# Urine Cultures – A Review

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# Agenda

URINE CULTURE BASICS

- The Urinary Tract
- Signs and Symptoms of Urinary Tract Infections
- Types of Urinary Tract Infections
- Urine Tests for the Detection of Infection
- Urine Culture Collection
- Urine Culture Workup

# URINE CULTURE BASICS

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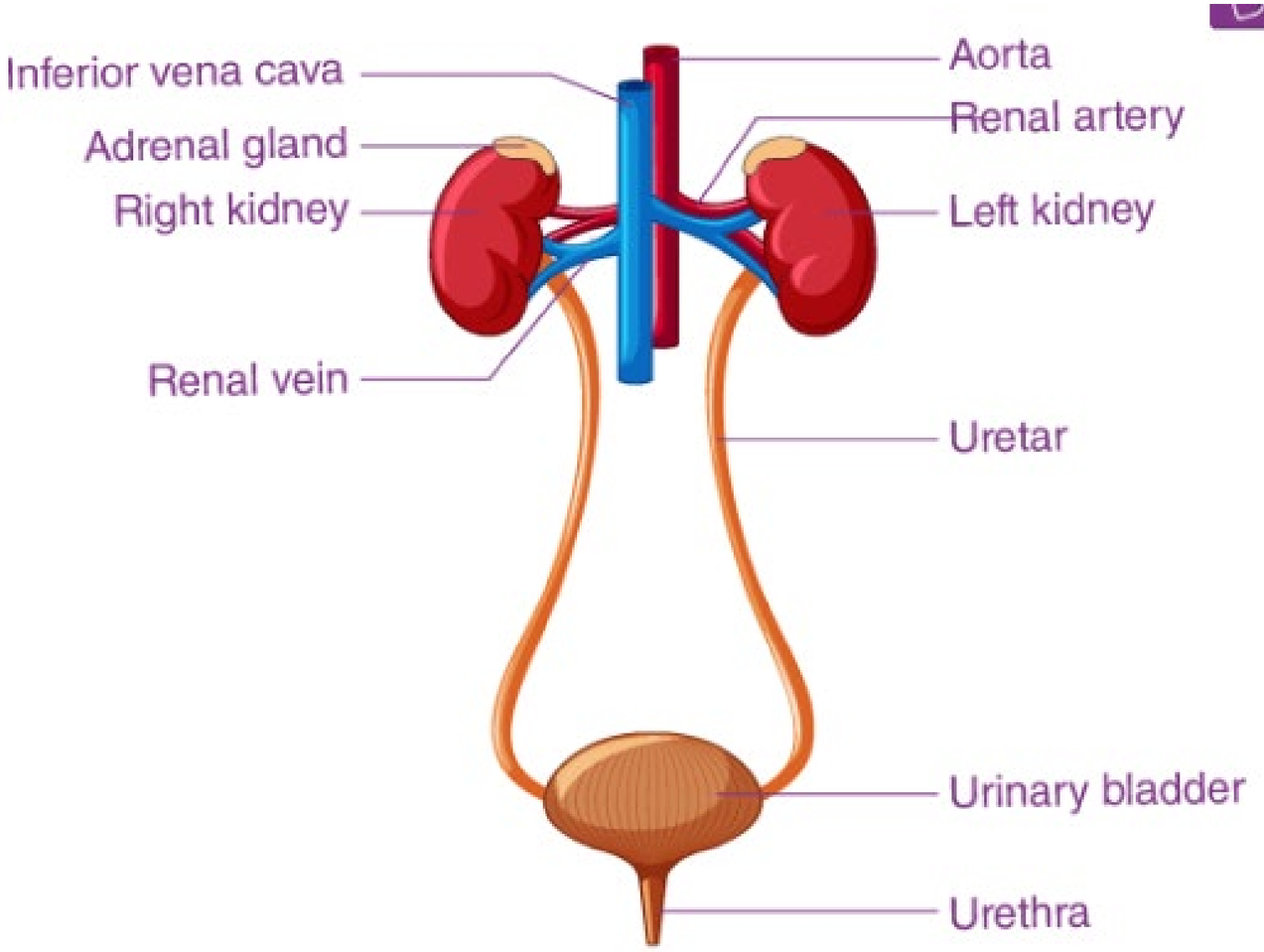
# The Urinary Tract

