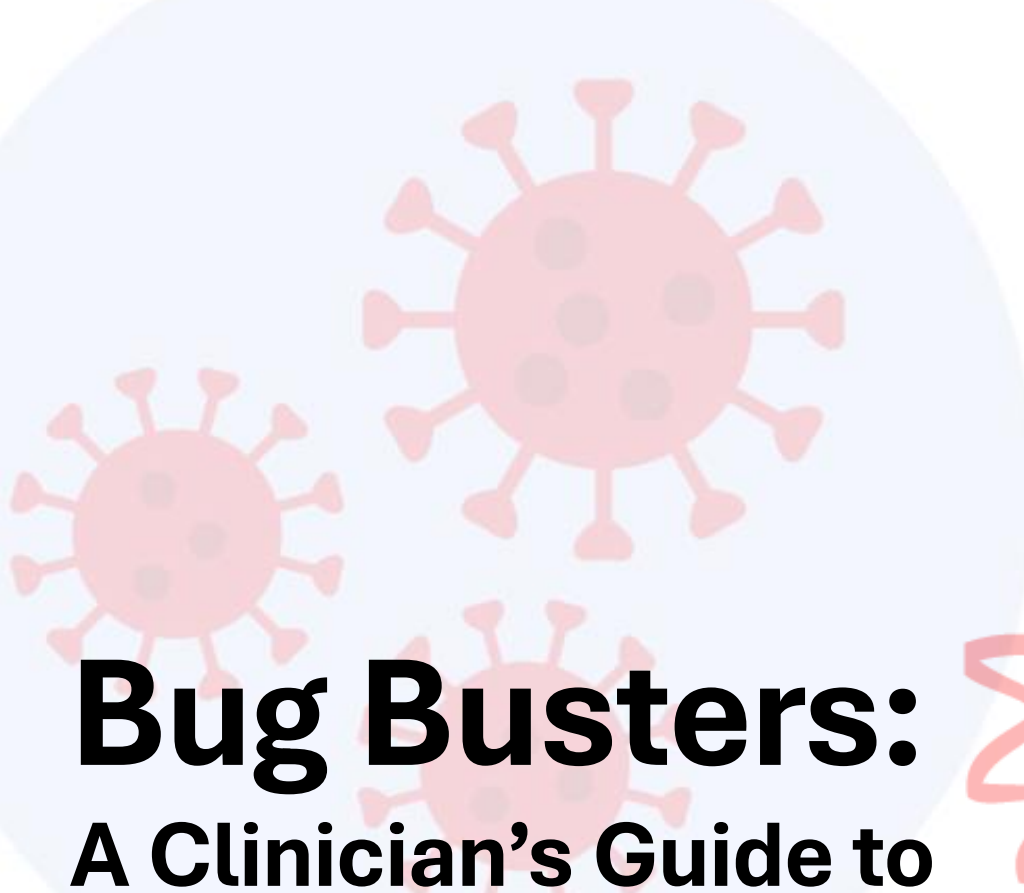


A light blue circular background containing several stylized red virus particles with spiky protrusions.

# **Bug Busters:**

## **A Clinician's Guide to Infectious Diseases**

***Shivani Patel, PharmD***

**Infectious Diseases/Antimicrobial Stewardship Pharmacist**

**Mount Carmel Health System**



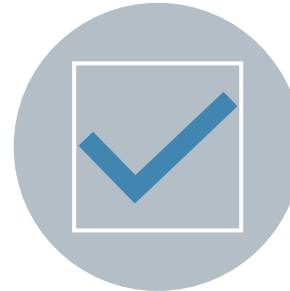
# Disclosures

This presenter has no current or potential conflicts to report.

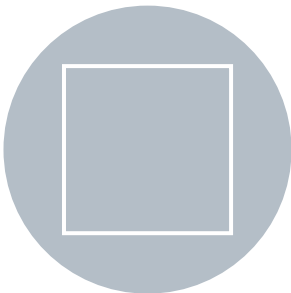
# Objectives



Understand the principles of infectious disease and summarize antibacterial drugs by class



Identify treatment and prophylaxis of specific infections



Review antifungals, antivirals, and associated disease states



Understand the importance of antimicrobial stewardship and how to apply it to daily practice

# Introduction

Infectious diseases are caused by one or more pathogens (like bacteria, fungi, viruses, protozoa, parasites, or infectious proteins called prions)

They are transmitted through various mechanisms such as physical contact or airborne transmission

The primary factors that impact treatment decisions include the bug (pathogen), the drug (the antimicrobial), and the patient (host). They should all be thought of together when learning about infectious disease

# Mechanisms of Action

## Cell Wall Inhibitors

Beta-lactams  
Monobactams  
Vancomycin  
Dalbavancin  
Telavancin  
Oritavancin

## Cell Membrane Inhibitors

Polymyxin  
Daptomycin  
Telavancin  
Oritavancin

## Protein Synthesis Inhibitors

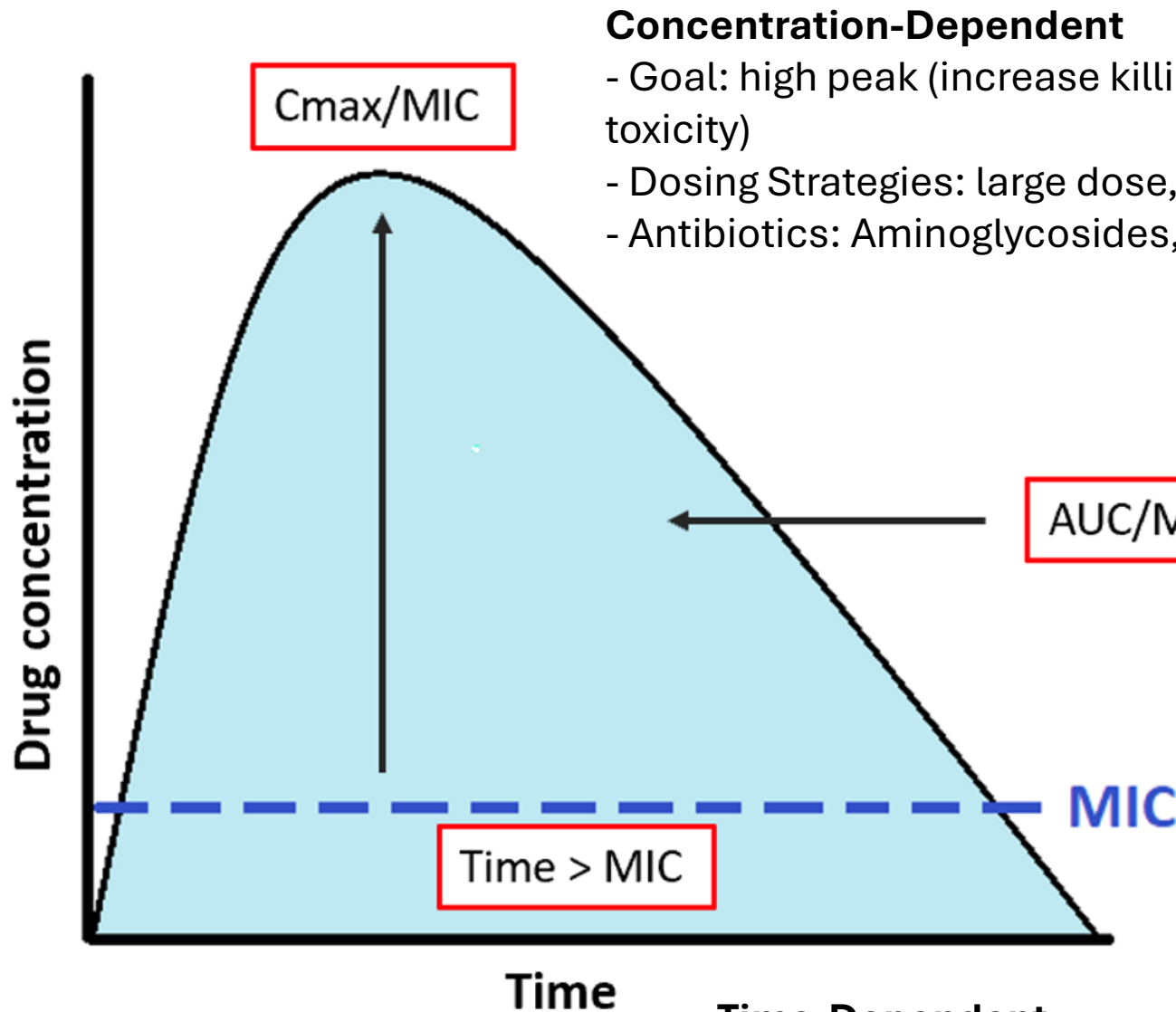
Aminoglycosides  
Macrolides  
Tetracyclines  
Clindamycin  
Linezolid

