019 and 2023

- The antibiotic resistance rates observed among the three main Enterobacterales species isolated from midstream urine cultures in men with community-acquired infections in France (***E. coli***, ***K. pneumoniae***, and ***P. mirabilis***) are presented in Table 2.
- The overall resistance rates for these three Gram-negative bacilli, weighted by prevalence, are approximately **53–59% for amoxicillin, 29–32% for amoxicillin-clavulanate, 5–11% for parenteral** third-generation cephalosporins (3GC), **16–19% for fluoroquinolones,** and **28–31% for** trimethoprim-sulfamethoxazole (SXT).
- The prevalence of ESBL-producing strains ranges from approximately 2 to 8.4% for *E. coli*, 11.0 to 22.8% for *K. pneumoniae*, and 1.0 to 1.3% for *P. mirabilis*.
- Among men over 65 years of age residing in long-term care facilities, the rate of resistance to 3GC is estimated at 15–18% for *E. coli* and 32–36% for *K. pneumoniae* (PRIMO data) [35].
- Prevalence of carbapenemase-producing strains remains low, at approximately 0.1% for *E. coli* and 0.3% for *K. pneumoniae*, and occurs only exceptionally for *P. mirabilis*.

Table 2
Prevalence (%) of antibiotic resistance among *E. coli*, *K. pneumoniae*, and *P. mirabilis* isolated from midstream urine cultures in men in France with community-acquired infections (data from MBL).

	Percentage of resistant isolates by antibiotic or antibiotic class (%)											
Bacterial species	**AMX**	**AMC**	**MEC**	**PTZ**	**FOX**	**3GC**	**TEM**	**FQ**	**AMI**	**FOS**	**SXT**	**FT**
E. coli	47-53.5	24-35.7	6.8-8.9	5.9-6.8	2.2-2.5	4.7-9.3	*7.3*	16.3- 20.2	0.4-0.7	1.4-1.5	25.4-31.5	0.4-0.7
***E. coli* ESBL**	*100*	*55.3*	14.7	11.5	*5.1*	*100*	*15.4*	*78.8*	*3.6*	*4.3*	*61.6*	*3.0*
K. pneumoniae	100	20.1-33	**	13.4-17.3	**	10.8-24.5	*9.2*	15.3-27.1	0.9-1.8	*	20.3-26.8	15.6-53.2
P. mirabilis	39.7-42.3	10.4-14.4	*	0.5-0.8	**	1.3-1.5	*1.7*	13.9-16.6	0.7-0.8	*	29.5-33.5	100

AMX: amoxicillin; AMC: amoxicillin–clavulanic acid; MEC: mecillinam; PTZ: piperacillin–tazobactam; FOX: cefoxitin; 3GC: parenteral third-generation cephalosporins; TEM: temocillin; FQ: fluoroquinolones; AMI: amikacin; FOS: fosfomycin; SXT: trimethoprim–sulfamethoxazole; FT: nitrofurantoin; ESBL: extended-spectrum β-lactamase.
Data in italics are derived from a single source (emergency departments of 15 French hospitals).
Data are expressed as min-max values according to the source.
* Antibiotic tested on a number of isolates insufficient to provide robust data.
**Absence of a defined clinical breakpoint.
Color coding / resistance levels:: ■ > 20%; ▒ :10–20%; □:<10%.

Table 3
Antibiotic dosages for treatment of acute urinary tract infections in men.

Antibiotic	Cystitis	Pyelonephritis	Prostatitis*	Sepsis/ Septic Shock
Nitrofurantoin	100 mg tid	NR		NR
Trimethoprim	300 mg od	NR		NR
TMP-SMX (160–800)	1 pill bid			NR
Ofloxacin	200 mg bid			NR
Levofloxacin	500 mg od			NR
Ciprofloxacin	500 mg bid			NR
Fosfomycin-trometamol	3 g (1 dose) every other day	NR	3 g (1 dose) od or every other day if poor digestive tolerance.	NR
Amoxicillin	1 g tid			NR
Amoxicillin-clavulanate	1 g tid			NR
Pivmecillinam	400 mg bid	NR		NR
Cefixime	NR	200 mg bid		NR
Piperacillin-tazobactam	NR	4,5 g tid		NR
Temocillin	NR	2 g/ tid		NR
Cefoxitin	NR	6 g/d		NR
Cefixime	NR	200 mg bid		NR
Cefotaxime	NR	1 g tid		2 g tid
Ceftriaxone	NR	1 g od		2 g od
Imipenem	NR	500 mg tid		1 g tid
Meropenem	NR	1 g tid		2 g tid
Ertapenem	NR	1 g od		NR
Amikacin	NR	30 mg/kg/day		

NR: not recommended; TMP-SMX**: trimethoprim–sulfamethoxazole; tid: three times a day; bid: twice a day; od: once a day.**
**The dosages of antibiotics for treatment of acute epididymitis and orchitis are identical to those used in treatment of acute prostatitis.*

- Lastly, *E. faecalis* strains remain uniformly susceptible to amoxicillin. Resistance rates are below 1% for vancomycine, linezolid and nitrofurantoin, and below 5% for levofloxacin.