**Ascending**

**Descending**




**UPPER URINARY TRACT**

**LOWER URINARY TRACT**

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# Risk Factors for Urinary Tract Infections

- Anatomy – females have shorter urethras (easier to get bladder infections)
- Sexual activity (frequency and # of partners)
- Birth control methods
- Menopause (decrease in estrogen)
- Immunosuppression
- Blockage:  Kidney stones or an enlarged prostate – can trap urine in the bladder
- Catheter use
- Recent urinary tract procedure

# Signs and Symptoms of Urinary Tract Infection

- A strong urge to urinate that doesn't go away
- A burning feeling when urinating
- Urinating often, and passing small amounts of urine
- Cloudy urine
- Red, pink or cola-colored urine (indicates blood in urine
- Strong-smelling urine
- Pelvic pain (In women this may be centered in the area of the pubic bone – bladder)

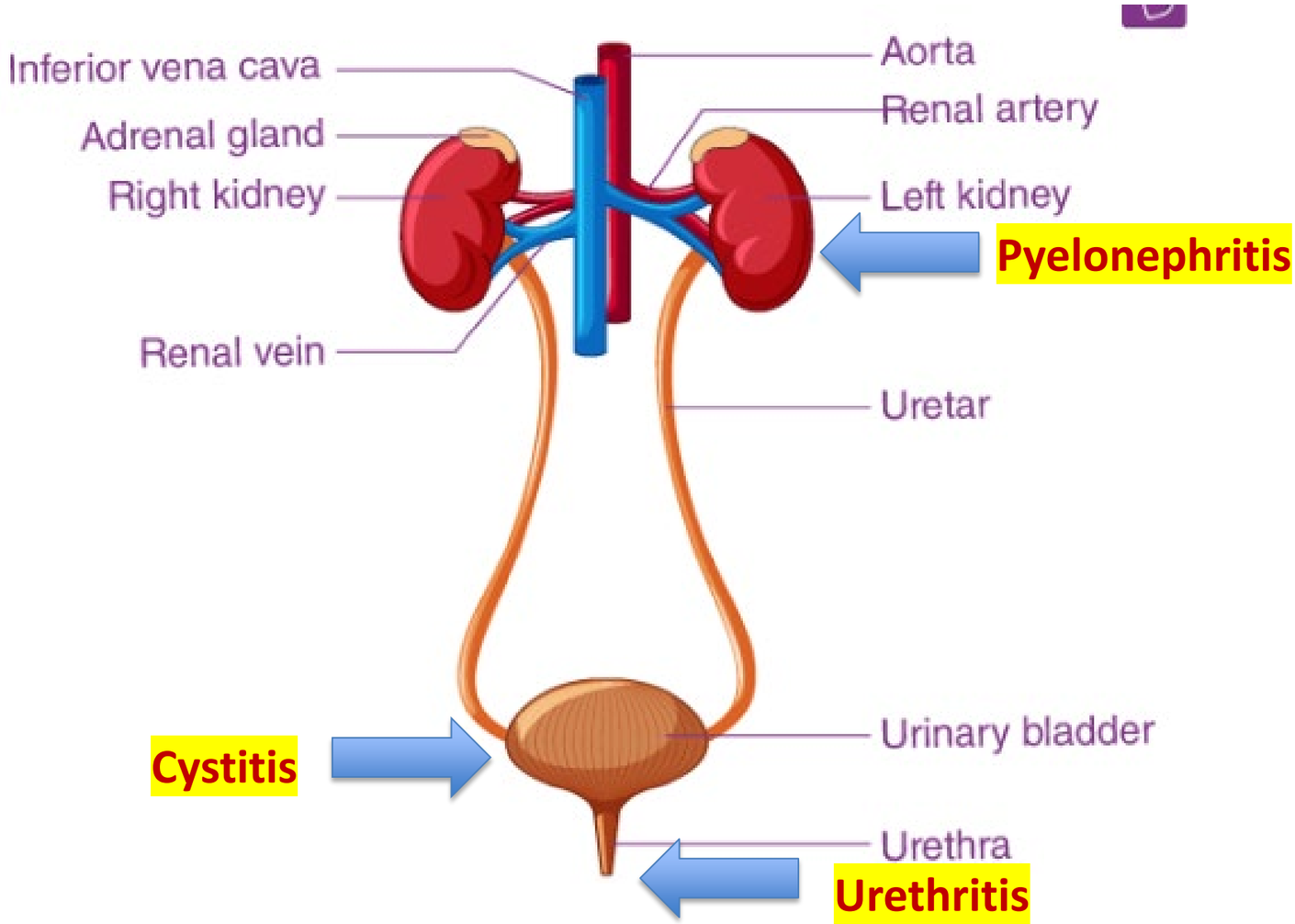
**NOTE:** Signs may vary based on the location of infection.

