ANTIBIOTICS:
WHEN TO USE THEM
AND WHEN NOT TO

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DISCLOSURES

• **No conflict of interest**
OBJECTIVES

• **After this intervention, the participants will be able to:**

  • **Recognize the benefits versus risks of antibiotic therapy, including serious or potentially lethal adverse events**

  • **Identify and distinguish clinical scenarios when antibiotic’s use are needed and when they are not, using a case-based approach**
DO YOU NEED ANTIBIOTICS?

90% of GPs have felt under pressure from a patient to prescribe antibiotics.

70% of GPs prescribe antibiotics when they are unsure if they are treating a viral or bacterial infection.

49% of GPs prescribe antibiotics once a week or more without knowing whether they are medically necessary.

44% of GPs have prescribed antibiotics to get a patient to leave the surgery.
GLOBAL USE OF ANTIBIOTICS

• **Since their introduction into medicine in the 1940’s, antibiotics have been an essential tool for management of patients both in the outpatient and inpatient setting.**

• **Between 2000 and 2010, global antibiotic consumption increased by more than 30%**

• **It is estimated that half of the amount of antibiotics consumed is inappropriate.**
USA USE OF ANTIBIOTICS

Community Antibiotic Prescriptions per 1,000 Population by State - 2015

Each year 269.4 million antibiotic prescriptions are written in the United States; enough to give 4 out of every 5 people one prescription.

Data source: QuintilesIMS Xponent, 2015
Do antibiotics have side effects?

Anytime antibiotics are used, they can cause side effects. When antibiotics aren’t needed, they won’t help you, and the side effects could still hurt you. Common side effects of antibiotics can include:

- Rash
- Dizziness
- Nausea
- Yeast Infections
- Diarrhea

More serious side effects include *Clostridioides difficile* infection (also called C. difficile or C. diff), which causes diarrhea that can lead to severe colon damage and death. People can also have severe and life-threatening allergic reactions.

**Antibiotics save lives. When a patient needs antibiotics, the benefits outweigh the risks of side effects.**

To learn more about antibiotic prescribing and use, visit [www.cdc.gov/antibiotic-use](http://www.cdc.gov/antibiotic-use)
ALLERGIC REACTION

- **B lactam allergy**
- **Four categories of B lactam antibiotics:**
  - **Penicillins**
  - **Cephalosporins**
  - **Carbapenems**
  - **Monobactams – aztreonam**
- **Up to 10% of patients report allergy to penicillin**
- **85-90% of such patients can be shown to be non-allergic**
## Classification of Allergic Reactions

### Gell and Coombs classification of hypersensitivity

<table>
<thead>
<tr>
<th>Type</th>
<th>Mechanism</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>IgE</td>
<td>Anaphylaxis, asthma, hay fever, eczema, food allergies</td>
</tr>
<tr>
<td>II</td>
<td>Cytotoxic Ab</td>
<td>HTR by ABO incompatibility, HDN by Rh incompatibility</td>
</tr>
<tr>
<td>III</td>
<td>Immune complexes</td>
<td>Arthus phenomenon, serum sickness, rheumatoid arthritis</td>
</tr>
<tr>
<td>IV</td>
<td>Cell-mediated</td>
<td>Koch’s phenomenon, contact dermatitis</td>
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HTR= hemolytic transfusion reaction, HDN= hemolytic disease of the newborn
## HYPERSENSITIVITY REACTIONS

<table>
<thead>
<tr>
<th>Type of Reaction</th>
<th>Previously Sensitized Patients</th>
<th>Patients Not Previously Sensitized</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0-1 h</td>
<td>0-1 h</td>
</tr>
<tr>
<td>II</td>
<td>24-36 h</td>
<td>7-14 d</td>
</tr>
<tr>
<td>III</td>
<td>24-36 h</td>
<td>7-14 d</td>
</tr>
<tr>
<td>IV</td>
<td>48-96 h</td>
<td>14 d</td>
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TYPE I IMMEDIATE HYPERSENSITIVITY

- Reaction within one hour of ingestion
  - Urticarial rash, pruritus, flushing, angioedema, wheezing, gastrointestinal symptoms, hypotension, altered mental status, and anxiety
  - Neither fever nor elevation in C-reactive protein are seen
TYPE II, III, AND IV - DELAYED HYPERSENSITIVITY

- **Onset one hour or more after drug exposure**

- **Not mediated by IgE**
  - **Type II - Hemolytic anemia, neutropenia, thrombocytopenia**
  - **Type III -**
    - Serum sickness (fever, urticarial or purpuric rash, arthralgias, lymphadenopathy, and/or acute glomerulonephritis)
      - Antibiotics rarely cause classical serum sickness; however, they have been implicated in serum sickness like reactions (SSLR)
    - Vasculitis (palpable purpura and/or petechiae often involving the lower extremities, fever, urticaria, arthralgias, lymphadenopathy, elevated erythrocyte sedimentation rate, and low complement levels)
      - Penicillins, cephalosporins, and sulfonamides have been shown to cause vasculitis
  - **Drug fever**
    - Trimethoprim-sulfamethoxazole and minocycline have been a cause of drug fever
  - **Type IV - Contact dermatitis, morbilliform eruptions, Stevens-Johnson, toxic epidermal necrolysis (TEN), and drug-induced hypersensitivity syndrome (DIHS)**
SERUM SICKNESS – TYPE 3 HS

- FEVER
- URTICARIAL OR PURPURIC RASH
- ARTHRALGIAS
- LYMPHADENOPATHY, AND/OR
- ACUTE GLOMERULONEPHRITIS
SERUM SICKNESS–LIKE REACTIONS (SSLRS)

- Clinically resemble true serum sickness but are believed to be caused by different mechanisms
  - Generally less severe than classic serum sickness
  - Can include arthralgias, lymphadenopathy, and urticarial rash with and without fever
  - Not associated with immune complexes, vasculitis, nephritis, or hypocomplementemia
  - The most common antibiotics implicated in SSLR are amoxicillin and cefaclor, although other antibiotics such as trimethoprim-sulfamethoxazole have also been implicated
VASCULITIS

- Palpable purpura and/or petechiae often involving the lower extremities
- Fever
- Urticaria
- Arthralgias
- Lymphadenopathy
- Elevated erythrocyte sedimentation rate
- Low complement levels
Examples of urticarial skin lesions resulting from drug hypersensitivity. (Type 3 HS)

A. Localized raised erythematous papules with subtle or absent central pallor.

B. Extensive wheal and flare reaction with central blanching sharply circumscribed by and erythematous raised border.
## Type IV Hypersensitivity Reactions

<table>
<thead>
<tr>
<th><strong>Contact dermatitis</strong></th>
<th><strong>SJS and TEN</strong></th>
<th><strong>DRESS</strong></th>
</tr>
</thead>
</table>
| • reaction to topically applied medications characterized by erythema and edema with vesicles or bullae that often rupture and leave a crust | • serious cutaneous eruptions characterized by extensive exfoliation and mucosal membrane involvement  
• sulfonamides, tetracyclines, and dapsone  
• increased risk for SJS/TEN due to TMP-SMX has been reported in patients with HIV | • drug rash with eosinophilia and systemic symptoms  
• severe type IV hypersensitivity reaction characterized by fever, rash, and multiorgan failure with liver, kidneys, heart, and/or lungs most commonly affected |
STEVENS JOHNSON SYNDROME
• **History** – notoriously inaccurate most of the time