4. Pharmacokinetics and pharmacodynamics of antibiotics in the male urinary tract

4.1. Introduction

- Pharmacokinetic and pharmacodynamic (PK/PD) data on antibiotics within the male urinary tract are scarce, and their interpretation is complex.
- Many parameters are insufficiently known:
- the intratissue localization of bacteria and the penetration of antibiotics within the different organs (kidney, prostate, testis, epididymis, bladder) and (vascular, interstitial, intracellular) compartments of the male urinary tract.
- the relative contribution of each factor enhancing prostatic penetration (lipophilicity, low molecular weight, weak ionization, poor plasma protein-binding) [37]
- numerous factors that may influence antibacterial efficacy in situ (local immunity, physicochemical characteristics of the environment (pH, iron availability, oxidative stress, etc.), and bacterial-specific characteristics [38,39].
- Existing studies may lead to conflicting results according to methodological characteristics:
- Dosage performed in uninfected patients (i.e. without local inflammation) [40].
- Sampling schedule (early, or at steady state)
- Analytical techniques [40–42]
- Matrix in which the measurements were performed (often a tissue homogenate that combines all compartments) [39,43,44]
- Plasma concentrations are generally considered a good predictive marker of concentrations within the renal tissue [45]. Older studies suggest that antibacterial efficacy within the bladder lumen requires high urinary concentrations [46]. However, the impact of intracellular bladder reservoirs, in which bacteria do not divide ("persisters") and are protected from antibiotic activity may also play a role [47–49]. Very limited data are available for other organs.

Despite these limitations, based on literature analysis and given the physicochemical properties of major antibiotic molecules, experts propose guidelines to assist clinicians.

4.2. Beta-lactams

- In the prostate, the pharmacokinetic characteristics of beta-lactams and beta-lactamase inhibitors are contrasting, with satisfactory diffusion into the interstitium but very limited diffusion into prostatic fluids and no intracellular penetration. Experimental data confirm good diffusion of beta-lactams into the interstitium. Among these agents, amoxicillin and mecillinam exhibit the pharmacokinetic profiles most favorable for intra-prostatic diffusion. Among carbapenems, ertapenem is theoretically disadvantaged compared to meropenem and imipenem in terms of physicochemical properties.
- Renal diffusion is satisfactory, with tissue concentrations close to plasma levels.
- Urinary concentrations are very high for most beta-lactams.
- Data regarding diffusion into the testis or epididymis are very limited.
- In patients at risk of underdosing (such as those with increased renal clearance, obesity, or sepsis), and in cases of infections caused by bacteria with high MICs, we recommend high doses and continuous or prolonged infusion administration, according to PK/PD modeling.

4.3. Fosfomycin, trimethoprim-sulfamethoxazole (SXT) and fluoroquinolones

The pharmacokinetic profile and physicochemical properties of these antibiotics appear highly favorable, particularly in the prostate, seminal fluid, epididymis, bladder, and urine. Fosfomycin, SXT and fluoroquinolones diffuse into both the interstitial compartment and intracellular space.

4.4. Nitrofurantoin

The pharmacokinetic profile of nitrofurantoin does not appear suitable for treating prostatic, renal, or epididymo-testicular infections. Its concentrations in the interstitial and intracellular sectors seem negligible.

4.5. Aminoglycosides

The pharmacokinetic profile of aminoglycosides is generally favorable for treating renal or bladder infections. Their diffusion is adequate in the interstitial sector but absent in the intracellular sector. For prostatic infections, on the other hand, available data are insufficient to form an opinion.

4.6. Other antibiotic classes (glycopeptides, lipoglycopeptides, daptomycin, oxazolidinones, streptogramins)

Available data are insufficient to provide recommendations regarding these molecules.

5. Therapeutic management of male urinary tract infections

Antibiotic choices and dosages are based on literature data, epidemiological data, and pharmacokinetic (PK) and pharmacodynamic (PD) data presented in specific chapters of these recommendations. They incorporate antibiotic stewardship principles and aim to promote treatment adherence by favoring the simplest therapeutic regimens. It should be noted that most antibiotics recommended for the treatment of male cystitis do not currently have marketing authorization (AMM) for this indication.

Treatment dosages are summarized in Table 3.

5.1. Treatment of acute cystitis

Only one randomized placebo-controlled study, describing several limitations, has demonstrated the non-inferiority of a 7-day treatment with SXT or ciprofloxacin compared to a 14-day treatment of male UTIs without signs of prostatic involvement [11]. The efficacy of other treatments for male cystitis, using narrower-spectrum antibiotics (nitrofurantoin, trimethoprim, and pivmecillinam) has been reported in retrospective cohort studies involving tens of thousands of patients [50–57]. The efficacy of oral fosfomycin (fosfomycin-trometamol) in this indication has been reported in several observational studies with smaller sample sizes [58–63]. Many international guidelines have long since integrated these different treatments for male cystitis [16].

5.1.1. Empirical antibiotic therapy

- If cystitis symptoms are well-tolerated and the diagnosis is uncertain, it is recommended to await the UC results before initiating antibiotic treatment according to the microbiological documentation and antibiogram [AE, A+].
- Otherwise, oral empirical antibiotic treatment, in alphabetical order:

fosfomycin-trometamol OR nitrofurantoin OR pivmecillinam [C, A-].