# Signs and Symptoms of Urinary Tract Infection

| KIDNEY | BLADDER | URETHRA |
|---|---|---|
| • High fever<br>• Chills<br>• Nausea<br>• Vomiting<br>• Back or side pain | • Blood in urine<br>• Frequent, painful urination<br>• Pelvic pressure<br>• Discomfort in the lower belly | • Burning with urination<br>• Discharge |

**NOTE: Some patients can present with an asymptomatic bacteriuria (bacteria in the urine)**

# Types of Urinary Tract Infections

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# Tests for Detection of Urinary Tract Infection

- Chemical Urinalysis –
  - Leukocyte esterase – detects the presence of WBCs (pyuria)
  - Nitrite – Product of bacterial nitrate reductase
  - Hemoglobin – blood in the urine
  - pH – Organisms that produce urease and/or cause kidney stones produce an Alkaline pH
- Microscopic Urinalysis –
  - Detects cells, crystals and bacteria
  - Squamous epithelial cells indicate contamination
- Routine Culture – may not detect some STI infectious agents
  - Chlamydia
  - Trichomonas
  - Mycoplasma/Ureaplasma
- PCR – Lab developed tests (LTD) designed to look for all possible agents

# Tests for Detection of Urinary Tract Infection

## URINE GRAM STAIN

- Use one 10 µL loopful of uncentrifuged urine
- WBCs may or may not be seen
- Threshold for detection for the gram stain approximates $10^5$ cfu/mL of urine (1 organism seen = 100,000 cfu/mL)
- May miss infection in symptomatic patients with colony counts below the threshold of detection

# KNOWLEDGE CHECK

Which of the following IS NOT a risk factor for urinary tract infection?

1. Normal female anatomy
2. Normal male anatomy
3. In and Out Catheterization
4. Enlarged prostrate

The urine gram stain prepared with a 10 uL calibrated inoculating loop will be negative if the culture colony count is 50,000 cfu/mL.

1. Yes
2. No

# KNOWLEDGE CHECK

Which of the following IS NOT a risk factor for urinary tract infection?

1. Normal female anatomy
2. **Normal male anatomy**
3. In and Out Catheterization
4. Enlarged prostrate

The urine gram stain prepared with a 10 uL calibrated inoculating loop will be negative if the culture colony count is 50,000 cfu/mL.

1. **True**
2. False

# KNOWLEDGE CHECK

Which of the following IS NOT a risk factor for urinary tract infection?

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2. **Normal male anatomy**
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The urine gram stain prepared with a 10 uL calibrated inoculating loop will be negative if the culture colony count is 50,000 cfu/mL.

1. **True**
2. False

# KNOWLEDGE CHECK

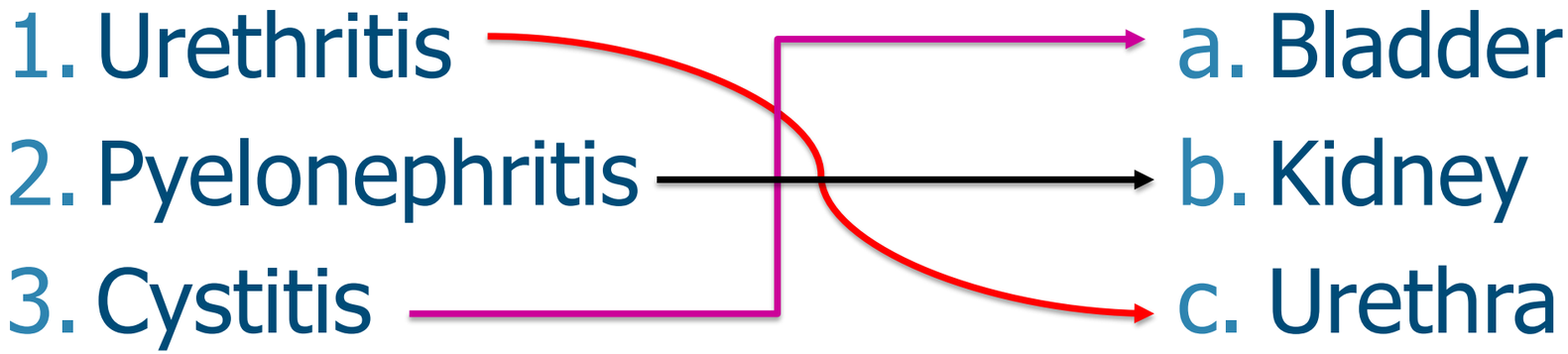
## *Match the type of infection with the location in the urinary tract*

1. Urethritis
2. Pyelonephritis
3. Cystitis

a. Bladder
b. Kidney
c. Urethra

# KNOWLEDGE CHECK

*Match the type of infection with the location in the urinary tract*



# URINE CULTURE COLLECTION

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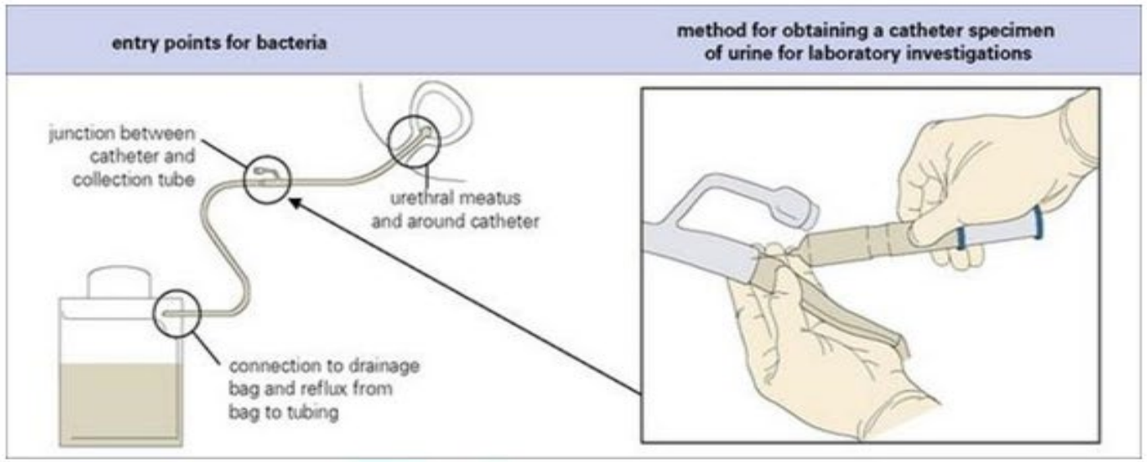
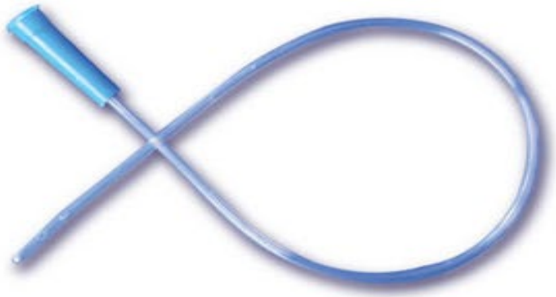
# Urine Specimen Collection







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# Urine Culture Specimen Types

**Can be colonized or have mixed flora**

- Clean Catch
- Indwelling Catheter
- Ileal Conduit
- Bag Urine
- Birth Defect Urine – usually involves obstruction in the urinary tract
- Urology Specimen

**Usually aseptically collected**

- Straight In & Out Catheter
- Bladder Aspirate
- Bladder Washout
- Cystoscopy
- Suprapubic Aspirate
- Know Kidney Transplant – *may have mixed flora as cause of infection*
- Renal Failure Patient – *may have mixed flora as cause of infection; need to determine cause of failure*

# Urine Specimen Collection

- **Randomly Collected Specimens** - **Not the specimen of choice** because of the potential for dilution of the specimen when collection occurs soon after the patient has consumed fluids.
- **First Morning Specimen -** Specimen of choice for urinalysis and microscopic analysis, since the urine is generally more concentrated.
- **Midstream Clean Catch Specimens** - **Strongly recommended for microbiological culture and antibiotic susceptibility testing** because of the reduced incidence of cellular and microbial contamination.
- **Timed Collection Specimens** - May be required for quantitative measurement of certain analytes, including those subject to diurnal variation. Analytes commonly tested using timed collection include creatinine, urea, potassium, sodium, uric acid, cortisol, calcium, citrate, amino acids, catecholamines, metanephrines, vanillylmandelic acid (VMA), 5-hydroxyindoleacetic acid, protein, oxalate, copper,17-ketosteroids, and 17-hydroxysteroids.

- **Collection from Catheters (e.g. Foley catheter) -** Use of a syringe, followed by transfer to a specimen tube or cup, or draw the urine directly from the catheter to an evacuated tube using an appropriate adaptor.
- **Supra-pubic Aspiration** - Used when a non-ambulatory patient cannot be catheterized or where there are concerns about obtaining a sterile specimen by conventional means.
- **Pediatric Specimens present many challenges.** For infants and small children, a special urine collection bag can be adhered to the skin surrounding the urethral area.
- **Post Prostate Massage -** May be collected to rule out *Trichomonas vaginalis* or *Neisseria gonorrhoeae* infections. **Specimens must be transported to the laboratory for immediate processing and should not be refrigerated.**

# Urine Collection Tubes

| | | |
|---|---|---|
| REJECT THIS TUBE FOR CULTURE  |  |  |
| **Tiger Top Urine Transport**<br>**Cellular integrity preservative with bacterial inhibitor** | **Yellow Top Urine Transport**<br>**No Additives** | **Grey Top Urine Transport**<br>**Boric Acid Preservative** |
| **For Urinalysis (UA) ONLY** | **Use for Random urine testing only** | **For Urine Culture (CX) ONLY** |
| ***Preserves urine for Urinalysis for up to 72 hours at room temp*** | • Microalbumin<br>• Creatinine<br>• Electrolytes<br>• Urine Drugs<br>• Other urine chemistry tests<br>• Urine pregnancy<br><br>**NOTE: May be used for urine culture when Grey Top (boric acid preservative) is not available (Perform Culture processing 1st)** | ***Preserves urine for Culture for up to 48 hours at room temp*** |

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# KNOWLEDGE CHECK

Which of the following specimens may yield mixed flora as a source of infection?

1. Straight catheter urine from a known kidney transplant patient
2. Urine from a pregnant mother on bed rest
3. Suprapubic urine collection from a patient with a birth defect obstruction of the urinary tract
4. Post prostatic massage urine

A tiger top urinalysis tube can be used for urine culture if the specimen is sampled before urinalysis is performed.

1. True
2. False

# KNOWLEDGE CHECK

Which of the following specimens may yield mixed flora as a source of infection?

1. **Straight catheter urine from a known kidney transplant patient**
2. Urine from a pregnant mother on bed rest
3. Suprapubic urine collection from a patient with a birth defect obstruction of the urinary tract
4. Post prostatic massage urine

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1. True
2. **False**

# URINE CULTURE WORKUP

# What Impacts Urine Culture Workup

- Prior Antibiotic Therapy
- Specimen Collection Method
- Specimen Preservation Method (Storage conditions or lack thereof)
- Specimen Processing – How soon and how
- Media
- Incubation
- Patient Demographics
- Colony Count
- **YOU – Skill, Commitment, Attitude, Mission Focus**

# PATIENT DEMOGRAPHICS COUNT!

| PATIENT TYPE | PATIENT AGE |
|---|---|
| Neonate | 0 – 4 weeks |
| Neonatal Intensive Care Unit Location (NNN) | Any Age |
| Infant | >4 weeks – 12 months |
| Child | 13 months – 12 years |
| Adolescent | 13 – 18 years |
| Adult | >18 years |

# Is it a Pathogen or a Contaminant?

| Common Urinary Pathogens Found in Urine Cultures | Common Bacterial Contaminants Found in Urine Cultures* |
|---|---|
| • *Escherichia coli*<br>• *Klebsiella species*<br>• *Enterococcus species*<br>• *Streptococcus agalactiae* (GBS)<br>• *Staphylococcus saprophyticus* (females)<br>*Pseudomonas aeruginosa*<br>• Yeasts | • *Lactobacillus species*<br>• *Corynebacterium species*<br>• Coagulase-negative staphylococci other than *Staphylococcus saprophyticus* |

***These organisms are not considered clinically relevant urine isolates for otherwise healthy individuals when isolated in low numbers.**

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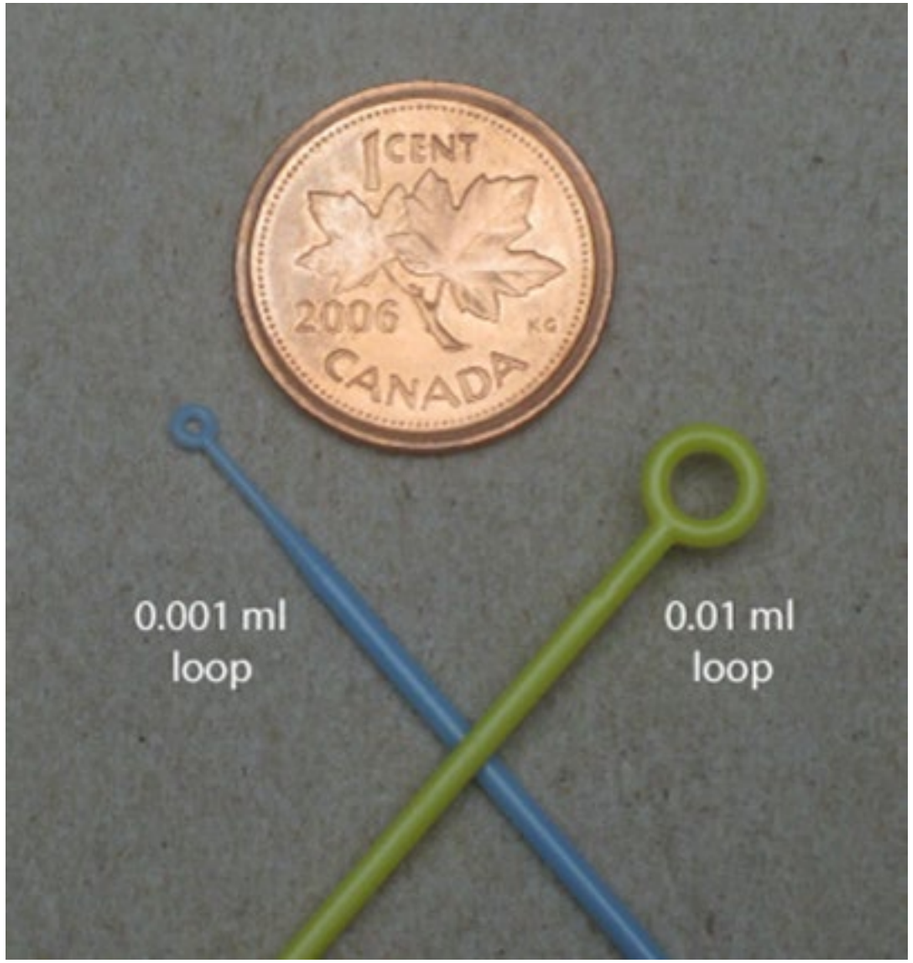
# To Work Up or Not to Work Up




- **The urine culture growth should be judged with the naked eye to determine the colony count**. If you cannot discriminate morphology easily, **the culture is "Young Growth".**
- **The loop makes the count.** Choose wisely according to specimen type and/or patient age.
- **Never determine the colony count from the bi-plate**. Use the blood agar plate for the colony count.

# Clean Catch Group Specimens

## Pediatric

- **1 – 2 colony types:** Perform ID/Sensitivity at ≥ $10^4$ cfu/ml
- **≥3 colony types or 1-2 contaminants ≥ $10^4$ cfu/ml** :
  Descriptive Id – Mixed
- **Pure culture of contaminant ≥ $10^4$ cfu/ml** : Descriptive ID with colony count
- **Neonates ≥3 colony types , any count:** Descriptive ID, telephone report of mixed culture to physician or nurse practitioner with consult for guidance

## Adult/Adolescent

- **1 – 2 colony types,<$10^4$ cfu/mL**: Descriptive ID in log with report of<$10^4$ cfu/mL
- **1 – 2 colony types,$10^4$– 49,000 cfu/mL**: Perform and report descriptive ID with colony count (i.e. 35,000 cfu/mL Alpha Streptococcus)
- **1 – 2 colony types:** Perform ID/Sensitivity at ≥ 50,000 cfu/ml
- **≥3 colony types, any count** : Perform descriptive ID in internal log and forward appropriate Mixed Culture report

# Bladder Group Specimens

## <1,000 cfu/mL

- **Pure culture of any uropathogen:** Perform ID/Sensitivity
- **1-2 colony types**: Perform descriptive ID only
- **≥3 colony types:** Contact physician and perform ID/Sensitivity based on physician's guidance (include statement of request and physician's name on the report

## ≥ 1,000 cfu/mL

- **Pure culture of any uropathogen:** Perform ID/Sensitivity
- **1 – 2 colony types:** Perform ID/Sensitivity
- **≥3 colony types:** Contact physician and perform ID/Sensitivity based on physician's guidance (include statement of request and physician's name on the report

# KNOWLEDGE CHECK

A 1 uL inoculating loop was used to plate a clean catch urine culture and yields 10 colonies on the blood agar plate of a pure gram-negative rod. What should you do next?

1. Perform a descriptive identification only of the gram-negative rod.
2. Check for a urinalysis WBC result before proceeding with workup
3. Perform full ID/Susceptibility testing
4. **Check the patient demographics.**

A 1 uL inoculating loop was used to plate a 16-year-old female's bladder urine culture. The culture yields 1 colony on the blood agar plate of a coagulase negative staphylococcus. What should you do next?

1. Report the staphylococcus as a contaminant.
2. Perform full ID/Susceptibility testing.
3. Report 1,000 cfu/mL Coagulase Negative Staphylococcus.
4. **Perform ID tests only.**

# Critical Values

- Initial positive neonatal urine cultures regardless of type
- Initial isolation or detection of any organisms from a known kidney transplant patient
- Different organisms isolated after the initial report

# What Would You Do?

| PATIENT | SCENARIO |
|---|---|
| Adult Male | Clean Catch - 24 hours = 50,000 cfu/mL mixed bacterial flora including 10,000 cfu/ml E. coli |
| Pregnant Female | Clean Catch - 24 hours = 100,000 cfu/mL mixed bacterial flora including 50,000 cfu/ml E. coli predominating |
| Adolescent Male | Clean Catch - 24 hours = 60,000 cfu/mL mixed flora |
| Neonate | Gram stain = 1 gram-negative rod seen<br>24 hours (0.01 uL loop) = 1 col mucoid Lactose Fermenting GNR |
| Child | Bag Urine - 24 hours = 8,000 cfu/ML E. coli |

# What Would You Do?

## ALWAYS CHECK PATIENT HISTORY

| PATIENT | SCENARIO |
|---|---|
| Adult Male | Clean Catch - 24 hours = 50,000 cfu/mL mixed bacterial flora including 10,000 cfu/ml E. coli – Mixed Bacterial Flora **FINAL** |
| Pregnant Female | Clean Catch - 24 hours = 100,000 cfu/mL mixed bacterial flora including 50,000 cfu/ml E. coli predominating – Check previous history for previous infection and treatment (Breakthrough?) and urinalysis for indicators of infection. Check tests to rule out GBS. Otherwise = Mixed culture **FINAL** |
| Adolescent Male | Clean Catch - 24 hours = 60,000 cfu/mL Mixed Flora **FINAL** |
| Neonate | **Gram stain = 1 gram-negative rod seen** – **CRITICAL VALUE**<br>24 hours (0.01 uL loop) = 1 col mucoid Lactose Fermenting GNR – 100 cfu/mL (Consult with physician to discuss possible inhibition of growth, need for workup and perform tests for identification and susceptibility if requested) |
| Child | Bag Urine - 24 hours = 8,000 cfu/ML E. coli - Check previous history for previous infection and treatment (Breakthrough?). **IF NONE,** <10,000 cfu/mL E. coli **FINAL** |