## DNA/RNA Inhibitors

Quinolones  
Metronidazole  
Rifampin

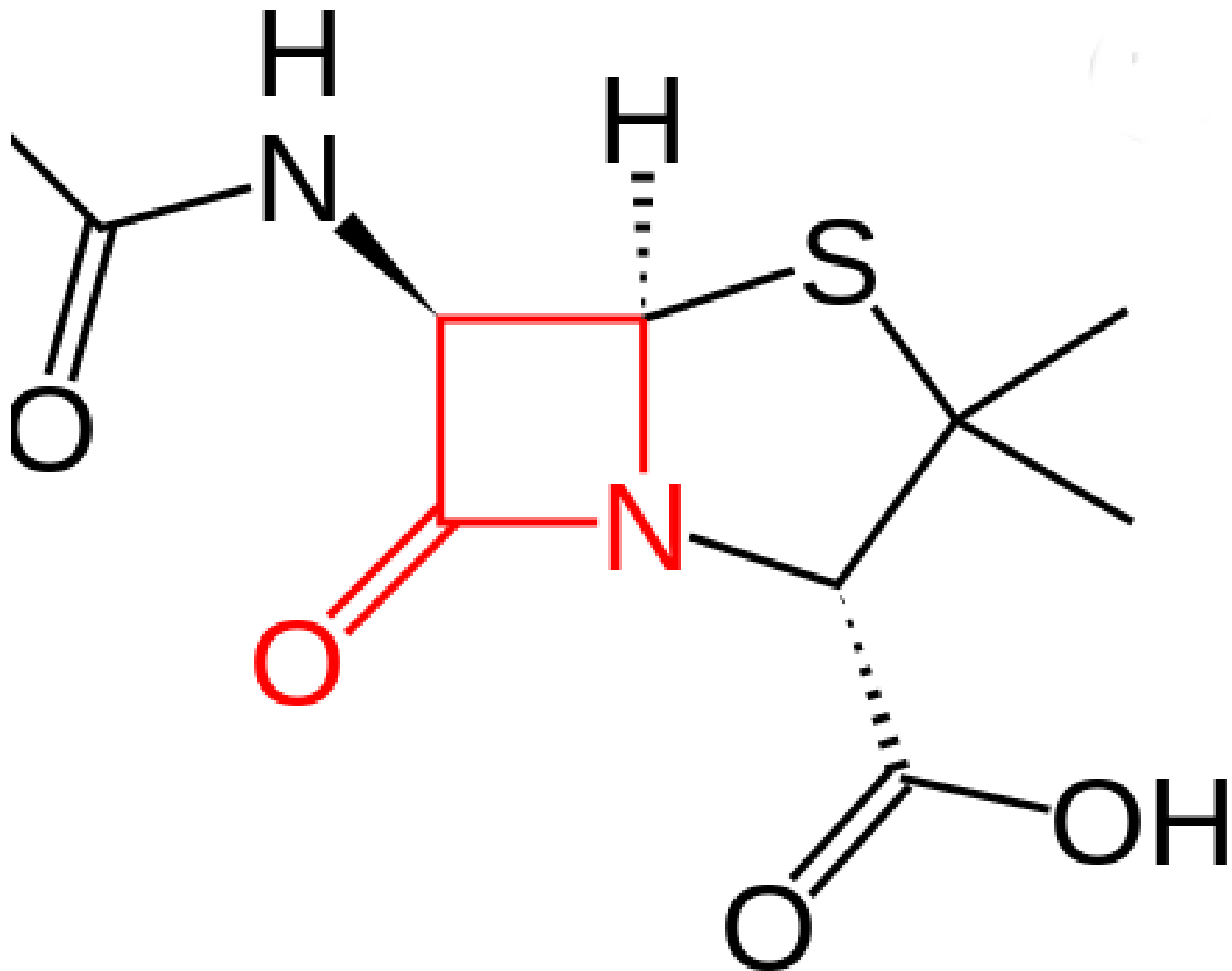
## Folic Acid Synthesis Inhibitors

Sulfonamides  
Trimethoprim  
Dapsone



- Goal: exposure over time
- Dosing Strategies: variable
- Antibiotics: Vancomycin, macrolides, tetracyclines, polymyxins

## Beta Lactams



| PENICILLINS                                                                                  | Antibiotics                                     | Coverage                                                                                                                |
|----------------------------------------------------------------------------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Natural Penicillins                                                                          | Penicillin G<br>Penicillin VK                   | Gram Positive Cocci<br>- Streptococci<br>- Enterococci<br><br>Gram Positive anaerobes<br>- mouth flora                  |
| Aminopenicillins                                                                             | Amoxicillin<br>Ampicillin                       | - Streptococci<br>- Enterococci<br>- Gram positive anaerobes<br>- Haemophilus<br>- Neisseria<br>- Proteus<br>- E. coli  |
| Aminopenicillins combined with beta lactamase inhibitor (clavulanate, sulbactam, tazobactam) | Amoxicillin/Clavulanate<br>Ampicillin/Sulbactam | - Adds activity against MSSA, some resistant strains of gram-negative bacteria, gram negative anaerobes (B. fragilis)   |
| Extended Spectrum Penicillins with beta lactamase inhibitor                                  | Piperacillin/tazobactam                         | Broad Spectrum<br>- adds expanded coverage gram negative bacteria including pseudomonas                                 |
| Antistaphylococcal penicillins                                                               | Dicloxacillin<br>Nafcillin<br>Oxacillin         | - Streptococci<br>- enhanced MSSA coverage<br>-NO activity against Enterococcus, Gram negative pathogens, and anaerobes |

# Key Features of Penicillins

## Class Effects

- All penicillins increase the risk of seizures if accumulation occurs (i.e. in renal failure)

### Oral

|                                            |                                                                                                                                                                                                                           |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Penicillin VK</b>                       | First line treatment for strep throat and mild, nonpurulent skin infections (no abscess)                                                                                                                                  |
| <b>Amoxicillin</b>                         | <ul style="list-style-type: none"><li>• First line treatment for acute otitis media (80-90 mg/kg/day)</li><li>• Drug of choice for IE prophylaxis before dental procedures (2g x1 30-60 min prior to procedure)</li></ul> |
| <b>Amoxicillin/Clavulanate (Augmentin)</b> | First line treatment for acute otitis media (90 mg/kg/day) and for sinus infections (if antibiotics are indicated)                                                                                                        |
| <b>Dicloxacillin, oxacillin</b>            | <ul style="list-style-type: none"><li>• Cover MSSA</li><li>• No renal dose adjustment needed</li></ul>                                                                                                                    |

# Key Features of Penicillins

| Parenteral                                |                                                                                                                                                                                     |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Penicillin G Benzathine (Bicillin)</b> | <ul style="list-style-type: none"><li>• Drug of choice for syphilis (2.4 million units IM x1)</li><li>• NEVER used IV</li></ul>                                                     |
| <b>Nafcillin</b>                          | <ul style="list-style-type: none"><li>• Cover MSSA</li><li>• No renal dose adjustment needed</li></ul>                                                                              |
| <b>Piperacillin/Tazobactam (Zosyn)</b>    | <ul style="list-style-type: none"><li>• Only penicillin active against pseudomonas</li><li>• Extended infusions (4 hours) can be used to maximize <math>T &gt; MIC</math></li></ul> |