5.1.2. Antibiotic therapy after documentation

- The antibiotic empirically initiated according to the above recommendation should be continued if the uropathogen is susceptible (including in cases of extended-spectrum beta-lactamase-producing Enterobacterales) and tolerance is good [AE, A+].
- Otherwise, antibiotic therapy should be adjusted as follows:
  By alphabetical order: amoxicillin, fosfomycin-trometamol, nitrofurantoin, pivmecillinam, trimethoprim [AE, A-].

5.1.3. Treatment duration

Seven days for all recommended antibiotics, except for fosfomycin-trometamol: one dose on day 1, one dose on day 3, and one dose on day 5 (D1-D3-D5) [C, A+].

5.2. Management of a patient with acute prostatitis or pyelonephritis

5.2.1. Criteria for referral to an emergency hospital service

5.2.1.1. Risk of sepsis or septic shock. Use the clinical score detailed in chapter 2.1.2.

5.2.1.2. Suspected or confirmed urinary obstruction.

- Certain situations should prompt urgent investigation for urinary tract obstruction (lower: acute urinary retention; upper: obstructive acute pyelonephritis), such as a history of (congenital or acquired) uropathy, history of urinary lithiasis, intense and/or persistent pain despite usual analgesics [AE, A+].
- In case of confirmed obstruction, the patient should be transferred to an appropriate care facility, and urgent drainage or urinary diversion is recommended [AE, A+].

5.2.1.3. Other criteria for hospital evaluation.

- Inability to take oral medication with risk of non-compliance and dehydration (dysphagia, nausea, vomiting, delirium, agitation, social context, isolation) [AE, A+].
- Functional decline preventing home care [AE, A+].
- Decompensation of comorbidities requiring hospitalization (uncontrolled diabetes, acute renal failure, dehydration, cardiac decompensation, etc.) [AE, A+].
- Uncontrolled pain [AE, A+].

5.2.2. A specialized consultation with an urologist or infectious diseases specialist (in-person or telemedicine) is recommended during acute episode management

- In case of underlying uropathy (malformation, history of urinary lithiasis, solitary kidney, reflux, etc.) [AE, A+].
- For assistance in choosing empirical antibiotic therapy in case of previous history or infection with multidrug-resistant bacteria [AE, A+].

5.2.3. In case of outpatient management

- Ensure that the relevant criteria for good therapeutic compliance and home monitoring are met [AE, A+].
- Propose a follow-up consultation or teleconsultation for reassessment within 48–72 h [AE, A+].

5.2.4. Antibiotic treatment

5.2.4.1. Empirical antibiotic therapy

5.2.4.1.1. Absence of signs of sepsis or septic chock.

- If treatment is initiated in a hospital setting: cefotaxime or ceftriaxone [B, A-].
- If treatment is initiated on an outpatient basis: ceftriaxone OR oral fluoroquinolone (in alphabetical order: ciprofloxacin or levofloxacin) (if no fluoroquinolone use in the past six months and if oral efficacy is not compromised by nausea, vomiting, malabsorption, or uncertain compliance) [B, A-] [64,65].

5.2.4.1.2. Sepsis. Cefotaxime or ceftriaxone.
plus a single dose of amikacin [C, A-].

5.2.4.1.3. Septic shock.*

- No risk factors for infection with 3GC-resistant Enterobacterales (3GC-R) **:

cefotaxime OR ceftriaxone.
plus a single dose of amikacin [AE, A-].

- At least one risk factor for infection with 3GC-R Enterobacterales**: Imipenem OR meropenem plus a single dose of amikacin [AE, A+].

***Sepsis with hemodynamic failure requiring a vasopressor and lactate level > 2 mmol/L.**

**Risk factors for infection with 3GC-R Enterobacterales:

- Residing in a nursing home
- Infection and/or colonization with 3GC-R Enterobacterales in the past three months
- Travel abroad in the past three months
- Use of fluoroquinolones, amoxicillin-clavulanate, or 3GC in the past three months

Resistance data collected for this update from urine cultures in men show a high rate of 3GC-R Enterobacterales in men living in nursing homes. This situation has consequently been added to the documented risk factors for infection with 3GC-R Enterobacterales. Additionally, amikacin is proposed in this context of severe infection due to its rapid bactericidal activity, preserved activity against most Enterobacterales (including ESBL and carbapenemase producers), and safety in a single dose.

5.2.4.2. Step-down antibiotic therapy according to antibiogram results

5.2.4.2.1. Oral step-down possible (susceptible uropathogen and no contraindications)

5.2.4.2.1.1. Acute pyelonephritis

In order of preference: amoxicillin, SXT, amoxicillin-clavulanate, fluoroquinolone (in alphabetical order: ciprofloxacin OR levofloxacin OR ofloxacin), cefixime [C, A-].

5.2.4.2.1.2. Acute prostatitis

In order of preference: SXT, fluoroquinolone (ciprofloxacin OR levofloxacin OR ofloxacin) [B, A+].

If resistance or contraindication to SXT and fluoroquinolones, and after defervescence:

In order of preference: fosfomycin-trometamol, amoxicillin, amoxicillin-clavulanate [C, A-].

Specific data on acute pyelonephritis or prostatitis in men are rare, and the distinction between these two entities is not always clearly established in the literature. For febrile urinary tract infections in men (encompassing both entities), the efficacy of fluoroquinolones and SXT has been reported [26,66–69]. Intravenous beta-lactams, either as initial treatment or for a prolonged duration, have likewise been shown to be effective in this indication [70]. The efficacy of oral beta-lactam step-down therapy after intravenous antibiotic treatment has been reported as non-inferior to oral step-down with fluoroquinolones or SXT for the treatment of urinary bacteremia (study including 90% men, but with retrospective design) [71]. Literature data indicate that oral fosfomycin is effective in treating acute prostatitis [72–74]. Data regarding pivmecillinam for febrile urinary tract infections in men include few patients, and it appears premature to recommend this treatment [75–77].

5.2.4.2.2. Oral step-down not possible (resistant uropathogen or contraindication)

5.2.4.2.2.1. Acute pyelonephritis

Enterobacterales susceptible to 3GCs: cefotaxime or ceftriaxone [B, A-].

5.2.4.2.2.2. Acute prostatitis

Enterobacterales susceptible to 3GCs: cefotaxime or ceftriaxone [B, A-].

5.3. Acute pyelonephritis and acute prostatitis caused by Enterobacterales resistant to 3GCs

- Resistance due to cephalosporinase hyperproduction and for susceptible bacteria: cefepime OR temocillin, if susceptible [B, A-].
- Resistance due to ESBL production

First choice, in alphabetical order, if susceptible: cefoxitin [only if *E. coli* or *Proteus*] OR piperacillin-tazobactam OR temocillin.

Default option: carbapenem (in alphabetical order: ertapenem OR imipenem OR meropenem) [C, A-].

Several studies have demonstrated the efficacy of non-carbapenem beta-lactams (temocillin, piperacillin/tazobactam, cefoxitin) in treating febrile urinary tract infections caused by ESBL-producing Enterobacterales [78–84].

5.3.1. Step-down oral treatment

5.3.1.1. Acute pyelonephritis. In order of preference: SXT, amoxicillin-clavulanate, fluoroquinolone (in alphabetical order ciprofloxacin OR levofloxacin OR ofloxacin) [C, A-].

5.3.1.2. Acute prostatitis. In order of preference: SXT, fluoroquinolone (in alphabetical order: ciprofloxacin OR levofloxacin OR ofloxacin), fosfomycin-trometamol [C, A-].

5.3.2. If Oral treatment not possible (resistant Uropathogen or contraindication)

Intravenous treatment, in order of preference: narrower spectrum beta-lactams (in alphabetical order: cefoxitin [only if *E. coli* or *Proteus*], piperacillin-tazobactam or temocillin) or carbapenem (in alphabetical order: ertapenem, imipenem or meropenem) [C, A+].

If outpatient treatment Ertapenem (single daily injection) IV, IM or SC may be more convenient.

5.4. Acute pyelonephritis and acute prostatitis caused by Enterococcus

- Amoxicillin [AE, A+].
- Contraindication or resistance to amoxicillin: seek specialized advice [AE, A-].

5.5. Acute prostatitis and pyelonephritis and allergy contraindicating all Beta-lactams

5.5.1. Empirical therapy

5.5.1.1. Absence of signs of sepsis or septic chock. Ciprofloxacin or levofloxacin orally (or intravenously if oral efficacy is compromised: nausea, vomiting, malabsorption, uncertain compliance, etc.) if no fluoroquinolone use in the last six months [B, A+].

5.5.1.2. If contraindication to fluoroquinolones. Single dose of amikacin.

5.5.1.3. If sepsis, septic shock. Single dose of amikacin AND fluoroquinolone (IV ciprofloxacin OR IV levofloxacin) and seek specialized advice [AE, A+].

5.5.2. Oral step-down therapy

In order of preference: SXT, fluoroquinolone (ciprofloxacin OR levofloxacin OR ofloxacin), fosfomycin-trometamol (only for prostatitis) [AE, A-].

5.5.3. If Oral step-down not possible

Seek specialized advice.

5.6. Duration of antibiotic treatment

5.6.1. Acute pyelonephritis

- Seven days if treated with parenteral beta-lactam and/or fluoroquinolone and/or SXT [AE, A-].

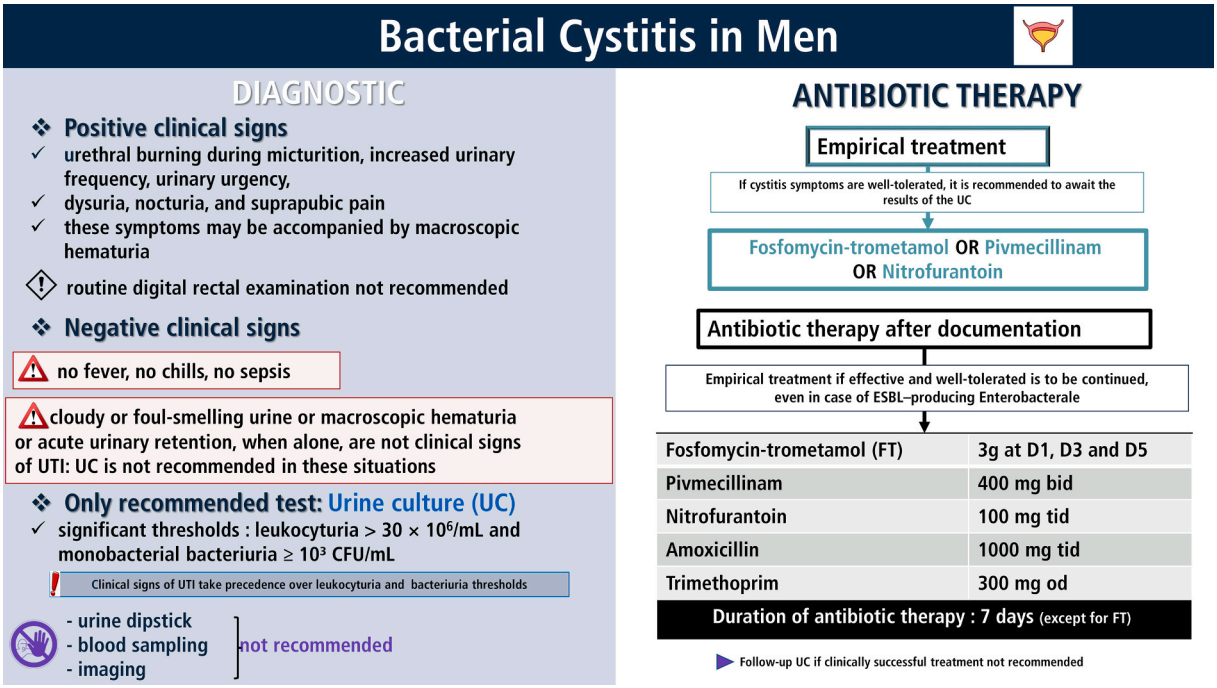

Fig. 1. Summary vignette for the management of bacterial cystitis in men.

- Ten days if oral step-down involves an antibiotic other than fluoroquinolone or SXT [AE, A-].
- Five days if treated exclusively with aminoglycoside [C, A-].

5.6.2. Acute prostatitis

14 days [A, A+].

Two randomized studies including men alone compare two treatment durations for febrile urinary tract infection [26,67]. The non-inferiority of 14 days versus 28 days of ciprofloxacin in 72 men was demonstrated in a monocentric study [67]. In the multicenter randomized Prostashort study including 240 patients, infection a 7-day treatment was found to be inferior to a 14-day treatment [26]. In a multicenter randomized study (200 patients), the non-inferiority of 7 days versus 14 days of antibiotics was not demonstrated in terms of early clinical cure for "pyelonephritis" (the definition applied could not really discriminate between pyelonephritis and prostatitis in men) [68]. Subgroup analysis showed that clinical efficacy was lower in men treated for seven days compared to those treated for 14 days [68].

5.7. Management of a Patient with epididymitis or Orchitis

The current scientific rationale defining antibiotic treatment for epididymo-orchitis is poorly supported. Two old, double-blind, randomized controlled studies in hospitalized patients evaluated treatment efficacy (85,86]. The first, involving 159 patients, showed more treatment failures with pivampicillin (40% failure rate) as compared to ciprofloxacin (20%) [85]. The second found no efficacy in 18 patients treated with SXT compared to 17 patients receiving lactose powder for five days [86]. There have been no recent prospective or retrospective cohort studies.

In international guidelines, the recommended empirical treatment for uncomplicated epididymo-orchitis (excluding sexually transmitted infections) is most often a fluoroquinolone [64,87–93]. The alternative proposed antibiotic therapy is SXT, and occasionally amoxicillin-clavulanate [64,87,91]. The usual recommended treatment duration is 10 to 14 days, but without precise justification for these durations. Treatment of epididymo-orchitis linked to sexually transmitted infections is not addressed in these guidelines.

5.7.1. Empirical antibiotic therapy

- If treatment is initiated in a hospital setting: cefotaxime OR ceftriaxone [AE, A+].
- If treatment is initiated on an outpatient basis: ceftriaxone OR fluoroquinolone (ciprofloxacin OR levofloxacin) [AE, A+] (if no fluoroquinolone use in the past six months and if oral efficacy is not compromised by nausea, vomiting, malabsorption, or uncertain compliance).

5.7.2. Step-down therapy

5.7.2.1. Oral step-down possible (susceptible uropathogen and no contraindications).

- In order of preference: SXT, fluoroquinolone (ciprofloxacin OR levofloxacin OR ofloxacin) [AE, A+].
- If resistance or contraindication to SXT and fluoroquinolones: beta-lactam (initial treatment recommended parenterally), in order of preference: amoxicillin, amoxicillin-clavulanate, cefixime [AE, A-].

5.7.2.2. Oral step-down not possible (resistant uropathogen or contraindication).

- Enterobacterales susceptible to 3GCs: cefotaxime or ceftriaxone.
- Enterobacterales resistant to 3GCs:
- Resistance due to cephalosporinase hyperproduction and for susceptible bacteria: cefepime OR temocillin [AE, A+].
- Resistance due to ESBL production:

  Intravenous treatment, in order of preference: narrower spectrum beta-lactams (by alphabetical order: cefoxitin [only if *E. coli* or *Proteus*], piperacillin-tazobactam, temocillin) or carbapenem (by alphabetical order: ertapenem, imipenem, meropenem) [AE, A+].

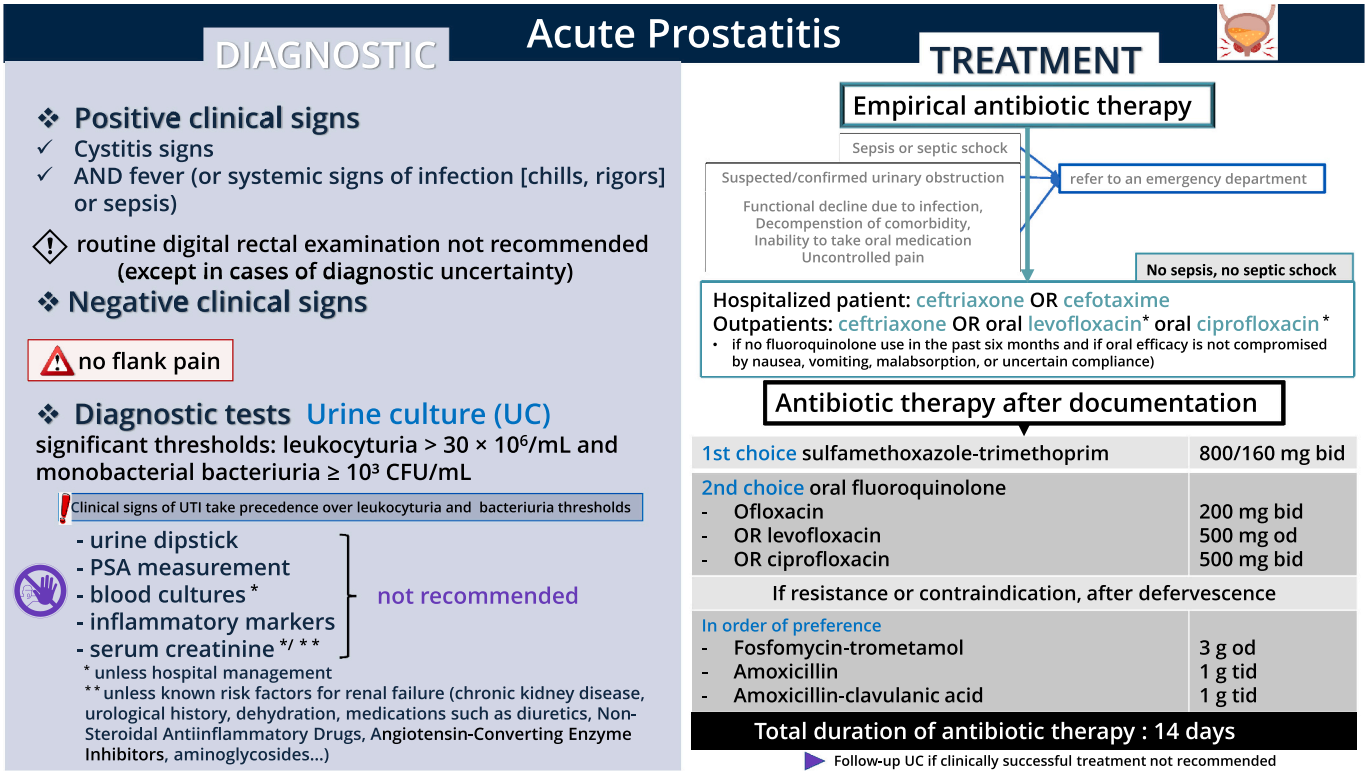

Fig. 2. Summary vignette for the management of acute prostatitis.

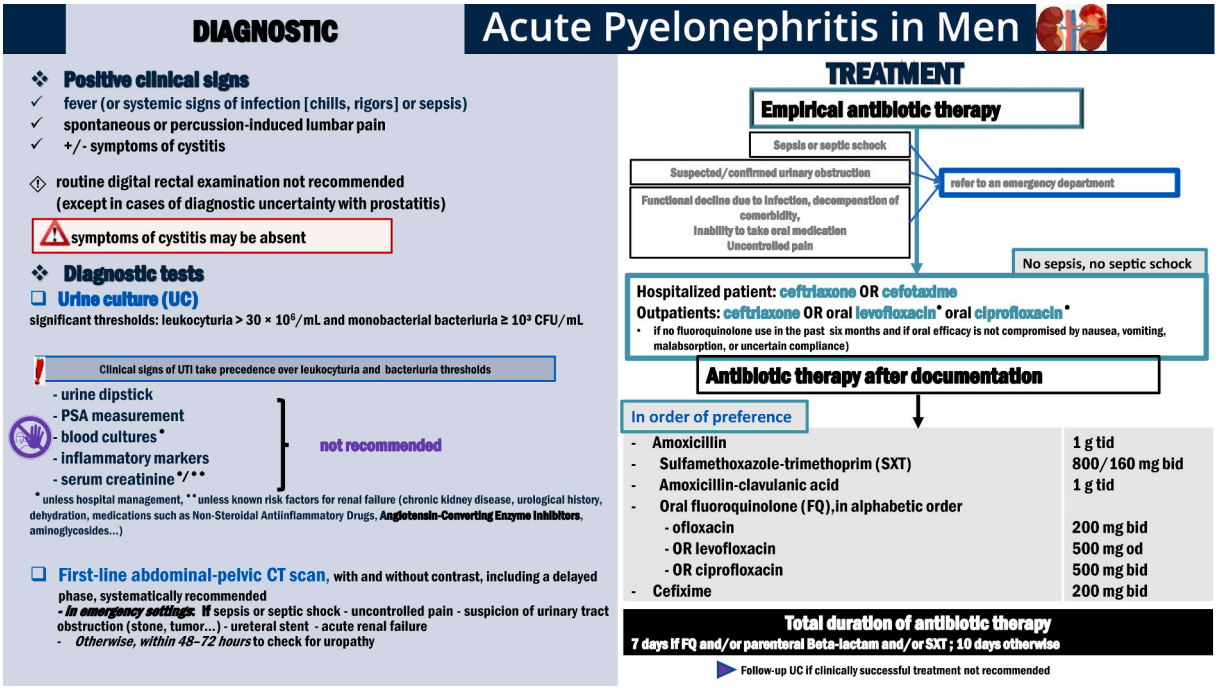

Fig. 3. Summary vignette for the management of acute pyelonephritis in men.

5.7.2.3. No microbiological documentation. Continue the initiated empirical treatment or consider oral step-down, in order of preference: SXT, fluoroquinolone (ciprofloxacin, levofloxacin, or ofloxacin) [AE, A+].

5.7.3. Treatment duration

10 days for all recommended antibiotics [AE, A+].

6. Which investigations should be performed after a FIRST episode of male urinary tract infection?

- Occurrence of a male urinary tract infection should systematically prompt the search for at least one predisposing factor. The main hypothesis underlying this approach is that whatever the initial diagnosis, a urinary tract infection may be secondary to an

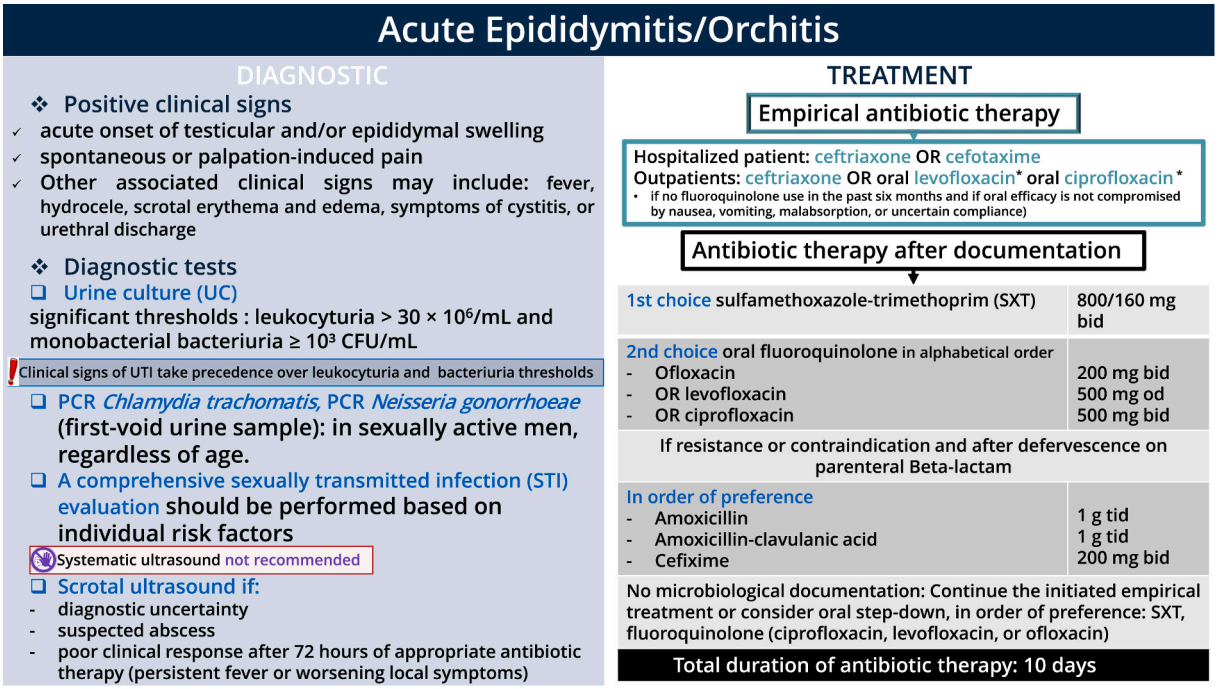

Fig. 4. Summary vignette for the management of acute epididymitis and orchitis.

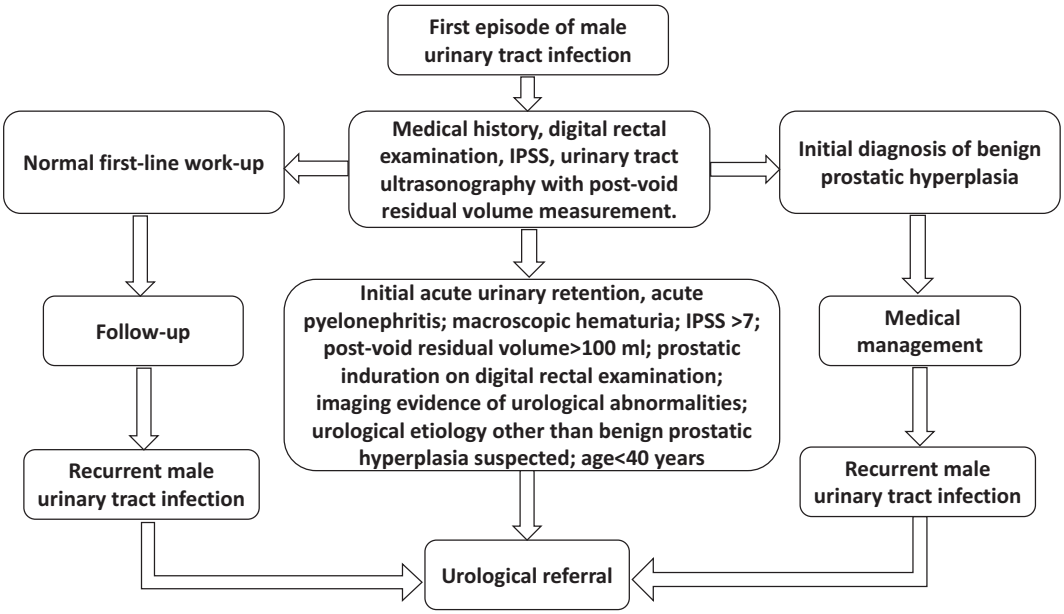

Fig. 5. Decision algorithm for identifying and managing the most common uropathies possibly predisposing to urinary tract infection. IPSS: International Prostate Symptom Score.

underlying etiology and should lead to identification of anatomical or functional abnormalities in the urinary tract [94].

- No national or international recommendations or literature define the etiological work-up to be performed after occurrence of a first episode of male UTI. In some cases, imaging studies performed during the acute phase of the infection may help to identify the factor (s) predisposing to the infection. The proposals below are therefore primarily based on expert opinions and should be adapted according to the information collected during the initial assessment at the time of the urinary tract infection. They are summarized in the decision algorithm (Fig. 5).
- This algorithm was designed to identify the most common etiologies (benign prostatic hyperplasia, urethral stricture, etc.) using simple, non-invasive, low-cost, and primary care-accessible examinations. There are numerous etiologies to consider, and prostatic pathology should not systematically be incriminated [95]. The indicator threshold values proposed in the algorithm (Fig. 1) are given for guidance and allow for objectively determination of the need to consult a urologist to avoid delaying etiological management.

- The etiological work-up is based on simple clinical data collected by the primary care physician in the weeks following the urinary tract infection, supplemented by ultrasound of the urinary tract. A second-line assessment, including an urological consultation and more specialized additional tests, is justified only in the cases specified below.

6.1. First-line assessment

6.1.1. Clinical examination

- It is recommended to systematically conduct a targeted medical history to identify macroscopic hematuria or lower urinary tract symptoms (LUTS) that existed before the infection or having appeared since the infection [AE, A-].
- It is recommended to supplement the medical history with calculation of the International Prostate Symptom Score (IPSS) (https://www.urofrance.org/fileadmin/medias/scores/score-IPSS.pdf) and completion of a voiding diary if LUTS are reported by the patient [96] [AE, A-].
- It is recommended to systematically perform a digital rectal examination after the infectious episode so as to estimate the volume and consistency of the prostate [AE, A-].

LUTS are categorized as follows [107]:

- Storage-phase LUTS (formerly known as irritative symptoms): urgency, daytime and nocturnal frequency, nocturia, urgency incontinence.
- **Voiding-phase LUTS** (formerly known as obstructive symptoms): hesitancy or straining to void, weak or intermittent stream, prolonged micturition.
- **Post-micturition LUTS**: terminal dribbling and persistent sensation of incomplete bladder emptying.

6.1.2. Biological tests

- It is not recommended following a male urinary tract infection to systematically measure PSA levels [AE, A+].
- If PSA measurement is deemed necessary, it should be performed at least three months after the infection, taking into account the indications mentioned in the current recommendations of the French Association of Urology [97] [AE, A+].

There is no link between a first episode of male UTI and prostate cancer. Following acute prostatitis, PSA levels can remain elevated for three months without correlation to inflammation or prostate size [98]. PSA levels are not associated with a risk of recurrence of male urinary tract infection [99].

6.1.3. Imaging

It is systematically recommended to perform an ultrasound of the urinary tract with measurement of post-void residual urine (PVR) [AE, A+].

6.2. Second-line assessment

A urological consultation is recommended in cases of pyelonephritis, initial urinary retention, macroscopic hematuria, IPSS >7, induration on digital rectal examination, PVR > 100 mL, recurrent UTI, age < 40 years and/or urological abnormalities on imaging [AE, A+].

Statement for studies in humans and animals

Not relevant.
I declare that this article has been written without AI assistance.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.idnow.2026.105312.

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