• **Evaluation should begin with a detailed history**
  - Source of the reported allergy history (patient, family member, healthcare professional)
  - How long ago was the reaction?
    - 80% of patients with IGE-mediated reactions lose their IGE-mediated penicillin sensitivity over 10 years
  - **Indication**
  - **Dose/Route of medication**
  - Signs/Symptoms experienced - anaphylaxis, angioedema, bronchospasm, or urticaria
  - The timing of onset of the reaction in relationship to the initiation of the medication
  - Whether or not the reaction necessitated hospitalization
  - Treatment(s) given for the reaction and response
  - Whether or not the patient has taken the medication again since the prior reaction
  - Whether or not any recurrent signs or symptoms occurred with subsequent drug exposure
  - Concurrent medications at the time that the reaction occurred and if any of these were newly started
DIAGNOSIS OF ALLERGY

• **Skin testing is next step in diagnostic process**

• **Only 10%–20% of patients reporting allergy to PCN are truly allergic**

• **Patients with positive skin test results should undergo desensitization**

• **Virtually all patients with negative penicillin skin tests results can take penicillin without serious sequelae**
Cephalosporins, carbapenems and monobactams may all cause allergic reactions to mechanisms similar to penicillins but cross reactivity is controversial.

Cross reactivity between cephalosporins and penicillin is higher in 1\textsuperscript{st} and 2\textsuperscript{nd} generation cephalosporins than with 3\textsuperscript{rd}, 4\textsuperscript{th}, and 5\textsuperscript{th} generation (ceftriaxone, cefepime, ceftaroline).

Cross reactivity of penicillins and carbapenems estimated 10%.
ANAPHYLAXIS

• Respiration failure followed by cardiovascular compromise
  • Maintenance of the airway and cardiovascular system comprise the critical foundation of management
  • Epinephrine should be administered immediately
  • Fluid resuscitation and vasopressor infusion if needed
  • Antihistamines
  • Corticosteroids
DESENSITIZATION

• Classical desensitization protocols are designed to treat type 1 (IGE–mediated) mast cell reactions

• It is critical to note that this procedure does not eliminate the IGE-mediated drug sensitivity; rather, it desensitizes the individual to allow him/her to receive the therapeutic course safely
RED MAN SYNDROME

- **Pseudoallergic reaction** that does not involve antibodies and results from direct stimulation of mast cells with severe reactions including hypotension and muscle spasm.

- **Histamine-mediated flushing** during or immediately following vancomycin infusion:
  - Flushing usually involves the face and neck but can involve the entire body.

- Incidence related to the rate of infusion.

**Treatment:**
- Prolonging infusion time (drug rate no more than 500 mg/hr).
- Antihistamines administration (prior to or during infusion).
DRUG INDUCED PHOTOSENSITIVITY

- Development of a cutaneous disease due to exposure to a chemical agent and sunlight
- Affected areas are face, neck, forearms and hands
- Sparring of non-sun exposed areas
- Pruritic eczematous eruption of photoallergy
  - Type IV hypersensitivity reaction
  - 24 hours or more after initial exposure
  - Dermatitis that may extend beyond area of sun exposed skin
  - Usually resolved after discontinuation of medication
DRUG INDUCED PHOTOREACTION

• **Exaggerated sunburn eruption of phototoxicity**
  - Minutes to hours after sun exposure
  - Associated burning and itching on sun-exposed areas

• **If patient cannot discontinue the offending agent, topical steroids, sunscreen and protective clothing can be used to minimize effects**
PHOTOSENSITIVITY

- May last for several days after last dose of the drug
- Tetracyclines – minocycline
- Trimethoprim-sulfamethoxazole
- Fluoroquinolones
- Ceftazidime – increased susceptibility to sunburn
- Cefotaxime – photodisturbed telangiectasia
QTC INTERVAL PROLONGATION

**QT INTERVAL**

- QT interval – measure of time between the start of the Q wave and the end of the T wave in the heart’s electrical cycle (electrical depolarization and repolarization of the ventricles)

- Lengthened QT interval is a marker for the potential of ventricular arrhythmias such as torsades de pointes
  - Risk factor for sudden death
QTC INTERVAL PROLONGATION

**Risk Factors**

- **Female Sex**
- **Bradycardia**
- **PVC's**
- **CHF**
- **Older Age**
- **Hypokalemia**
- **Hypomagnesemia**
- **Family History of Arrhythmia or Sudden Death**

  - **Use of Stimulant Drugs** – Dopamine, Epinephrine, Albuterol
  - **Use of Antiarrhythmics** – Amiodarone, Disopyramide, Dofetilide, Flecainide, Quinidine, Quinine, Sotalol
  - **Anti-infective Agents** –
    - Azoles (Fluconazole, Ketoconazole)
    - Fluoroquinolones (Ciprofloxacin, Levofloxacin, Moxifloxacin)
    - Macrolides (Erythromycin, Clarithromycin, Azithromycin)
    - Antimalarials
    - Pentamidine
# QTC INTERVAL PROLONGATION

<table>
<thead>
<tr>
<th>Avoid use of drugs known to prolong QTc interval</th>
<th>Take family history</th>
<th>EKG prior to starting treatment</th>
<th>When in need of using an anti-infective known to prolong QTc</th>
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</table>
| • Look for treatment alternatives               | • Sudden death episodes | • If baseline QTC borderline or prolonged - evaluate for hypokalemia, hypomagnesemia, CHF, and presence of another drug known to prolong QTc | • Monitor with EKG  
• Reduce dose or discontinue if QTc increases by 60 ms or exceeds 500 ms |

- Avoid use of drugs known to prolong QTc interval
  - Look for treatment alternatives

- Take family history
  - Sudden death episodes

- EKG prior to starting treatment
  - If baseline QTC borderline or prolonged - evaluate for hypokalemia, hypomagnesemia, CHF, and presence of another drug known to prolong QTc

- When in need of using an anti-infective known to prolong QTc
  - Monitor with EKG
  - Reduce dose or discontinue if QTc increases by 60 ms or exceeds 500 ms
When Can Antibiotics Cause Diarrhea?

- More than one antibiotic is prescribed
- An antibiotic is used for an extended period of time
- An antibiotic is taken at a higher dose
- A powerful, broad-spectrum antibiotic is used
CLOSTRIDIODES DIFFICILE ASSOCIATED DIARRHEA

Gram positive anaerobic bacilli that forms spores

Disturbance of the normal bacterial flora of the colon, overgrowth and colonization by C. difficile, and the release of toxins that cause mucosal inflammation and damage

Antibiotic therapy is the key factor that alters the colonic flora

• most commonly implicated agents include the cephalosporins (especially second and third generation), the fluoroquinolones, ampicillin/amoxicillin, and clindamycin

Occurs primarily in inpatient setting

Most patients develop diarrhea during or shortly after starting antibiotics, however, 25-40% of patients may not become symptomatic for as many as 10 weeks after completing antibiotic therapy

3 million cases in US yearly with increasing incidence
C difficile forms heat-resistant spores that can persist in the environment for several months to years.

Outbreaks of C difficile diarrhea may occur in hospitals and outpatient facilities where contamination with spores is prevalent.

Although normal gut flora resists colonization and overgrowth with C difficile, the use of antibiotics, which alter and suppress the normal flora, allows proliferation and toxin production.
CLOSTRIDIIOIDES DIFFICILE

- **Even brief exposure to any single antibiotic can cause C. difficile colitis**
- **Prolonged antibiotic course or the use of 2 or more antibiotics increases the risk of disease**
- **Antibiotics traditionally used to treat C. difficile, vancomycin and metronidazole, have also been shown to cause disease**
- **Hospitalized patients who occupy a bed whose previous occupant received antibiotics appear to have an increased risk of C. difficile infection**
- **Possible association with use of proton pump inhibitors**
- **Two related studies documented an increased risk of CDI in adults taking the antidepressants mirtazapine and fluoxetine**
**Pathophysiology of Clostridiodoides difficile associated diarrhea**

- **Pathogenic strains of** *C. difficile* **produce 2 distinct toxins** – high molecular weight proteins capable of binding to specific receptors on the intestinal mucosal cells
  - **Toxin A (enterotoxin)**
  - **Toxin B (cytotoxin)**
- **Both appear to play a role in the pathogenesis of** *C. difficile* **colitis in humans**
When to Suspect C. Diff?

- Patient with diarrhea who:
  - Has received antibiotics within the previous 3 months,
  - Has been recently hospitalized, and/or
  - Has an occurrence of diarrhea 48 hours or more after hospitalization
**CDAD CLINICAL PRESENTATION**

**SYMPTOMS OF *C. DIFFICILE* COLITIS OFTEN INCLUDE THE FOLLOWING:**

- Mild to moderate watery diarrhea that is rarely bloody
- Cramping abdominal pain
- Anorexia
- Malaise

**PHYSICAL EXAMINATION MAY REVEAL THE FOLLOWING:**

- Fever - especially in more severe cases
- Dehydration
- Lower abdominal tenderness
- Rebound tenderness - raises the possibility of colonic perforation and peritonitis
CLOSTRIDIOIDES DIFFICILE ASSOCIATED DIARRHEA

• *C. difficile* colitis is currently one of the most common nosocomial infections.

• Approximately 20% of individuals who are hospitalized become colonized with *C. difficile* during hospitalization, and more than 30% of these patients develop diarrhea.

• Relapse anticipated in 10-20% of patients.

• Avoid antiperistaltic medicine during acute phase.

• If possible, discontinue offending antibiotic, hydrate, and place in enteric isolation.
CLOSTRIDIOIDES DIFFICILE ASSOCIATED DIARRHEA

- **Wide spectrum of clinical conditions:**
  - Asymptomatic carrier state
  - Mild, self-limited diarrhea
  - Pseudomembranous colitis
  - Fulminant colitis – toxic megacolon and perforation
  - Acute toxic colitis with dilatation of the colon - dilated colon on plain radiograph of the abdomen
Real-time polymerase chain reaction (PCR) assay (sensitivity, 86%; specificity, 97%)

Stool cytotoxin test - positive test result is the demonstration of a cytopathic effect that is neutralized by a specific antiserum (sensitivity, 70-100%; specificity, 90-100%)

EIA for detecting toxins A and B – used in most laboratories (moderate sensitivity, 79-80%; excellent specificity, 98%)
DIAGNOSTIC TESTS FOR C. DIFF COLITIS

- **Abdominal computed tomography (CT) scanning** is the imaging modality of choice for *C. difficile* colitis when *C. difficile* colitis, pseudomembranous colitis, complications of CDI such as perforation, or other intra-abdominal pathology is suspected.
DIAGNOSTIC TESTS FOR C. DIFF

- Colonoscopy - less sensitive for diagnosing C. difficile than stool assays
  - May demonstrate the presence of raised, yellowish white, 2- to 10-mm plaques overlying an erythematous and edematous mucosa - pseudomembranes
  - Endoscopic findings may be normal in patients with mild disease or may demonstrate nonspecific colitis in moderate cases

Classic pseudomembranes are visible as raised, yellow plaques ranging from 2 to 10 mm in diameter and scattered over the colorectal mucosa

Courtesy of Gregory Ginsberg, MD, University of Pennsylvania.
CLOSTRIDIUM DIFFICILE ASSOCIATED DIARRHEA

Mild to moderate disease
- WBC <15,000
- No increase in serum creatinine

Severe disease
- WBC >15,000
- ≥50% increase in serum creatinine
- Zar score ≥ 2
  - Age > 60 (one point)
  - Body temperature > 38.3°C (one point)
  - Albumin < 2.5g (1 point)
  - WBC > 15,000 (1 point)
  - Endoscopic evidence of pseudomembranous colitis (2 points)
  - Admission to ICU (2 points)
CLOSTRIDIODES DIFFICILE ASSOCIATED DIARRHEA

- Once infected with *C. difficile*, the rate of disease recurrence is 20-40%, especially when first-line agents such as metronidazole and vancomycin are not successful.
- In patients with CDI who develop fulminant colitis, early surgical intervention is crucial.
- The use of oral metronidazole or vancomycin produces response rates of greater than 95% in mild to moderate cases; with symptomatic improvement (diarrhea) in as little as 3-4 days and complete resolution in 7-10 days.
- Patients who relapse once are at an even greater risk for further relapses.
  - Relapse rate for patients with 2 or more relapses is 65%.
CLOSTRIDIODES DIFFICILE ASSOCIATED DIARRHEA

Mild disease
- Vancomycin 125 mg PO QID for 10 days
- Metronidazole 500 mg PO TID in resource constrained settings (limited access to vancomycin)

More severe disease
- Vancomycin 125 mg PO QID for 10 days OR
- Fidaxomicin 200 mg PO BID for 10 days (expensive)

Severe disease
- Metronidazole 500 mg IV q6h + Vancomycin 500 mg PO or via nasogastric tube q6h ± retention enema of Vancomycin 500 mg in 100 mL
- Vancomycin/metronidazole combination associated with decrease in mortality from 36 to 16%

Severe disease with toxic megacolon
- Treatment as above PLUS
  - Colectomy
  - Loop ileostomy with irrigation of colon with v + IV metronidazole
CLOSTRIDIODES DIFFICILE ASSOCIATED DIARRHEA

**Treatment Failure**
- **First relapse – repeat course of Vancomycin 125 mg PO qid for 10 days**
- **Second relapse - vancomycin taper**
  - 125 mg PO QID for 10 days, followed by 125 mg PO tid for one wk,
  - then 125 mg PO bid for one wk,
  - then 125 mg daily for one wk,
  - then 125 mg Q48 for one wk,
  - then 125mg once every third day for one wk
- **Fecal microbiota transplantation emerging as treatment of choice for recurrent infections**
- **A retrospective study of oral vancomycin in patients with recurrent C. Diff while they were receiving systemic antibiotics found reduced incidence of recurrence (4.2% vs 26.6%)**

INFECTION CONTROL MEASURES FOR CDAD

• Hand washing with soap and water is more effective for removal of spores than alcohol based hand hygiene

• Insufficient data to recommend use of probiotics for primary prevention of C. diff

C. difficile requires special care

- C. difficile forms spores that are not killed by alcohol-based hand sanitizer.
- Always use gloves when caring for patients with C. difficile. In addition, when there is an outbreak of C. difficile in your facility, wash your hands with soap and water after removing your gloves.

Protect Yourself. Protect Your Patients.

Who do your #CLEANHANDSCOUNT for?

www.cdc.gov/HandHygiene

This material was developed by CDC. The Clean Hands Count Campaign is made possible by a partnership between the CDC Foundation and GOJO.
Clostridioides difficile (C. difficile) bacteria can cause life-threatening diarrhea. Infections occur most often in people who have taken antibiotics for other conditions. It is the most common healthcare-associated infection.

**WHAT YOU NEED TO KNOW**

- While healthcare-associated C. difficile cases are decreasing, community-associated cases are not.
- Strategies to reduce C. difficile infections include improving antibiotic use, infection control, and healthcare facility cleaning and disinfection.
- C. difficile infections are more common and tend to be more severe in older patients.

Previously Clostridium difficile. Also called C. diff. Cost includes hospital-onset cases only.

**CASES OVER TIME**

Continued appropriate infection control, antibiotic use, and diagnostic testing are important to maintain decreases in C. difficile cases.
CLOSTRIDIODES DIFFICILE

WHERE INFECTIONS HAPPEN

*C. difficile* infection affects thousands of people every year. It is rarely resistant to antibiotics; however, *C. difficile* usually occurs in people who have taken antibiotics. Improving antibiotic use is an important strategy to reduce these infections. Antibiotics disrupt (unbalance) our microbiome (a community of germs). A common strain of *C. difficile* (ribotype 027) that can cause more serious disease can be associated with use of certain antibiotics, such as fluoroquinolones.

More than half of *C. difficile* cases among long-term care facility residents happen in those who were recently hospitalized. However, from 2011 to 2015, sites within CDC’s Emerging Infections Program saw a decrease in *C. difficile* cases in people 65 years or older in long-term care facilities. During this same time, there were declines in hospital fluoroquinolone antibiotic use and *C. difficile* ribotype 027 among people 65 years or older. Improving antibiotic use may have contributed to the decrease in *C. difficile* cases.

C. DIFFICILE CASES

Improving antibiotic use may have contributed to the decrease in long-term care facility-onset *C. difficile* cases in 10 U.S. sites.

![Graph showing the decrease in C. difficile cases](graph.png)

Adjusted cases for sex, race, and the percent of cases diagnosed by nucleic acid amplification test.

ONLINE RESOURCES

About *C. difficile* Infections
www.cdc.gov/cdiff/index.html

Tracking *C. difficile* Infections
www.cdc.gov/hai/eip/cdiff-tracking.html

This fact sheet is part of CDC’s 2019 Antibiotic Resistance Threats Report. The full report, including data sources, is available at www.cdc.gov/DrugResistance/Biggest-Threats.html.
RENAL TOXICITY

Nephrotoxicity is defined as \( \geq 50\% \) increase over baseline Serum Creatinine or a 50% decrease in Creatinine Clearance from baseline.

Most common antibiotics implicated in causing nephrotoxicity are vancomycin and aminoglycosides (gentamicin, amikacin, tobramycin are most commonly used).

Vancomycin is a glycopeptide antibiotic that is active against Gram-positive bacteria, including methicillin-resistant Staphylococcus aureus.

Nephrotoxicity is most serious common adverse effect.
VANCOMYCIN INDUCED NEPHROTOXICITY

**Associated risk factors:**

- **The dose and duration of vancomycin therapy**
- **High trough vancomycin level (>20 mg/L)** - Contemporary guidelines which were updated in 2020 recommend targeting vancomycin trough concentrations of ≥10 mg/L to prevent resistance and AUC24 dosing (Area under the serum concentration vs time curve for 24 hours)*
  - Trough levels of 15–20 mg/L is less preferred method due to nephrotoxicity
- **High doses (>4 g/day)**
- **Treatment with concomitant nephrotoxic agents**
- **Prolonged therapy (>7 days)**
- **Prolonged ICU stay**
- **Greater patient weight**
- **Preexisting renal impairment**

*Clin Infect Dis 2020, 70:1536.*
AVOIDING NEPHROTOXICITY WHILE USING VANCOMYCIN

- **Vancomycin induced nephrotoxicity expected to be reversible in the majority of patients after antibiotic is discontinued**

- **Initial doses should be based on actual body weight, including obese patients**

- **Subsequent doses should be adjusted, as needed, to achieve target AUC24 serum levels of 400-600 mg/mL x hr**
  - **Allow 24-48 hours to achieve steady state, then measure peak and trough levels**
  - **Calculate AUC24 based on measured peak and trough levels**

- **Several methods for calculation of AUC24**
  - **Vancomycin AUC dosing calculator**
  - **Bayesian (software)**
AMINOGLYCOSIDE INDUCED NEPHROTOXICITY

- The successful and continuing use of AGs can be attributed to various factors including a rapid concentration-dependent bactericidal effect, synergism with β-lactam antibiotics, a low rate of true resistance and a low cost.

- Mainly used for management of severe infections.

- The reported incidence of functional renal impairment related to AG therapy ranges between 8 to 30%.

- Nephrotoxicity induced by aminoglycosides manifests clinically as nonoliguric renal failure, with a slow rise in serum creatinine and a hypoosmolar urinary output developing after several days of treatment.

- Progression to oliguric or anuric renal failure is infrequent, and recovery upon drug discontinuation is most often observed.

- Once daily dosing - administration of the daily dose of gentamicin as a single dose (thus creating one high daily peak level) has been demonstrated to be less toxic than administration of the same daily dose divided into three doses per day or by continuous infusion.

- Serum levels may help in dosing adjustment to prevent adverse effects.
OTOTOXICITY

- Possible side effect of amino glycoside therapy
- Irreversible
- Periodic assessments of renal function and of amino glycoside levels in the serum are essential to guide therapy
46 y/o male with GERD s/p endoscopy with positive biopsy for *Helicobacter pylori* was prescribed a 4 drug regimen containing metronidazole.

Took medications as prescribed for 10 days, avoiding alcohol consumption.

One day after treatment ended, patient went to a bar with some friends to celebrate that he had successfully completed medication course.

Several hours afterwards he developed flushing of his face, general malaise, fatigue, and abdominal discomfort.
WHAT IS THE DIAGNOSIS?

DISULFIRAM-LIKE REACTION

• Ethanol intolerance due to accumulation of acetaldehyde 2ry to inhibition of the hepatic aldehyde dehydrogenases

• Severe flushing, tachycardia, respiratory distress, chest pain, hypotension, nausea, vomiting, headache, sweating, thirst, vertigo and confusion

• Associated with metronidazole intake

• Patients should be advised to avoid alcohol consumption while on metronidazole and 24 hours after completion of treatment
II. ANTIBIOTICS: YES OR NO?

Do I really need antibiotics?

**SAY YES TO ANTIBIOTICS**
when needed for certain infections caused by **bacteria**.

**SAY NO TO ANTIBIOTICS**
for **viruses**, such as colds and flu, or runny noses, even if the mucus is thick, yellow or green. Antibiotics also won’t help for some common bacterial infections including most cases of bronchitis, many sinus infections, and some ear infections.

Antibiotics are only needed for treating certain infections caused by bacteria. Antibiotics do NOT work on viruses.

To learn more about antibiotic prescribing and use, visit [www.cdc.gov/antibiotic-use](http://www.cdc.gov/antibiotic-use)
Cómo tomar los antibióticos

Después de haber comprado antibióticos con su receta médica...

LEA ESTA INFORMACIÓN IMPORTANTE.

☐ Tome el medicamento exactamente como se lo indique el profesional de atención médica.

☐ No se salte ninguna dosis.

☐ No lo comparta con nadie.

☐ No lo guarde para usarlo en el futuro. Consulte al farmacéutico sobre cómo desechar de forma segura los medicamentos que sobren.

¿POR QUÉ ES TAN IMPORTANTE ESTA LISTA DE VERIFICACIÓN?

Todos los medicamentos pueden tener efectos secundarios. Los antibióticos salvan vidas, y cuando un paciente necesita este tipo de medicamentos, los beneficios superan los riesgos de los efectos secundarios. Puede protegerse usted y a otros al aprender cuándo los antibióticos son necesarios o no.

Si tiene preguntas sobre los antibióticos, consulte a un profesional de atención médica.


Taking Your Antibiotics

You have just filled a prescription for antibiotics.

READ AND FOLLOW THIS IMPORTANT INFORMATION.

☐ Take your antibiotic as prescribed by your healthcare professional.

☐ Do not share it with others.

☐ Talk to your pharmacist about safely discarding leftover medicines.

WHY IS THIS CHECKLIST SO IMPORTANT?

All medicines have side effects. Common side effects of antibiotics can include:

- Rash
- Dizziness
- Nausea
- Yeast Infection
- Diarrhea

More serious side effects include:

- Severe diarrhea, which could be a C. diff infection and needs immediate treatment.
- Severe and life-threatening allergic reactions, such as wheezing, hives, shortness of breath, and anaphylaxis (which also includes feeling that your throat is closing or choking, or your voice is changing).

Antibiotics can save lives. **When you need an antibiotic, the benefits outweigh the risks of side effects.** Talk with your healthcare professional if you have questions about your antibiotics, including interactions with other medications, or if you develop side effects.

1 out of 5 medication-related visits to the emergency room are from reactions to antibiotics.

To learn more about antibiotic prescribing and use, visit www.cdc.gov/antibiotic-use or call 1-800-CDC-INFO.
Viruses or Bacteria
What’s got you sick?

Antibiotics are only needed for treating certain infections caused by bacteria. Viral illnesses cannot be treated with antibiotics. When an antibiotic is not prescribed, ask your healthcare professional for tips on how to relieve symptoms and feel better.

<table>
<thead>
<tr>
<th>Common Condition</th>
<th>Common Cause</th>
<th>Are Antibiotics Needed?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bacteria</td>
<td>Virus</td>
</tr>
<tr>
<td>Strep throat</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Whooping cough</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Sinus infection</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Middle ear infection</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Bronchitis/chest cold</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Bronchitis/chest cold</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Common cold/runny nose</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Sore throat (except strep)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Flu</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

* Studies show that in otherwise healthy children and adults, antibiotics for bronchitis won’t help you feel better.

To learn more about antibiotic prescribing and use, visit www.cdc.gov/antibiotic-use.
What Is Watchful Waiting?

WAIT. DO NOT FILL YOUR PRESCRIPTION JUST YET.

Your healthcare professional believes your illness may go away on its own.
You should watch and wait for ___ days/hours before deciding whether to take
an antibiotic.

In the meantime, follow your healthcare professional's recommendations to help you
feel better and continue to monitor your own symptoms over the next few days.

- Rest.
- Drink extra water and fluids.
- Use a cool mist vaporizer or saline nasal spray to relieve congestion.
- For sore throats in adults and older children, try ice chips, sore throat spray, or
  lozenges.
- Use honey to relieve cough. Do not give honey to an infant younger than 1.

If you feel better, no further action is necessary. You don't need antibiotics.
If you do not feel better, experience new symptoms, or have other concerns, call
your healthcare professional _________________. Discuss whether you need a
recheck or antibiotics.

It may not be convenient to visit your healthcare professional multiple times, but
it is critical to take antibiotics only when needed. When antibiotics aren’t needed,
they won’t help you and the side effects could still hurt you. Common side effects
of antibiotics can include rash, dizziness, nausea, diarrhea, and yeast infections.

Antibiotics save lives, and when a patient needs antibiotics, the benefits outweigh
the risks of side effects. You can protect yourself and others by learning when antibiotics
are and are not needed.

To learn more about antibiotic prescribing and use, visit
www.cdc.gov/antibiotic-use.
Can I feel better without antibiotics?

Respiratory viruses usually go away in a week or two without treatment. To stay healthy and keep others healthy, you can:

- **Clean Hands**
- **Cover Coughs**
- **Stay Home When Sick**
- **Get Recommended Vaccines**

To learn more about antibiotic prescribing and use, visit [www.cdc.gov/antibiotic-use](http://www.cdc.gov/antibiotic-use).
A 78-year-old woman undergoes routine evaluation. She has been feeling relatively well but experiences occasional urinary incontinence when she coughs, sneezes, or laughs. Medical history is significant for hypertension. Medications are chlorthalidone and lisinopril.

On physical examination, vital signs and other physical examination findings are normal.

On dipstick urinalysis, urine is yellow and clear, specific gravity is 1.010, pH is 7.0, and moderate leukocyte esterase and nitrites are present; the urinalysis is negative for blood or glucose but 2+ for bacteria.
Which of the following is the most appropriate management?

A. Ciprofloxacin

B. Cystoscopy

C. Microscopic urinalysis

D. Urine culture and sensitivity

E. No further investigation or treatment
Key Point
No treatment is indicated for asymptomatic bacteriuria in otherwise healthy, nonpregnant patients.

• No treatment or further investigation is indicated in this asymptomatic older woman who has bacteriuria discovered on a routine dipstick urinalysis. Although commonly performed, analysis of the urine is not warranted, except when evaluating a patient who presents with clear signs or symptoms of a urinary tract infection (UTI), and may lead to unnecessary administration of antibiotics. Incontinence without urgency or dysuria is not unexpected in many older women.

• Prevalence of asymptomatic bacteriuria (ASB) is:
  • as low as 1% to 5% in healthy premenopausal women (2%-10% in pregnant women)
  • up to 100% in patients with long-term indwelling urinary catheters
  • most ASB occurs in older adult women and men, with a respective prevalence of
    • 11% to 16% and 4% to 19% in the community,
    • increasing to 25% to 50% and 15% to 40% in long-term care facilities.
MANAGE ASYMPTOMATIC BACTERIURIA.

Key Point
No treatment is indicated for asymptomatic bacteriuria in otherwise healthy, nonpregnant patients.

- **Except in specific patient groups,** well-designed studies have proven that although persons with bacteriuria are at increased risk for symptomatic UTIs, ASB treatment does not decrease the frequency of symptomatic infections or improve other outcomes.

- **ASB is associated with a higher prevalence of potentially dangerous antibiotic-resistant strains in women who progress to an active UTI.**

- **Except in pregnant women,** who have a known increased prevalence of ASB, which has been demonstrated to lead to serious complications, routine screening for infection in women without symptoms is unwarranted.

- **Screening and treatment are also indicated before invasive urologic procedures.**

- **The presence of pyuria accompanying ASB is not an indication for antimicrobial treatment.**
VIGNETTE 3

• A 30-YEAR-OLD WOMAN IS EVALUATED FOR A 2-DAY HISTORY OF SORE THROAT AND FATIGUE. SHE REPORTS ANOREXIA, CHILLS, FEVER, RHINORRHEA, AND A DRY PERSISTENT COUGH THAT KEEPS HER AWAKE AT NIGHT. SHE WORKS AS A SCHOOL BUS DRIVER. SHE HAS TRIED OVER-THE-COUNTER COUGH AND COLD PRODUCTS WITHOUT BENEFIT. MEDICAL HISTORY IS UNREMARKABLE, AND SHE TAKES NO MEDICATIONS.

• ON PHYSICAL EXAMINATION, TEMPERATURE IS 37.2 °C (99.0 °F); ALL OTHER VITAL SIGNS ARE NORMAL. SHE HAS NASAL AND PHARYNGEAL ERYTHEMA WITH SPARSE WHITISH EXUDATE. THERE IS NO LYMPHADENOPATHY OR RASH. THE REMAINDER OF THE EXAMINATION IS NORMAL.
Which of the following is the most appropriate management?

A. Amoxicillin

B. Streptococcal rapid antigen detection test

C. Symptom control

D. Throat culture
TREAT VIRAL PHARYNGITIS WITH SYMPTOM CONTROL.

Key Point
Hallmark signs of viral pharyngitis include conjunctivitis, cough, nasal congestion, and rhinorrhea; viral pharyngitis should be treated symptomatically.

• THE MOST APPROPRIATE MANAGEMENT OF THIS PATIENT WITH PHARYNGITIS IS SYMPTOM CONTROL THAT MIGHT INCLUDE AN ANALGESIC AGENT (SUCH AS AN NSAID OR ACETAMINOPHEN), LOZENGES OR TOPICAL SPRAYS, AND INCREASED ENVIRONMENTAL HUMIDITY.

• PHARYNGITIS MOST COMMONLY HAS VIRAL CAUSES; ONLY 5% TO 15% OF PHARYNGITIS CASES ARE CAUSED BY BACTERIA, MOST OFTEN GROUP A STREPTOCOCCUS PYOGENES (GAS).

• CLINICIANS MUST USE CLINICAL FEATURES TO DETERMINE WHETHER THE PATIENT MEETS THE THRESHOLD FOR USING A STREPTOCOCCAL RAPID ANTIGEN DETECTION TEST OR THROAT CULTURE.

• SEVERAL FEATURES ARE MORE PREDICTIVE OF A VIRAL SYNDROME, AND PATIENTS WHO PRESENT WITH A SORE THROAT WITH ACCOMPANYING FEATURES, SUCH AS CONJUNCTIVITIS, COUGH, HOARSENESS, NASAL CONGESTION, AND RHINORRHEA, SHOULD NOT BE TESTED FOR GAS PHARYNGITIS.
CORRECT ANSWER: C
TREAT VIRAL PHARYNGITIS WITH SYMPTOM CONTROL.

Key Point
Hallmark signs of viral pharyngitis include conjunctivitis, cough, nasal congestion, and rhinorrhea; viral pharyngitis should be treated symptomatically.

- **Additionally, the High Value Task Force of the American College of Physicians recommends that patients who meet fewer than three Centor criteria (fever by history, tonsillar exudates, tender anterior cervical lymphadenopathy, and absence of cough) need not be tested for GAS pharyngitis; these patients should be treated conservatively with symptom control.**

- **Antibiotic treatment of pharyngitis is reserved for patients with a positive result on a rapid antigen detection test or throat culture; amoxicillin and penicillin are first-line therapy.**

- **In this case, the patient has features suggesting a viral cause, including cough and rhinorrhea. She also has only two Centor criteria: fever and tonsillar exudates. Therefore, she should not be treated with amoxicillin or other antibiotics or tested for GAS through rapid antigen detection testing or throat culture. She should be advised that her sore throat may last as long as 1 week.**
VIGNETTE 4

• A 47-YEAR-OLD MAN IS EVALUATED FOR A 2-DAY HISTORY OF COUGH PRODUCTIVE OF SMALL AMOUNTS OF YELLOW SPUTUM, AS WELL AS SINUS CONGESTION, FRONTAL HEADACHE, RHINORRHEA, AND MALAISE. HE HAS HAD NO FEVERS, CHEST PAIN, OR SHORTNESS OF BREATH. MEDICAL HISTORY IS OTHERWISE UNREMARKABLE.

• ON PHYSICAL EXAMINATION, VITAL SIGNS ARE NORMAL. THERE IS TENDERNESS OVER THE MAXILLARY SINUSES BILATERALLY. THE NASAL MUCOSA IS DIFFUSELY EDEMATOUS WITH MODERATE AMOUNTS OF CLEAR DISCHARGE. PHARYNGEAL EXAMINATION REVEALS ERYTHEMA WITHOUT TONSILLAR EXUDATE. THE TYMPANIC MEMBRANES APPEAR NORMAL. NO CERVICAL LYMPHADENOPATHY IS NOTED. THE REMAINDER OF THE EXAMINATION IS NORMAL.
Which of the following is the most appropriate treatment?

A. Amoxicillin

B. Codeine

C. Inhaled albuterol

D. Intranasal fluticasone
CORRECT ANSWER: D
TREAT COUGH DUE TO ACUTE RHINOSINUSITIS.

Key Point
Acute rhinosinusitis may be treated symptomatically with analgesics and intranasal glucocorticoids; antibiotics are not recommended without clearly established bacterial infection.

- **This patient with acute cough due to acute rhinosinusitis should be treated with an intranasal glucocorticoid, such as fluticasone. Most upper respiratory tract infections (URIs) are caused by viral infections and resolve spontaneously within a few days. Patients without clear evidence of bacterial infection should be treated symptomatically.**

- **A meta-analysis of patients with acute rhinosinusitis found that use of intranasal glucocorticoids increased the rate of symptom response compared with placebo; there was a dose-response curve, with higher doses offering greater relief.**

- **Analgesics, such as NSAIDs and acetaminophen, may relieve pain.**

- **Only limited evidence supports saline irrigation in the relief of nasal symptoms; careful attention should be paid to the use of sterile or bottled water.**

- **First-generation antihistamines may help dry nasal secretions; however, evidence supporting their efficacy is lacking, and sedation is a common side effect.**

- **Decongestants are of possible benefit in patients with evidence of eustachian tube dysfunction but should be used with caution in elderly patients and those with cardiovascular disease, hypertension, angle-closure glaucoma, or bladder neck obstruction.**

- **Antitussive agents are generally ineffective.**
CORRECT ANSWER: D
TREAT COUGH DUE TO ACUTE RHINOSINUSITIS.

Key Point
Acute rhinosinusitis may be treated symptomatically with analgesics and intranasal glucocorticoids; antibiotics are not recommended without clearly established bacterial infection.

• **Empiric treatment of URI symptoms with antibiotics (such as amoxicillin) is ineffective, increases bacterial antibiotic resistance, and may cause multiple adverse effects, including Clostridium difficile colitis.**

• **Antibiotics should be reserved for:**
  • Patients with symptoms lasting more than 10 days,
  • Worsening symptoms after initially improving viral illness,
  • Or severe symptoms
  • Or signs of high fever (>39 °C [102.2 °F])
  • With purulent nasal discharge or facial pain for at least 3 consecutive days.
HANDLE ANTIBIOTICS WITH CARE IN SURGERY
Misuse of antibiotics puts all surgical patients at risk

Up to 33% of surgical patients get a postoperative infection, of which 51% can be antibiotic resistant
Up to 15% of women around the world get an infection after a caesarean section
43% of patients have surgical antibiotic prophylaxis (SAP) inappropriately continued after the operation

REDUCE
the risk of surgical site infection (SSI) by improving SAP and infection prevention and control practices

IMPROVE
quality of care and patient safety and reduce antimicrobial resistance (AMR) through SSI reduction

WHAT SHOULD HEALTH WORKERS DO TO PREVENT AMR IN SURGERY?

Give intravenous SAP - when recommended, depending on the type of operation - within 120 minutes preceding surgical incision
For effective SAP, adequate antibiotic tissue concentrations should be present at the time of surgical incision and throughout the procedure. Thus, antibiotics with a short half-life should be administered closer to incision time.

WHAT SHOULD YOU NOT DO?

Avoid prolonging SAP postoperatively
Avoid antibiotic wound irrigation
Avoid continuing antibiotic prophylaxis because there is a drain (evaluate each case)
Avoid giving antibiotic treatment unless there is a proven or suspected SSI or other infection

WHO SHOULD BE INVOLVED IN ENSURING APPROPRIATE ANTIBIOTIC USE IN SURGERY

Surgeons
Anesthetists
Operating room nurses
Infectious diseases doctors
Infection prevention & control team
Surgical ward staff
Pharmacists
Senior managers and procurement staff
Patients and their families (civil society)

These recommendations are based on evidence from studies in adult patients, but they are considered valid also for pediatric patients.

www.who.int/infection-prevention/publications/ssi-guidelines/en
COVID-19 AND ANTIBIOTIC USE

Data are limited, but bacterial superinfection does not appear to be a prominent feature of COVID-19.

For patients with documented COVID-19, it is not recommended to routinely administer empiric therapy for bacterial pneumonia.

- **Empiric Treatment for Bacterial Pneumonia in Select Patients May Be Reasonable:**
  - Since the clinical features of COVID-19 may be difficult to distinguish from bacterial pneumonia, empiric treatment for community-acquired pneumonia is reasonable when the diagnosis is uncertain.
  - Empiric treatment for bacterial pneumonia may also be reasonable in patients with documented COVID-19 if there is clinical suspicion for it (new fever after defervescence with new consolidation on chest imaging).
  - If empiric antibiotic therapy is initiated, we attempt to make a microbial diagnosis (e.g., through sputum Gram stain and culture, urinary antigen testing) and reevaluate the need to continue antibiotic therapy daily.
  - In such settings, a low procalcitonin may be helpful to suggest against a bacterial pneumonia; however, elevated procalcitonin has been described in COVID-19, particularly late in the course of illness, and does not necessarily indicate bacterial infection.
No, antibiotics do not work against viruses, only bacteria. The new coronavirus (2019-nCoV) is a virus and, therefore, antibiotics should not be used as a means of prevention or treatment. However, if you are hospitalized for the 2019-nCoV, you may receive antibiotics since bacterial co-infection is possible.

World Health Organization

#Coronavirus
Antimicrobial agents have a very important role in the successful management of patients both in the inpatient and outpatient setting.

But

Their real need should be studied with caution and they should be carefully selected to prevent adverse events and complications after treatment.
1. **Does my patient have an infection that requires antibiotics?**

2. **Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate?**

3. **A day or more has passed. Can I stop antibiotics? Can I narrow therapy or change from IV to oral therapy?**

4. **What duration of antibiotic therapy is needed for my patient's diagnosis?**
ANTIBIOTICS TREAT (FOR EXAMPLE):

- STREP THROAT
- URINARY TRACT INFECTIONS
- PNEUMONIA

BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

CDC
ANTIBIOTICS WON’T HELP:

- MOST BRONCHITIS
- MANY SINUS INFECTIONS
- SOME EAR INFECTIONS
III. A GUIDE TO A SMARTER AND SAFER ANTIBIOTIC USE...
WE HAVE TOOLS

DO YOU NEED ANTIBIOTICS?

You feel sick and miserable and want to get better fast. It could be a cold or even the flu. You’re probably thinking you need antibiotics to knock out your illness and help you feel better. Not so fast! When antibiotics aren’t needed, they won’t help you, and the side effects could still hurt you.

8 WAYS TO BE ANTIBIOTICS AWARE

1. Antibiotics save lives, but they aren’t always the answer when you’re sick.
2. Antibiotics do not work on viruses.
3. Antibiotics are only needed for treating certain infections caused by bacteria.
4. An antibiotic will NOT make you feel better if you have a virus.
5. Any time antibiotics are used, they can cause side effects.
6. Taking antibiotics creates resistant bacteria.
7. If you need antibiotics, take them exactly as prescribed.
8. Stay healthy: clean hands, cover coughs, and get vaccinated, for the flu, for example.

Talk to your healthcare professional about the best way to feel better.

Antibiotics aren’t always the answer when you’re sick. Ask your doctor how you can feel better.

For more information on antibiotic prescribing and use, visit www.cdc.gov/antibiotic-use.
5 Ways Hospital Pharmacists Can Be Antibiotics Aware

1. Verify Penicillin Allergy
   - Although 10% of the population in the United States reports a penicillin allergy, less than 1% of the population is truly penicillin allergic.
   - When possible, obtain a more detailed history of the penicillin reaction and review previously prescribed antibiotics. Alert the provider of your findings if you think the patient can tolerate a beta-lactam antibiotic, when appropriate.

2. Avoid Duplicative Anaerobic Coverage
   - Duplicative anaerobic coverage, such as piperacillin/tazobactam and metronidazole, is unnecessary in most cases.
   - When the pharmacy receives antibiotic orders for two or more agents with anaerobic activity, alert the provider that the antibiotics have overlapping spectra of activity.

3. Reassess Antibiotic Therapy
   - Review the patient’s microbiology results (e.g., rapid diagnostic tests and clinically relevant cultures).
   - Prompt the provider to consider stopping or tailoring antibiotic therapy as appropriate.

4. Avoid Treatment of Asymptomatic Bacteriuria
   - Patients with asymptomatic bacteriuria should not be treated with antibiotics in most cases.
   - Consider the importance of signs and symptoms consistent with urinary tract infection (UTI) when reviewing positive urine cultures and/or making treatment recommendations.

5. Use the Shortest Effective Antibiotic Duration
   - Guidelines for treatment duration are available for common infectious diseases such as pneumonia, UTI, and skin and soft tissue infection.
   - Alert the provider if the total days of inpatient and post-discharge antibiotic therapy exceeds the recommended duration.

Scenario

You are verifying an aztreonam order for a patient who has a penicillin allergy listed in his medical chart.

Although 10% of the population in the U.S. reports a penicillin allergy, less than 1% of the population is truly penicillin allergic. Correctly identifying if your patient is penicillin allergic can decrease the unnecessary use of broad spectrum antibiotics.1,2

Pharmacists can help verify penicillin allergy by:

1. Asking questions to evaluate if the patient is truly penicillin allergic.
   - What medication(s) were you taking when the reaction occurred?
   - Can you describe the symptoms you experienced?
   - How long ago did the reaction occur?
   - How was the reaction managed? What was the outcome?
   - Have you been prescribed amoxicillin or another penicillin since your reaction? Did you tolerate the antibiotic?

2. Reviewing the patient’s health record to obtain previous prescription history.
   - If the patient has tolerated a penicillin or cephalosporin in the past, aztreonam may not be necessary.

3. Discussing your findings with the ordering provider.
   - Consider preparing a list of alternative agents to discuss with the provider. Refer to your facility’s penicillin allergy evaluation protocol, if applicable.

You can apply this action plan to other antibiotics that are initiated for penicillin allergy (e.g., fluoroquinolones, clindamycin).

The scenarios and recommendations are applicable to most immunocompetent adult patients. Prior to making interventions, always assess the individual patient and use your clinical judgment. Follow your institution’s treatment guidelines when applicable.

www.cdc.gov/antibiotic-use

BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

BE ANTIBIOTICS AWARE
www.cdc.gov/antibiotic-use
Avoid Duplicative Anaerobic Coverage

**SCENARIO**
The pharmacy receives medication orders for piperacillin/tazobactam AND metronidazole for the same patient.

CDC's Core Elements of Hospital Antibiotic Stewardship Programs suggests that pharmacists review antibiotic therapy that is unnecessarily duplicative, including the use of agents with overlapping spectra. The combination of two agents with anaerobic activity is unnecessary in most cases. Exceptions may include Clostridium difficile infection, necrotizing fasciitis, and certain biliary infections. Pharmacists can help avoid unnecessary duplicative anaerobic coverage by:

1. Alerting the provider that the antibiotics ordered have overlapping spectra of activity.

2. Discussing the clinical case with the provider and consider recommending discontinuation of metronidazole to avoid duplicative therapy, when appropriate.

You can apply this action plan to other combinations of agents that have duplicative anaerobic coverage (e.g., metronidazole and a carbapenem).

Reassessment of antibiotic therapy evaluates the continued need for and choice of antibiotics when the clinical picture is clearer and more diagnostic information is available. Anti-MRSA coverage is a practical target for reassessment based on the patient's microbiology results. Exceptions to de-escalating anti-MRSA coverage may include purulent skin and soft tissue infections, prosthetic joint/orthopedic surgical infections, osteomyelitis, septic arthritis, and abscesses. Pharmacists can help reassess antibiotic therapy by:

1. Reviewing the patient's microbiology results, including rapid diagnostic tests and clinically relevant cultures.

2. Prompting the provider to consider discontinuation of anti-MRSA therapy if there is no microbiological evidence of MRSA, if appropriate.
Avoid Treatment of Asymptomatic Bacteriuria

**SCENARIO**
A medical resident calls you asking for your recommendation on antibiotic choice based on a patient’s urine culture report.

Asymptomatic bacteriuria refers to the isolation of bacteria in urine culture from a patient without signs or symptoms of urinary tract infection (UTI). A positive urine culture result (with or without pyuria) alone does not meet criteria for initiation of antibiotics according to infectious diseases guidelines. Exceptions include pregnancy and invasive genitourinary procedures.1

Pharmacists can help avoid unnecessary treatment of asymptomatic bacteriuria by:

1. Prompting the provider to consider if the patient has signs and symptoms consistent with UTI prior to making a recommendation for treatment. Signs and symptoms may include:1²
   - Urinary urgency
   - Urinary frequency
   - Dysuria
   - Suprapubic pain
   - Flank pain
   - Pelvic discomfort
   - Acute hematuria
   - Fever
   Note: Delirium or nausea/vomiting should be interpreted with caution as, by themselves, they have a low specificity for UTI.1

2. Discussing the potential for avoiding antibiotic use with the provider if the patient has asymptomatic bacteriuria.

The scenarios and recommendations discussed are applicable to most immunocompetent adult patients. Prior to making interventions, always assess the individual patient and use your clinical judgment. Follow your institution’s treatment guidelines when applicable.

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Use the Shortest Effective Antibiotic Duration

**SCENARIO**
You are performing medication reconciliation and reviewing discharge antibiotic orders for a patient.

Antibiotic stewardship programs are targeting interventions to reduce unnecessarily long durations of antibiotic treatment. In adult patients who have a timely clinical response, guidelines suggest the following durations for uncomplicated cases of these infections:

- **Community-Acquired Pneumonia:** Five days⁴
- **Hospital-Acquired Pneumonia:** Seven days⁵
- **Non-purulent Cellulitis:** Five days⁶

Pharmacists can help optimize antibiotic duration by:

1. Adding the total number of days of uninterrupted inpatient antibiotic therapy to planned post-discharge antibiotic duration.

2. Alerting the provider if the total duration of inpatient and post-discharge antibiotic therapy exceeds the recommended duration according to treatment guidelines.

3. Discussing optimizing the duration of post-discharge antibiotic therapy with the provider if the patient had an uncomplicated clinical course and has responded appropriately to treatment.

The scenarios and recommendations discussed are applicable to most immunocompetent adult patients. Prior to making interventions, always assess the individual patient and use your clinical judgment. Follow your institution’s treatment guidelines when applicable.

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QUESTIONS?

It's not too late to win the race against antibiotic resistance!

First get tested. Then get treated.
BE ANTIBIOTICS AWARE
SMART USE, BEST CARE

Antibiotics aren’t always the answer when you’re sick. Ask your doctor how you can feel better.

For more information on antibiotic prescribing and use, visit www.cdc.gov/antibiotic-use.