| CEPHALOSPORINS            |                                                                                                   |                                                                                                                                                                                                                                                                                                                       |
|---------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Generation                | Agents                                                                                            | Pearls                                                                                                                                                                                                                                                                                                                |
| First                     | Cefazolin (Ancef, IV, IM)<br>Cephalexin (Keflex, PO)<br>Cefadroxil                                | <ul style="list-style-type: none"> <li>Cefazolin is commonly used for MSSA, has good CNS penetration, and commonly used for surgical prophylaxis</li> </ul>                                                                                                                                                           |
|                           |                                                                                                   | <ul style="list-style-type: none"> <li>Cephalexin is commonly used for skin infections and strep throat</li> </ul>                                                                                                                                                                                                    |
| Second                    | Cefuroxime (PO, IV, IM)<br>Cefotetan (IV, IM)<br>Cefaclor (PO)<br>Cefoxitin (IV, IM)              | <ul style="list-style-type: none"> <li>Cefuroxime is often used for acute otitis media, community acquired pneumonia (CAP), sinus infections (if antibiotics are indicated)</li> </ul>                                                                                                                                |
|                           |                                                                                                   | <ul style="list-style-type: none"> <li>Cefotetan and Cefoxitin offer anaerobic coverage (<i>B. fragilis</i>) and are commonly used for colorectal surgical prophylaxis</li> <li>Cefotetan can cause a disulfiram-like reaction with alcohol ingestion</li> </ul>                                                      |
| Third (group 1)           | Cefdinir (PO)<br>Ceftriaxone (IV, IM)<br>Cefotaxime (IV, IM)<br>Cefixime (PO)<br>Cefpodoxime (PO) | <ul style="list-style-type: none"> <li>Cefdinir is commonly used for CAP and sinus infections (if antibiotics are indicated)</li> </ul>                                                                                                                                                                               |
|                           |                                                                                                   | <ul style="list-style-type: none"> <li>Ceftriaxone and Cefotaxime are commonly used for CAP, meningitis, spontaneous bacterial peritonitis (SBP), pyelonephritis</li> <li>Ceftriaxone does NOT require renal dose adjustments and should NOT be used in neonates (can cause biliary sludging, kernicterus)</li> </ul> |
| Third (group 2)           | Ceftazidime<br>Ceftazidime/Avibactam (Avycaz, IV)<br>Ceftolozane/Tazobactam (Zerbaxa, IV)         | <ul style="list-style-type: none"> <li>Ceftazidime is active against <i>Pseudomonas</i></li> </ul>                                                                                                                                                                                                                    |
|                           |                                                                                                   | <ul style="list-style-type: none"> <li>Ceftazidime/Avibactam and Ceftolozane/Tazobactam are used for MDR gram-negative organisms (like <i>Pseudomonas</i>)</li> </ul>                                                                                                                                                 |
| Fourth                    | Cefepime (Maxipime, IV, IM)                                                                       | <ul style="list-style-type: none"> <li>Cefepime is active against <i>Pseudomonas</i></li> </ul>                                                                                                                                                                                                                       |
| Fifth                     | Ceftaroline fosamil (Teflaro, IV)                                                                 | <ul style="list-style-type: none"> <li>Only beta lactam active against MRSA</li> </ul>                                                                                                                                                                                                                                |
| Siderophore Cephalosporin | Cefiderocol                                                                                       | <ul style="list-style-type: none"> <li>Broad spectrum against gram-negative bacteria</li> </ul>                                                                                                                                                                                                                       |

# CARBAPENEMS

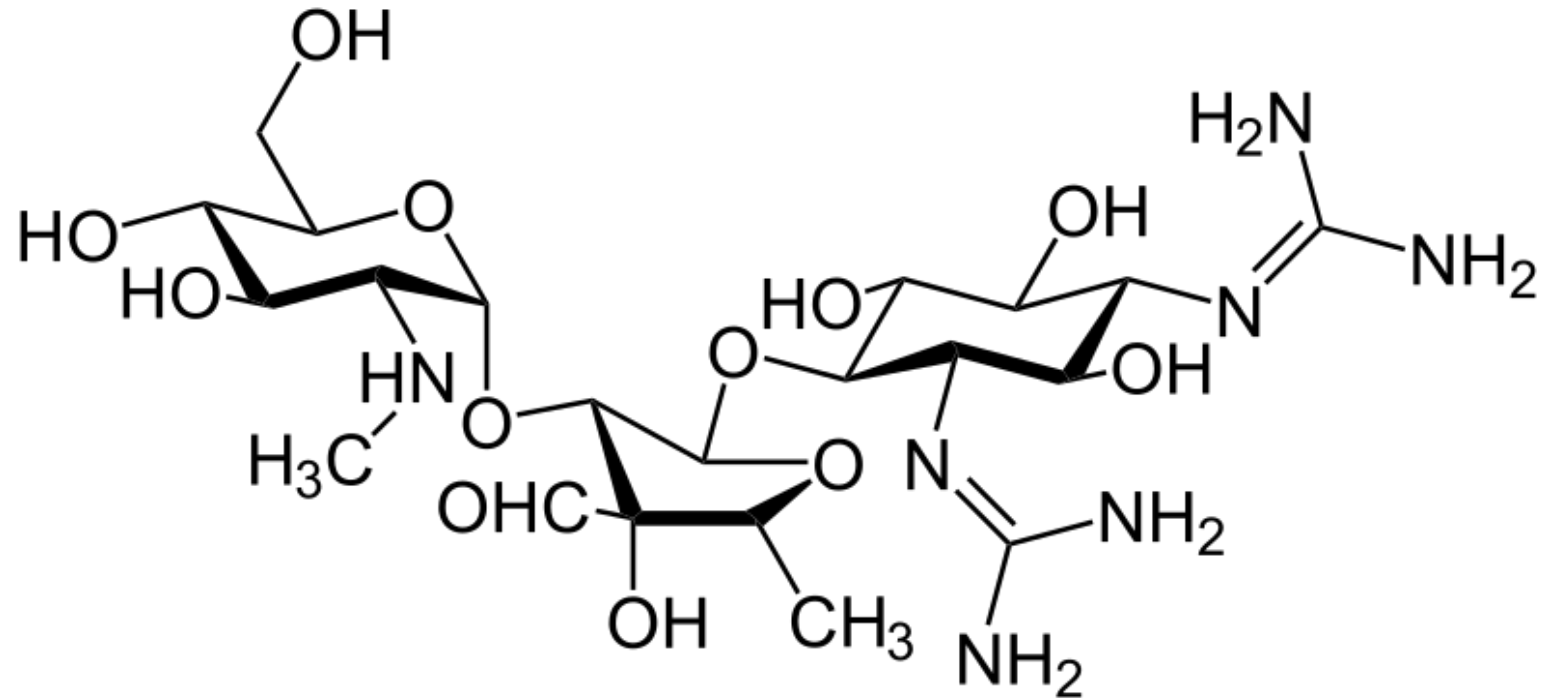
- Broad spectrum, reserved for MDR Gram negative infections
- Active against most Gram positive, Gram negative (including ESBL producers), and anaerobes
- NO activity against atypical pathogens, MRSA, VRE, C. difficile, Stenotrophomonas

| Agents                                                                                     | Key Features                                                                                                                                                                 |                                                                                                                                                                           |
|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Doripenem (IV)                                                                             | <ul style="list-style-type: none"> <li>• NOT used for pneumonia</li> </ul>                                                                                                   | <ul style="list-style-type: none"> <li>• CNS adverse effects (confusion, seizures)</li> <li>• <b>Major drug interaction with valproic acid and derivatives</b></li> </ul> |
| Imipenem (IV)<br>Imipenem/Cilastatin (IV)<br>Imipenem/Cilastatin/Relebactam (Recarbio, IV) | <ul style="list-style-type: none"> <li>• Imipenem/Cilastatin/Relebactam is approved for complicated UTI/Pyelonephritis and intraabdominal infections</li> </ul>              |                                                                                                                                                                           |
| Meropenem (Merrem, IV)                                                                     |                                                                                                                                                                              |                                                                                                                                                                           |
| Meropenem/Vaborbactam (Vabomere, IV)                                                       | Approved for complicated UTI/Pyelonephritis                                                                                                                                  |                                                                                                                                                                           |
| Ertapenem (Invanz, IV)                                                                     | Ertapenem <ul style="list-style-type: none"> <li>• No coverage for Pseudomonas, Acinetobacter, Enterococcus</li> <li>• Commonly used for diabetic foot infections</li> </ul> |                                                                                                                                                                           |

# Aztreonam

- **Monobactam**
- Its monobactam structure makes cross-reactivity with beta-lactam allergy unlikely
- Spectrum
  - Gram negative organisms (including **Pseudomonas**)
  - NO gram positive activity
  - NO anaerobic activity

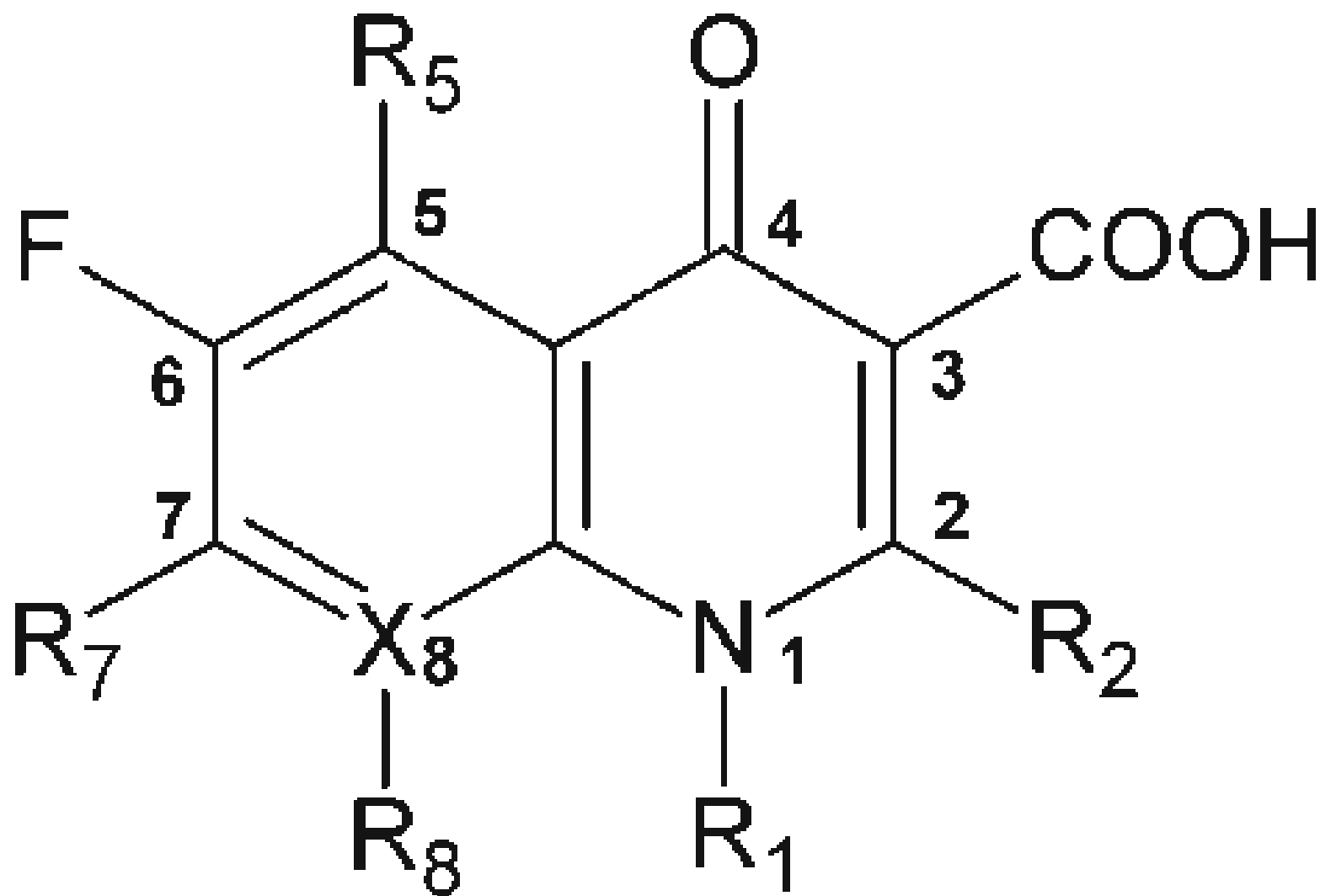
# Aminoglycosides



## Aminoglycosides

| Agents                                   | Pearls                                                                                 | Class Features                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gentamicin (IV, IM, ophthalmic, topical) | Can be synergistic with beta-lactams or vancomycin for certain gram positive organisms | <ul style="list-style-type: none"> <li>Coverage: gram negative (including Pseudomonas – EXCEPT Gentamicin)</li> <li>ADRs: renal toxicity, ototoxicity</li> </ul> <b>2 Dosing Strategies</b> <ul style="list-style-type: none"> <li><u>Traditional</u>: uses lower doses more frequently</li> <li><u>Extended Interval</u>: uses higher doses less frequently leading to less accumulation and less toxicity</li> </ul> |
| Tobramycin (IV, IM, ophthalmic, inhaled) | Often used in cystic fibrosis                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Amikacin (IV, IM)                        | Second-line treatment for Mycobacterial infections                                     |                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Plazomicin (IV)                          | For complicated UTI; use only when there are no alternative options                    |                                                                                                                                                                                                                                                                                                                                                                                                                        |

## Fluorouinolones



# Fluoroquinolones

Broad spectrum → Variety of gram negative, gram positive, and atypical pathogens

- *Notably, resistance to fluoroquinolones is increasing rapidly*

| AGENT                                                                                                       |               | PEARLS                                                                                                                                                                                                                                    | CLASS EFFECTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Respiratory<br>Fluoroquinolones<br>Used for pneumonia,<br>reliable activity against<br><i>S. pneumoniae</i> | Levofloxacin  | <b>Antipseudomonal</b>                                                                                                                                                                                                                    | <b>Black Box Warning:</b> <ul style="list-style-type: none"> <li>• Tendon inflammation/rupture</li> <li>• Peripheral Neuropathy</li> <li>• CNS effects</li> <li>• Avoid in patients with myasthenia gravis</li> </ul><br>ADRs <ul style="list-style-type: none"> <li>• <b>QTc prolongation</b></li> <li>• Hypo- and hyperglycemia</li> <li>• Photosensitivity</li> </ul><br>Counseling pearls: <ul style="list-style-type: none"> <li>• Avoid sun exposure</li> <li>• Separate from cations (to optimize absorption)</li> <li>• Monitor blood glucose</li> </ul> |
|                                                                                                             | Moxifloxacin  | <ul style="list-style-type: none"> <li>• Does not reach adequate concentrations in the urine so should not be used for UTIs</li> <li>• No renal dose adjustments needed</li> </ul>                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                             | Gemifloxacin  | Rarely used                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                             | Ciprofloxacin | <b>Antipseudomonal</b> <ul style="list-style-type: none"> <li>• Cannot put cipro suspension through NG tube</li> <li>• CAN crush immediate release tablets – hold tube feeds at least 1 hour before and 2 hours after the dose</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

# Fluoroquinolones

Broad spectrum → Variety of gram negative, gram positive, and atypical pathogens

- *Notably, resistance to fluoroquinolones is increasing rapidly*

| AGENT                                                                           |               | PEARLS                                                                                                                                                                              | CLASS EFFECTS                                                                                                                                                                    |
|---------------------------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Respiratory<br>Fluoroquinolones<br>Used for pne<br>reliable activ<br>S. pneumon | Levofloxacin  | Antipseudomonal                                                                                                                                                                     | <b>Black Box Warning:</b> <ul style="list-style-type: none"><li>• Tendon inflammation/rupture</li><li>• Peripheral Neuropathy</li><li>• CNS effects</li></ul>                    |
|                                                                                 | Moxifloxacin  | <ul style="list-style-type: none"><li>• Does not reach adequate concentrations in the urine so should not be used for UTIs</li></ul>                                                |                                                                                                                                                                                  |
| AVOID IN ELDERLY IF POSSIBLE                                                    |               |                                                                                                                                                                                     |                                                                                                                                                                                  |
|                                                                                 | Ciprofloxacin | <ul style="list-style-type: none"><li>• through NG tube</li><li>• CAN crush immediate release tablets – hold tube feeds at least 1 hour before and 2 hours after the dose</li></ul> | Counseling pearls: <ul style="list-style-type: none"><li>• Avoid sun exposure</li><li>• Separate from cations (to optimize absorption)</li><li>• Monitor blood glucose</li></ul> |

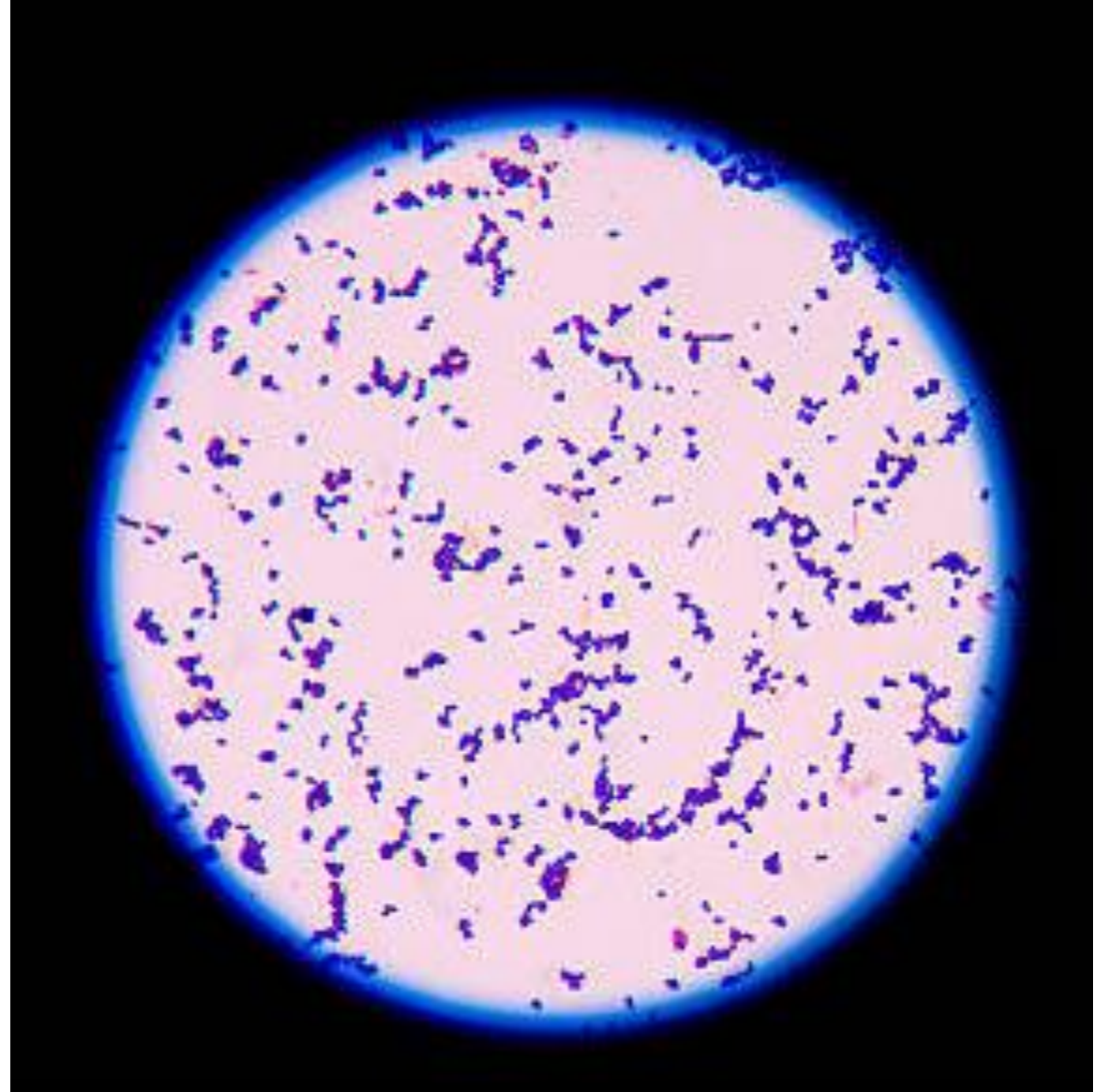
# Sulfonamides



# Sulfamethoxazole/Trimethoprim (Bactrim)

|                     |                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                           |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Spectrum</b>     | <b>Staphylococci (including MRSA)</b><br><b>Some broad gram-negative coverage:</b> <ul style="list-style-type: none"><li>• Haemophilus</li><li>• Proteus</li><li>• E. coli</li><li>• Klebsiella</li><li>• Enterobacter,</li><li>• Shigella</li><li>• Salmonella</li><li>• Stenotrophomonas</li></ul> | <b>Some opportunist infections (OI):</b> <ul style="list-style-type: none"><li>• Nocardia</li><li>• Pneumocystis</li><li>• Toxoplasmosis</li></ul><br><b>NO coverage for:</b> <ul style="list-style-type: none"><li>• Pseudomonas</li><li>• Enterococci</li><li>• Atypicals</li><li>• Anaerobes</li></ul> |
| <b>Formulations</b> | PO, IV<br>Single Strength (SS) tablets: 400 mg SMX/80 mg TMP<br>Double Strength (DS) tablets: 800mg SMX/160 mg TMP                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                           |
| <b>Pearls</b>       | <ul style="list-style-type: none"><li>• Dosed based on TMP component</li><li>• ADRs: Skin reactions (SJS/TEN), thrombotic thrombocytopenic purpura (TTP), <b>photosensitivity, hyperkalemia, AKI</b></li></ul>                                                                                       |                                                                                                                                                                                                                                                                                                           |

## Select Gram Positive agents

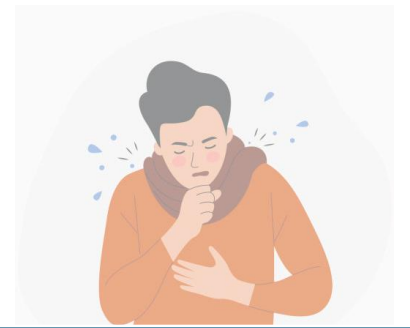


| Agent             | Route                 | Coverage                                                                                                                                                                                      | Pearls                                                                                                                                                                                                                                                                            |
|-------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Vancomycin</b> | PO (C. diff only), IV | Only gram-positive bacteria <ul style="list-style-type: none"> <li>Staphylococci (MRSA)</li> <li>Streptococci</li> <li>Enterococci (not VRE)</li> <li>C. difficile (PO route only)</li> </ul> | <ul style="list-style-type: none"> <li>Monitor for <b>AKI, infusion reaction</b></li> <li>Requires therapeutic drug monitoring <ul style="list-style-type: none"> <li>For severe MRSA infections: AUC/MIC target is 400-600, trough target is 15-20 mcg/mL</li> </ul> </li> </ul> |
| <b>Daptomycin</b> | IV                    | Only gram-positive bacteria <ul style="list-style-type: none"> <li>Staphylococci (MRSA)</li> <li>Enterococci</li> </ul>                                                                       | <ul style="list-style-type: none"> <li><b>Deactivated by lung surfactant so not to be used in pneumonias</b></li> <li>Can elevate <b>CK</b> (monitor at baseline then weekly)</li> <li>Can falsely elevate PT/INR but does not increase bleed risk</li> </ul>                     |
| <b>Linezolid</b>  | PO, IV                | Only gram-positive bacteria <ul style="list-style-type: none"> <li>Staphylococci (MRSA)</li> <li>Enterococci</li> </ul>                                                                       | ADRs: <ul style="list-style-type: none"> <li>Serotonin syndrome</li> <li>Myelosuppression</li> </ul>                                                                                                                                                                              |



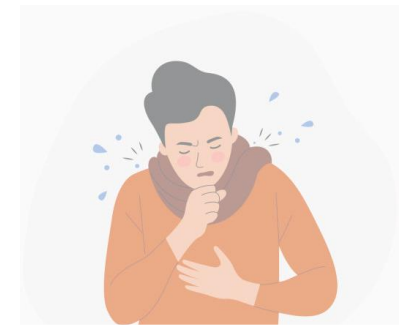
# Disease States

# Upper Respiratory Tract Infections

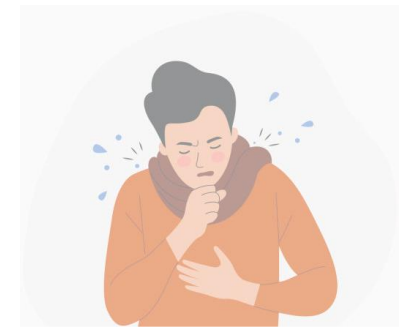


| Disease State                   | Common Pathogens                                                        | Treatment                                                                                                                                                                                                                        |
|---------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Acute Otitis Media (AOM)</b> | S. Pneumoniae<br>H. Influenzae                                          | <ul style="list-style-type: none"><li>• Amoxicillin (80-90 mg/kg/day in 2 divided doses)</li><li>• Amoxicillin/Clavulanate (90 mg/kg/day in 2 divided doses)</li><li>• Ceftriaxone (50 mg/kg IM or IV for 1 or 3 days)</li></ul> |
| <b>Influenza</b>                | H. Influenzae                                                           | Oseltamivir for 5 days                                                                                                                                                                                                           |
| <b>Pharyngitis</b>              | S. pyogenes                                                             | <ul style="list-style-type: none"><li>• Penicillin, Amoxicillin, or 1<sup>st</sup> or 2<sup>nd</sup> generation cephalosporin for 10 days</li><li>• Azithromycin x5 days</li></ul>                                               |
| <b>Sinusitis</b>                | Respiratory Viruses<br>S. Pneumoniae<br>H. Influenzae<br>M. catarrhalis | <ul style="list-style-type: none"><li>• <b>No antibiotics needed for respiratory viral infections</b></li><li>• Amoxicillin/Clavulanate – treatment duration varies</li></ul>                                                    |

# Lower Respiratory Tract Infections



| DISEASE STATE                      | COMMON PATHOGENS                                 | TREATMENT                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Community Acquired Pneumonia (CAP) | S. Pneumoniae<br>H. Influenzae<br>M. Catarrhalis | Empiric coverage should include: S. pneumoniae and atypical pathogens                                                                                                                                                                                                                                                                                                                                                               |
|                                    |                                                  | <b>Outpatient</b> <ul style="list-style-type: none"><li>• <i>No co-morbidities</i>: Amoxicillin (high dose, 1 g 3x daily) OR doxycycline OR azithromycin</li><li>• <i>Co-morbidities</i>: Beta-lactam (Amoxicillin/Clavulanate or cephalosporin) PLUS azithromycin OR monotherapy with respiratory fluoroquinolone</li></ul>                                                                                                        |
|                                    |                                                  | <b>Inpatient</b> <ul style="list-style-type: none"><li>• Beta Lactam (ceftriaxone) + macrolide (azithromycin) OR doxycycline OR</li><li>• Monotherapy with respiratory fluoroquinolone (levofloxacin, moxifloxacin – <i>NOT ciprofloxacin</i>)</li></ul> <p>If risk factors for MRSA: add vancomycin or linezolid<br/>If risk factors for Pseudomonas: add piperacillin/tazobactam or cefepime or another antipseudomonal agent</p> |
| Duration: 5 days                   |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                     |



# Lower Respiratory Tract Infections

| DISEASE STATE                                                    | COMMON PATHOGENS                                                                                                                                                                                                                                   | TREATMENT                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hospital Acquired and Ventilator Associated Pneumonias (HAP/VAP) | S. Pneumoniae<br>H. Influenzae<br>M. Catarrhalis<br>MRSA<br>Gram negative rods <ul style="list-style-type: none"><li>• P. aeruginosa</li><li>• Acinetobacter spp.</li><li>• Enterobacter spp.</li><li>• E. coli</li><li>• Klebsiella spp</li></ul> | <b>Choose 1 antibiotic to cover pseudomonas and MSSA if low risk for MRSA or MDR pathogens</b><br><i>Examples:</i> Cefepime or piperacillin/tazobactam                                                                                                                           |
|                                                                  |                                                                                                                                                                                                                                                    | <b>Choose 2 antibiotics, one for MRSA and one for Pseudomonas if risk for MRSA but low risk for MDR pathogens</b><br><i>Examples:</i> <ul style="list-style-type: none"><li>• Cefepime + Vancomycin OR linezolid</li></ul>                                                       |
|                                                                  |                                                                                                                                                                                                                                                    | <b>Choose 3 antibiotics, one for MRSA and two for pseudomonas if risk for both MRSA and MDR pathogens</b><br><i>Examples:</i> <ul style="list-style-type: none"><li>• Piperacillin/tazobactam + ciprofloxacin + vancomycin</li><li>• Cefepime + gentamicin + linezolid</li></ul> |
|                                                                  |                                                                                                                                                                                                                                                    | Duration: 7 days (may vary depending on clinical response)                                                                                                                                                                                                                       |

# Skin and Soft Tissue Infections (SSTI) - **Cellulitis**



## CAUSES

Previous trauma to the area  
Underlying lesions

## PATHOGENS

*S. pyogenes*  
*S. aureus*  
Gram negative bacilli  
Anaerobes

## LOCATION

Anywhere, common on the  
limbs and face

# Skin and Soft Tissue Infections (SSTI) -Cellulitis



| Non-purulent    |                                                                                         |                              |
|-----------------|-----------------------------------------------------------------------------------------|------------------------------|
| <b>Mild</b>     | <b>PO Route</b><br>Cephalexin<br>Penicillin VK<br>Amoxicillin<br>Dicloxacillin          | <b>Duration</b><br>5-10 days |
| <b>Moderate</b> | <b>IV Route</b><br>Cefazolin                                                            |                              |
| <b>Severe</b>   | Debridement with cultures<br><b>IV Route</b><br>Vancomycin +<br>piperacillin/tazobactam |                              |

Penicillin allergy: can use clindamycin

# Skin and Soft Tissue Infections (SSTI) -Cellulitis



| Purulent |                                                                                                                                                                          |                      |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Mild     | Incision and drainage (I & D) only                                                                                                                                       |                      |
| Moderate | Incision and drainage (I & D) and cultures<br><b>PO Route</b><br>Sulfamethoxazole/trimethoprim (Bactrim)*<br>Doxycycline*<br>Clindamycin*<br>Dicloxacillin<br>Cephalexin | Duration<br>Variable |
|          | Incision and drainage (I & D) and cultures<br><b>IV Route</b><br>Vancomycin*<br>Daptomycin*<br>Linezolid*<br>Dalbavancin<br>Oritavancin                                  |                      |
| Severe   |                                                                                                                                                                          |                      |

\*If community acquired MRSA suspected

# Urinary Tract Infection (UTI)



| DIAGNOSIS                                 | COMMON PATHOGENS                                                                                                                                                                                              | TREATMENT                                                                                                                          |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>Asymptomatic Bacteriuria</b>           | Any of the below                                                                                                                                                                                              | <b>NONE!</b><br><i>Exceptions: pregnancy, endourological procedures</i>                                                            |
| <b>Acute Uncomplicated Cystitis</b>       | Proteus, E. coli (majority), S. saprophyticus, Enterococci                                                                                                                                                    | Nitrofurantoin 100 mg by mouth twice daily x5 days<br>OR<br>SMX/TMP 1 DS tablet twice daily x3 days<br>OR<br>Fosfomycin 3g x1 dose |
| <b>Acute uncomplicated pyelonephritis</b> | E. coli, Enterococci, Proteus, Klebsiella, Pseudomonas                                                                                                                                                        | Ceftriaxone 1-2g IV once daily<br>OR                                                                                               |
| <b>Complicated UTI</b>                    | E. coli, Klebsiella, Enterobacter, Serretia, Pseudomonas, Enterococci, Staphylococci                                                                                                                          | Ciprofloxacin (500mg by mouth twice daily)<br>OR<br>Levofloxacin (750mg by mouth twice daily)<br>OR<br>Alternative beta-lactam     |
| <b>Candida in the urine</b>               | <b>Treatment is NOT recommended</b><br>Exceptions: symptomatic, high-risk patients include neutropenic patients, very low-birth-weight infants (<1500 g), and patients who will undergo urologic manipulation |                                                                                                                                    |

# Sexually Transmitted Infections (STI)

| INFECTION                                             | DRUG OF CHOICE                                                                                                              | ALTERNATIVE                                                                                                                            |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syphilis</b><br>(primary, secondary, early latent) | Penicillin G benzathine (2.4 million units IM x1)                                                                           | Doxycycline 100mg by mouth twice daily for 14 days                                                                                     |
| <b>Syphilis</b> (Late latent)                         | Penicillin G benzathine (2.4 million units IM weekly x3 weeks)                                                              | Doxycycline 100mg by mouth twice daily for 28 days                                                                                     |
| <b>Neurosyphilis</b>                                  | Penicillin G aqueous crystalline (1-24 million units daily, divided into 6 doses or by continuous infusion for x10-14 days) | Penicillin G procaine                                                                                                                  |
| <b>Gonorrhea</b>                                      | Ceftriaxone (250mg IM x1 dose)<br>+ Azithromycin (1g PO x1 dose)                                                            | Ceftriaxone (250mg IM x1)<br>+ doxycycline (100mg by mouth twice daily x7 day)<br><br>Monotherapy is NOT recommended due to resistance |
| <b>Chlamydia</b>                                      | Azithromycin (1g by mouth x1 dose)                                                                                          | Doxycycline (100mg by mouth twice daily x7 days)                                                                                       |
| <b>Bacterial Vaginosis</b>                            | Metronidazole (500mg by mouth twice daily x7 days)<br>OR metronidazole 0.75% gel (1 applicator daily or twice daily x5 day) | Clindamycin 300mg by mouth twice daily x7 days                                                                                         |
| <b>Trichomoniasis</b>                                 | Metronidazole (2g by mouth x1 dose)                                                                                         | Metronidazole 500mg by mouth twice daily x7 days                                                                                       |

# Meningitis



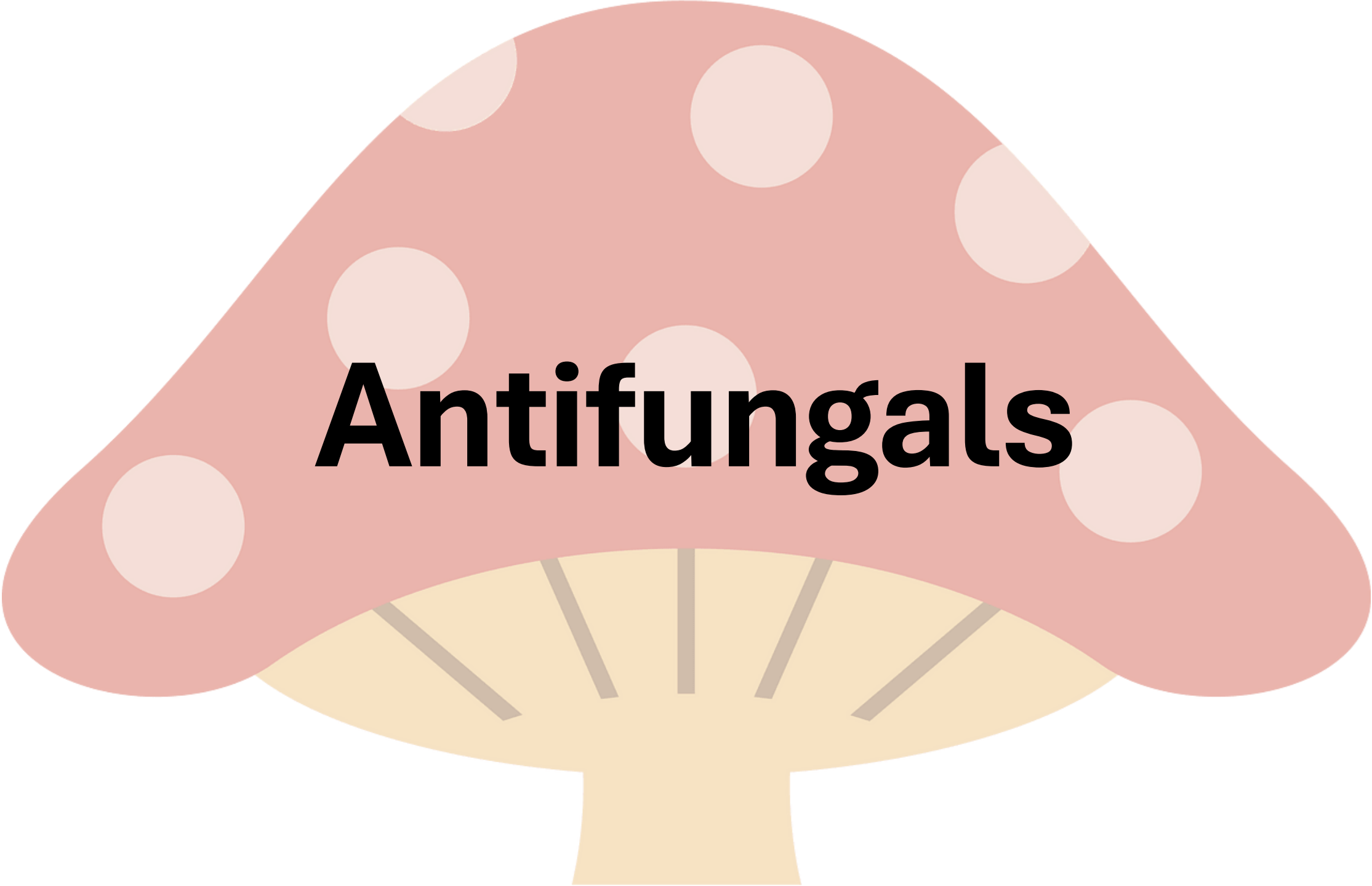
- Common pathogens: *Streptococcus pneumoniae*, *Neisseria meningitidis*, and *Haemophilus influenzae*
  - Add coverage for *Listeria monocytogenes* in neonates, age >50 years and immunocompromised patients

## MENINGITIS: EMPIRIC TREATMENT

| Age <1 month (neonates)                     | Age 1 month to 50 years                      | Age >50 years or immunocompromised                                                             |
|---------------------------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------|
| Ampicillin<br>+<br>Cefotaxime OR gentamicin | Vancomycin<br>+<br>Ceftriaxone OR cefotaxime | Ampicillin (for <i>Listeria</i> coverage)<br>+<br>Vancomycin<br>+<br>Ceftriaxone OR cefotaxime |

### Do not use Ceftriaxone in neonates

- Can cause biliary sludging and kernicterus in neonates



**Antifungals**

# Fungal Classifications

| YEASTS                                                                                                                                                                                                          | MOLDS                                                 | DIMORPHIC FUNGI                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------|
| <p>Candida spp</p> <ul style="list-style-type: none"><li>• C. albicans</li><li>• C. glabrata</li><li>• C. tropicalis</li><li>• C. parapsilosis</li><li>• C. krusei</li></ul> <p>Cryptococcus<br/>neoformans</p> | <p>Aspergillus spp</p> <p>Zygomycetes (Mucor spp)</p> | <p>Histoplasma capsulatum</p> <p>Blastomyces dermatitidis</p> <p>Coccidioides immitis</p> |

# Antifungals

| CLASS                    | AGENTS                                                                                                                                              | CLASS EFFECTS                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Amphotericin</b>      | Amphotericin B deoxycholate (conventional)<br>Amphotericin B Lipid Complex<br>Liposomal Amphotericin B                                              | ADRs: infusion reactions, hypokalemia, hypomagnesia, nephrotoxicity<br><br>Monitoring: renal function, electrolytes, LFTs                                                                                                                                                                                                                                                                                     |
| <b>Azole Antifungals</b> | Fluconazole (PO, IV)<br>Itraconazole (PO)<br>Ketoconazole (PO, topical)<br>Voriconazole (PO, IV)<br>Posaconazole (PO, IV)<br>Isavuconazole (PO, IV) | <ul style="list-style-type: none"><li>• All can cause increased LFTs</li><li>• All have a risk for QTc prolongation (except Isavuconazole)</li><li>• All azoles are moderate-strong CYP3A4 inhibitors</li><li>• Fluconazole is the only azole that requires renal dose adjustments</li><li>• Itraconazole can cause heart failure</li><li>• Voriconazole can cause visual changes and phototoxicity</li></ul> |
| <b>Echinocandins</b>     | Caspofungin<br>Micafungin<br>Anidulafungin                                                                                                          | ADRs: increased LFTs, severe skin reactions with caspofungin)                                                                                                                                                                                                                                                                                                                                                 |
| <b>Flucytosine</b>       |                                                                                                                                                     | ADRs: dose related myelosuppression, AKI                                                                                                                                                                                                                                                                                                                                                                      |

# Fungal Infection – Empiric Treatment

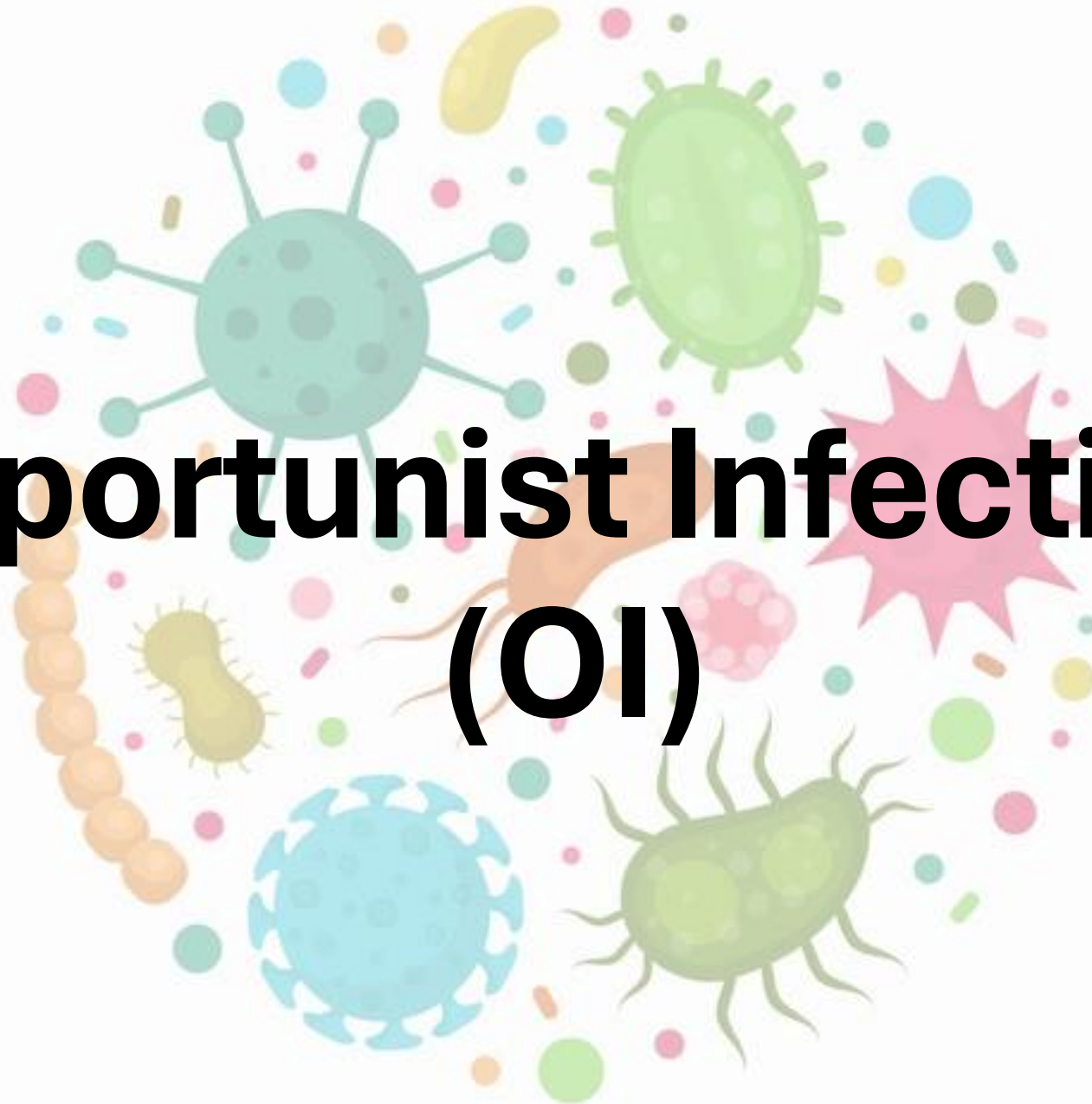
| <b>PATHOGEN</b>                                      | <b>PREFERRED REGIMEN</b>     | <b>ALTERNATIVE REGIMEN</b>    |
|------------------------------------------------------|------------------------------|-------------------------------|
| Candida albicans<br>Oropharyngeal infection (thrush) | Fluconazole                  | Nystatin                      |
| Candida albicans<br>Esophageal infection             | Fluconazole                  | Echinocandin                  |
| Candida krusei and glabrata<br>Bloodstream infection | Echinocandin                 | Amphotericin B                |
| Aspergillus (invasive)                               | Voriconazole, Posaconazole   | Amphotericin B, isavuconazole |
| Cryptococcus neoformans<br>meningitis                | Amphotericin B + flucytosine |                               |

A graphic featuring a light gray circle with a subtle gradient. Numerous orange triangles of varying sizes are scattered around and inside the circle, some pointing outwards and others inwards, creating a dynamic, virus-like pattern. The word "Antivirals" is centered in a bold, black, sans-serif font.

# Antivirals

| ANTIVIRAL      | COMMON INDICATION                                          | PEARLS                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acyclovir      | Herpes Simplex Virus (HSV)<br>Varicella Zoster Virus (VZV) | <b>Warnings</b> <ul style="list-style-type: none"> <li>Needs renal dose adjustment</li> <li>Acyclovir requires adequate hydration to reduce risk of renal tubular damage</li> </ul> <b>Side Effects</b> <ul style="list-style-type: none"> <li>Increased LFTs</li> <li>Neutropenia</li> <li>Increased Scr/BUN with crystal neuropathy</li> </ul> <b>Monitoring</b> <ul style="list-style-type: none"> <li>Renal function, LFTs, CBC</li> </ul> |
| Valacyclovir   |                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Ganciclovir    | Cytomegalovirus (CMV)                                      | <b>Boxed Warnings</b> <ul style="list-style-type: none"> <li>Myelosuppression, carcinogenic, teratogenic</li> </ul> <b>Side Effects</b> <ul style="list-style-type: none"> <li>Thrombocytopenia</li> <li>Neutropenia</li> <li>Leukopenia</li> </ul> <b>Monitoring</b> <ul style="list-style-type: none"> <li>CBC with differential</li> <li>Scr</li> <li>Retinal exam (valganciclovir)</li> </ul>                                              |
| Valganciclovir |                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                |

# Opportunist Infections (OI)



## OI - Primary Prophylaxis

| Infection                                                    | Indication in HIV                                                                                                                                                             | Regimen                                                                                                                                                                                    | Discontinuation                                                |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| <b>Pneumocystis pneumonia (PCP or PJP)</b>                   | CD4+ count <200 cells/mm <sup>3</sup>                                                                                                                                         | <b>Preferred:</b> SMX/TMP DS or SS by mouth daily<br><br>Alternatives:<br>SMX/TMP DS by mouth 3x weekly<br>OR<br>Dapsone<br>OR<br>Atovaquone<br>OR<br>Inhaled pentamidine                  | CD4+ count ≥200 cells/mm <sup>3</sup><br>for ≥ 3 months on ART |
| <b>Toxoplasma gondii encephalitis (commonly called Toxo)</b> | Toxoplasma IgG positive with<br>CD4+ count <100 cells/mm <sup>3</sup>                                                                                                         | <b>Preferred:</b> SMX/TMP DS by mouth daily<br><br>Alternatives:<br>SMX/TMP DS by mouth 3x weekly or 1 SS by mouth daily<br>OR<br>Dapsone + pyrimethamine + leucovorin<br>OR<br>Atovaquone | CD4+ count >200 cells/mm <sup>3</sup><br>for ≥ 3 months on ART |
| <b>Mycobacterium avium complex (MAC) infection</b>           | Not recommended if ART is started immediately<br><br>Initiate if NOT taking ART and CD4+ count <50 cells/mm <sup>3</sup><br><br>Must rule out active disseminated MAC disease | <b>Preferred:</b> Azithromycin 1,200 mg by mouth weekly<br><br>Alternatives:<br>Azithromycin 600 mg by mouth twice weekly<br>OR<br>Clarithromycin 500 mg by mouth twice daily              | Taking fully suppressive ART                                   |

## OI - Treatment

| Infection                                                    | Preferred Regimen                                                              | Alternative                                                                                                              | Secondary Prophylaxis            |
|--------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| <b>Candidiasis (thrush)</b>                                  | Fluconazole                                                                    | Itraconazole, posaconazole                                                                                               | None                             |
| <b>Cryptococcal meningitis</b>                               | Induction therapy:<br>Amphotericin B (deoxycholate or liposomal) + flucytosine | Fluconazole +/- flucytosine                                                                                              | Fluconazole (low dose)           |
| <b>Cytomegalovirus (CMV)</b>                                 | Valgancyclovir<br>OR<br>Ganciclovir                                            | If toxicities to ganciclovir or resistant strains: letermovir, foscarnet, cidofovir                                      | N/A                              |
| <b>Mycobacterium avium complex (MAC) infection</b>           | Clarithromycin OR azithromycin + ethambutol                                    | Add a 3 <sup>rd</sup> or 4 <sup>th</sup> agent using rifabutin, amikacin, or streptomycin, moxifloxacin, or levofloxacin | Same as treatment regimen        |
| <b>Pneumocystis pneumonia (PCP or PJP)</b>                   | SMX/TMP +/- prednisone or methylprednisolone<br><br>Duration: 21 days          | Atovaquone<br>OR<br>Clindamycin + primaquine<br>OR<br>Pentamidine IV<br>OR Dapsone + trimethoprim                        | Same as primary prophylaxis      |
| <b>Toxoplasma gondii encephalitis (commonly called Toxo)</b> | