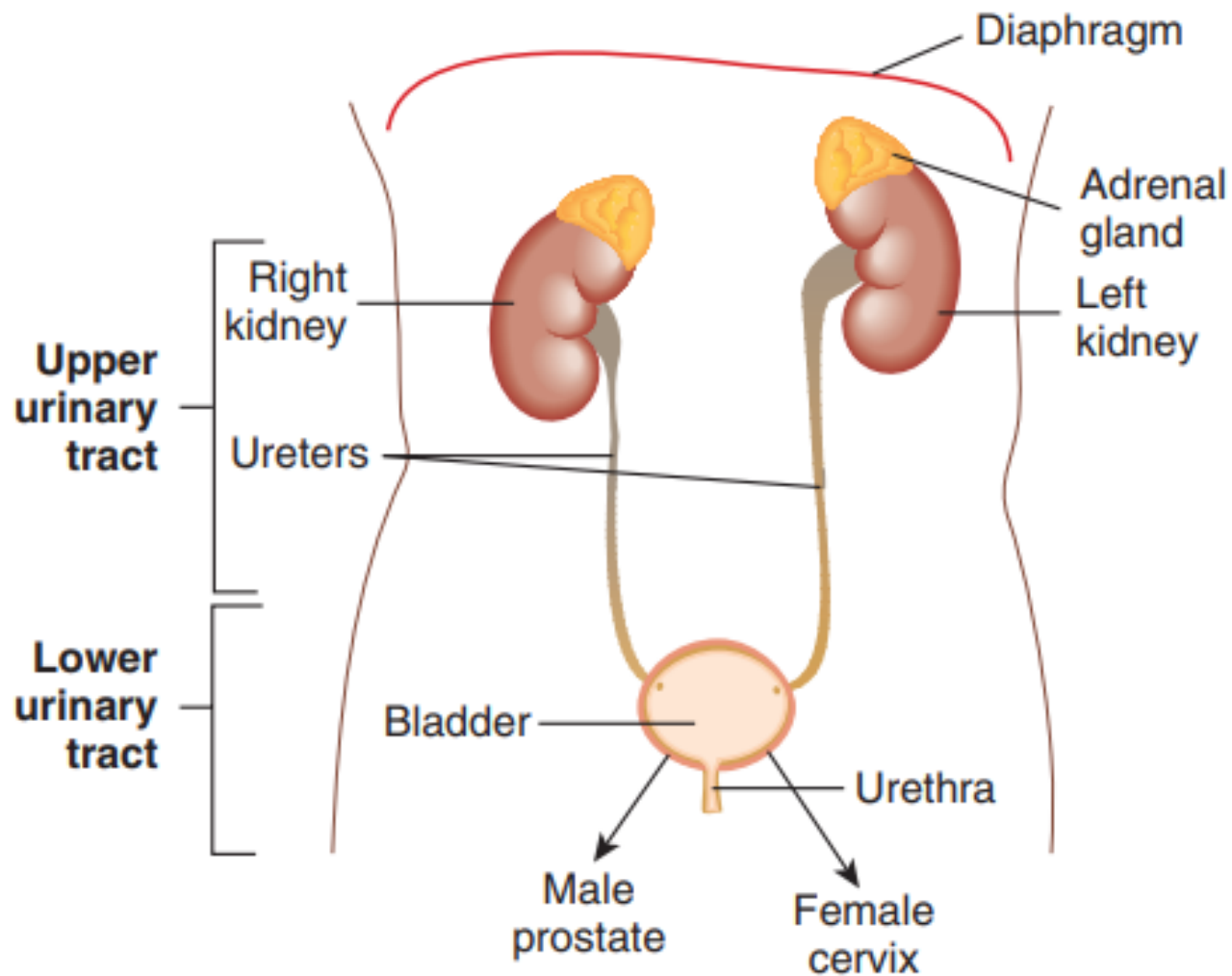


Interpretation of UC



Anatomy

Urine is normally a sterile fluid,

UTIs are characterized as:

1. upper (U-UTI): ureters and kidneys
2. lower (L-UTI): bladder and urethra

Patient Age, Status	Usual Flora
Newborn 1–3 days old	Sterile Staphylococci Enterococci Diphtheroids <i>Mycobacterium smegmatis</i>
Prepubertal	Micrococci Streptococci (α -hemolytic and nonhemolytic) Coliforms Diphtheroids
Adult	<i>Lactobacillus acidophilus</i> <i>Staphylococcus epidermidis</i> Streptococci (α -hemolytic and nonhemolytic) <i>Escherichia coli</i> Diphtheroids Yeasts Anaerobic streptococci <i>Listeria</i> spp. <i>Clostridium</i> spp.
Pregnancy	Increase in <i>L. acidophilus</i> Yeasts <i>S. epidermidis</i>
Postmenopausal	Similar to prepubertal flora

Resident Microflora

lactobacilli, corynebacteria, and coagulase-negative staphylococci

Transient colonizers: gram-negative aerobic bacilli and occasional yeasts

All areas of the urinary tract above the urethra in a healthy human are sterile.

Risk Factors

Age: Infants, Pre-school and school-age girls, Adults, Adults over 65 years old

Institutionalized Care

Pregnancy

Renal Transplantation

Bladder Catheterization

Clinical Signs and Symptoms

Children younger than 2 years: nonspecific symptoms, such as failure to thrive, vomiting, lethargy, and fever.

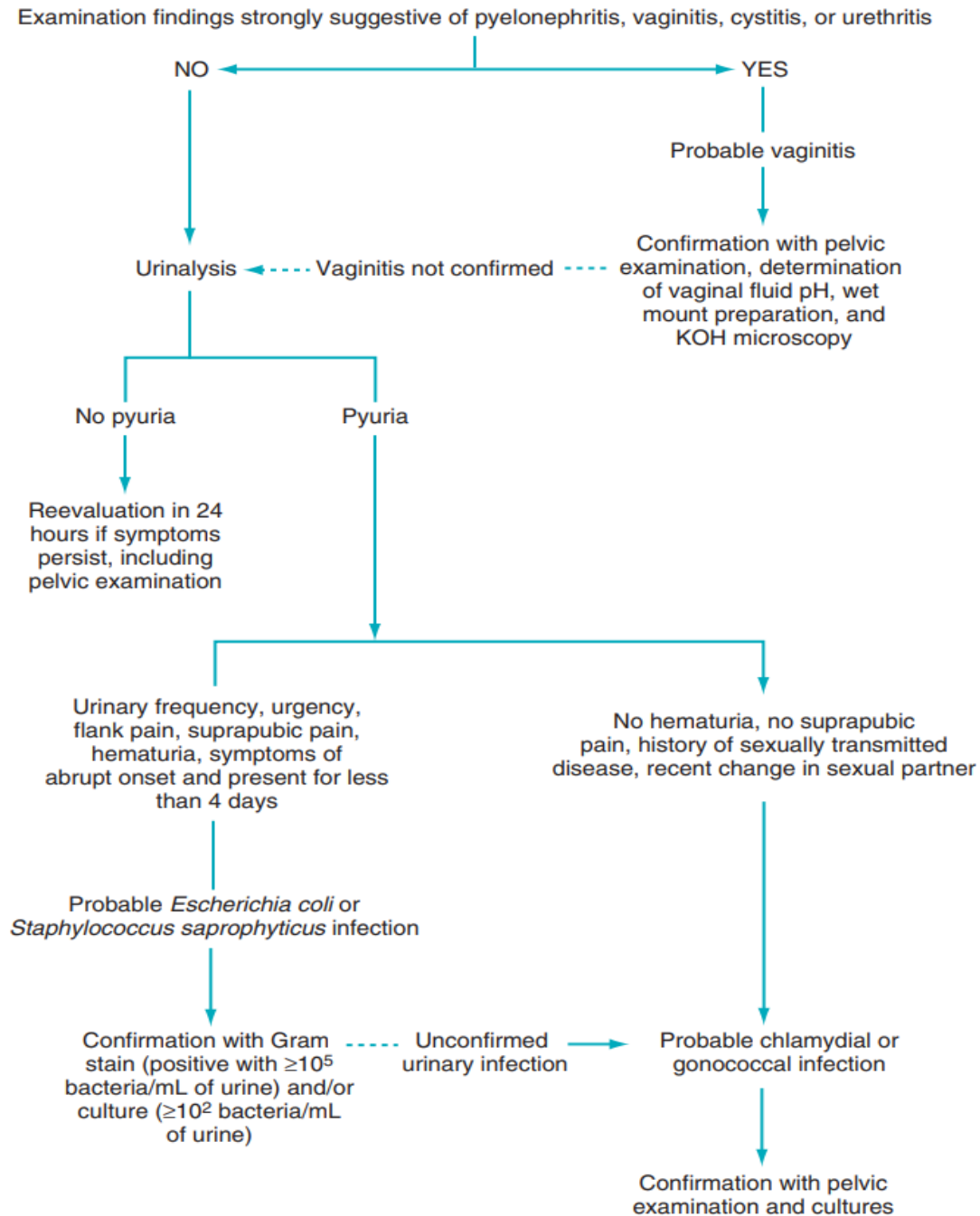
Children older than 2 years: more localized symptoms, such as dysuria, frequency, and abdominal pain.

Adults with uncomplicated lower UTIs, acute, complicated UTI : dysuria, often in combination with frequency, urgency, suprapubic pain, and hematuria.

Each episode of uncomplicated UTI in women is usually associated with 1 week of symptoms.

Upper UTI: present with flank pain, nausea, vomiting, fevers, chills, night sweats, and costovertebral angle tenderness.

Dysuria



BOX 37.3 Recognized Microbial Agents of Urinary Tract Infections

Common Agents

Enterococci (including vancomycin-resistant enterococci)
Streptococcus agalactiae (group B streptococci)
Enterobacteriaceae (especially *Escherichia coli*)
Pseudomonas spp.
Streptococcus pyogenes (group A streptococci)
Staphylococcus aureus
Staphylococcus saprophyticus
Candida spp.

Less Common Agents

Gardnerella vaginalis
Ureaplasma urealyticum
Mycoplasma hominis
Mobiluncus spp.
Leptospira spp.
Mycobacterium spp.
Chlamydia trachomatis (in males)

Agents Often Associated with Multisystem Diseases

Salmonella spp. (with gastroenteritis)
Schistosoma haematobium
Cryptococcus neoformans
Trichosporon beigelii
Trichomonas vaginalis
Aspergillus spp.
Penicillium spp.
Adenovirus
Herpes simplex virus

Causative Agents

Specimen Collection

Voided Midstream Specimen Collection

Catheterized Specimen Collection

Suprapubic Aspiration

Other Considerations

Interpretation of Urine Cultures

UTIs may be completely asymptomatic, produce mild symptoms, or cause life-threatening infections.

Of importance, the criteria most useful for microbiologic assessment of urine specimens is dependent not only on the type of urine submitted (e.g., voided, straight catheterization) but the clinical history of the patient (e.g., age, sex, symptoms, antibiotic therapy).

One major problem in interpreting urine cultures arises because urine cultures collected by the voided technique may be contaminated with normal flora, including Enterobacteriaceae.

Determining what colony count represents true infection from contamination is of utmost importance and is related to the patient's clinical presentation.

A number of studies have proposed the use of different cutoffs in colony counts based on clinical presentation; an example of one such set of guidelines is given in Table 1

Category	Clinical	Laboratory
Acute, uncomplicated UTI in women	Dysuria, urgency, frequency, suprapubic pain No urinary symptoms in last 4 weeks before current episode No fever or flank pain	≥ 10 WBC/mm ³ $\geq 10^3$ CFU/mL uropathogens* in CCMS urine
Acute, uncomplicated pyelonephritis	Fever, chills Flank pain on examination Other diagnoses excluded No history or clinical evidence of urologic abnormalities	≥ 10 WBC/mm ³ $\geq 10^4$ CFU/mL uropathogens in CCMS urine
Complicated UTI and UTI in men	Any combination of symptoms listed above One or more factors associated with complicated UTI†	≥ 10 WBC/mm ³ $\geq 10^5$ CFU/mL uropathogens in CCMS urine
Asymptomatic bacteriuria	No urinary symptoms	$\pm >10$ WBC/mm ³ $\geq 10^5$ CFU/mL in two CCMS cultures >24 hours apart

Table 1

Uropathogens: Organisms that commonly cause UTIs.

† Factors associated with complicated UTI include:

- any UTI in a male,
- indwelling or intermittent urinary catheter,
- >100 mL of postvoid residual urine,
- obstructive uropathy,
- urologic abnormalities,
- azotemia (excess urea in the blood, even without structural abnormalities),
- renal transplantation

Complicating urine culture interpretation

Further complicating urine culture interpretation is the increasing difficulty in distinguishing between infection and contamination as the criterion for a positive culture is lowered from 10^5 CFU/mL to 10^2 CFU/mL.

Because of these issues, many laboratories establish their own interpretative criteria for urine cultures based on the type of urine submitted (e.g., clean-catch midstream, catheterized, and surgically obtained specimens such as suprapubic aspirates).

Variations in interpretative guidelines occur from one laboratory to another but some generalities can be made; these are listed in Table 2.

a pure culture of *S. aureus* is considered to be significant regardless of the number of CFUs, and antimicrobial susceptibility tests are performed.

The presence of yeast in any number is reported to physicians, and pure cultures of yeast may be identified to the species level.

In all urine, regardless of the extent of final workup, all isolates should be enumerated (e.g., three different organisms present at 10^3 CFU/mL), and those present in numbers greater than 10^4 CFU/mL should be described morphologically (e.g., non-lactose-fermenting gram-negative rods)

Result	Specific Specimen Type/Associated Clinical Condition, if Known	Workup
≥10 ⁴ CFU/mL of a single potential pathogen or for each of two potential pathogens	CCMS urine/pyelonephritis, acute cystitis, asymptomatic bacteriuria, or catheterized urines	Complete*
≥10 ³ CFU/mL of a single potential pathogen	CCMS urine/symptomatic males or catheterized urines or acute urethral syndrome	Complete
≥Three organism types with no predominating organism	CCMS urine or catheterized urines	None; because of possible contamination, ask for another specimen
Either two or three organism types with predominant growth of one organism type and <10 ⁴ CFU/mL of the other organism type(s)	CCMS urine	Complete workup for the predominating [†] organism(s); description of the organism(s)
≥10 ² CFU/mL of any number of organism types (set up with a 0.001- and 0.01-mL calibrated loop)	Suprapubic aspirates, any other surgically obtained urines (including ileal conduits, cystoscopy specimens)	Complete

Table 2

The flow diagram 1 that takes into account three features that should be considered in all UTIs:

- Colony count of a pure or predominant organism
- Measurement of pyuria
- Presence or absence of symptoms (dysuria and frequency)

if the patient is receiving antibiotic therapy, then Gram stain, WBC analysis, and culture results may not agree.

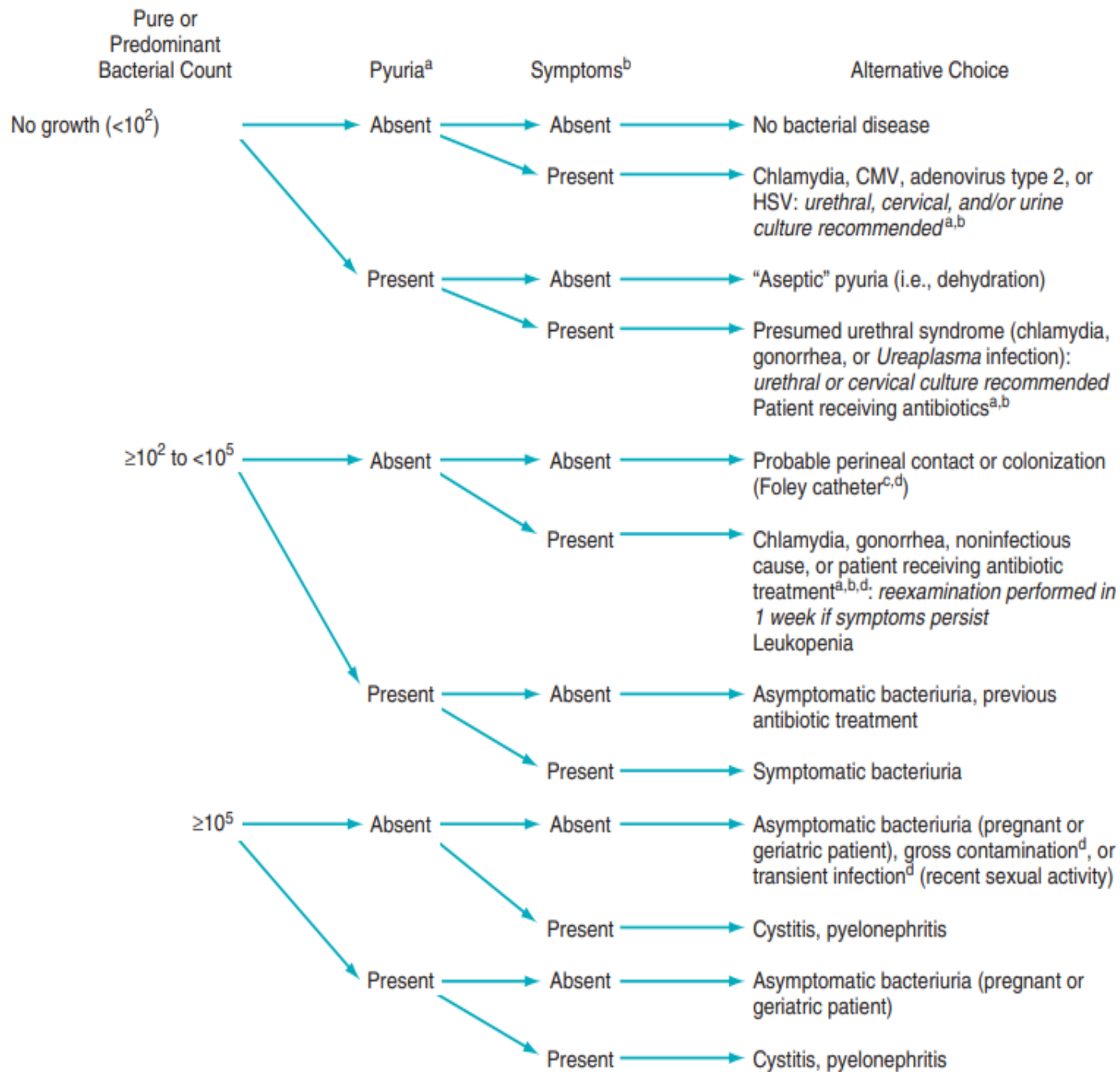
Finally, quantitation of organisms and WBCs by urinalysis of a centrifuged specimen has no comparative value for the leukocyte esterase and bacteria measurement in microbiological study, which is performed routinely on a noncentrifuged urine specimen.

It is imperative that clinicians recognize that routine urine cultures do not include

It is also important to recognize that given the high propensity of negative cultures sent to the laboratory ($\approx 50\%$), reevaluation of the patient with a negative culture result may require consideration of a sexually transmitted lists guidelines for the interpretation of urine culture results and suggests the subsequent workup.

In summary, these guidelines recommend the following, keeping in mind that cost-effective strategies may define different algorithms for inpatient and outpatient cases:

- Multiple uropathogens (i.e., three or more) in a specimen indicates probable contamination.
- One or two significant uropathogens present ($\geq 10^5$ CFU/mL) should be routinely identified. Susceptibility tests should be performed for inpatients. Outpatient cases may use a different algorithm that does not routinely call for susceptibility tests; rather, it emphasizes empiric selection based on antibiograms. However, some centers may perform susceptibility testing on all urine culture specimens in the setting of increasing drug resistance.
- One or two uropathogens present in small numbers ($\geq 10^2$ CFU/mL) should be routinely identified ($\geq 10^2$ to $< 10^5$ CFU/mL) if the clinical situation warrants, such as in acute urethral syndrome or cases of previous antibiotic therapy.



Flow Diagram 1

a: If patient is receiving antibiotic treatment, the result of the Gram stain, WBC analysis, and culture may not agree.

B: Quantitation of organisms and WBCs by urinalysis of a centrifuged specimen is of no comparative value for the measurement of leukocyte esterase and bacteria done by microbiological study, which is performed routinely on a noncentrifuged specimen.

C: Interpretation for indwelling catheter has not been established.

D: Plates held for 72 hours for consultation.

a Leukocyte esterase (+); equivalent to 5 WBCs/hpf.

b Clinical dysuria and frequency.

TABLE 37.8 Guidelines for Interpretation of Urine Culture Results and Subsequent Workup

Colony Count (CFU/mL) ^a	Symptoms, Clinical Disease, or Patient Population ^b	Urine Source	No. of Organism Types Isolated	Laboratory Workup Suggested (Inpatient) ^c
<10 ^h		CV, CA	None	None ^d
≥10 ^b	Pediatric	Suprapubic	≤2 organisms by anaerobic culture	ID and AST
≥10	Symptomatic female, urethritis	CV	Pure culture	ID and AST
≥10	Symptomatic male, prostatitis	CA	≤2 organisms	ID and AST
		CA	Pure culture	ID and AST
≥10		Bladder washout		ID and AST
≥10 ^d	Cystitis, pyelonephritis	CV	Pure culture	ID and AST
			Two or three organisms	Q and SID
			Three organisms	Q and M or Q and GS

CA, Straight catheterized; CFU, colony-forming unit; CV, clean-catch voided; ID and AST, perform identification and antimicrobial susceptibility testing; Q and GS, quantitate and report Gram stain morphotypes; Q and M, quantitate total amount of bacteria and report as “mixed urethral flora”; Q and SID, quantitate and perform sight identification, identification and sensitivity not indicated, hold plates for 72 hours. a Inoculation of 0.01 mL of urine is required to detect 10² CFU/mL. b See Table 37.1 for description of clinical diseases, symptoms, and patient population. c Workup required. Any yeast may be quantitated and reported (regardless of number); >100,000 needed to identify to species

Susceptibility Reporting

Antimicrobial agents approved by FDA for routine testing and reporting by clinical microbiology laboratories for urinary tract isolates are listed as **group U** supplemental for urine only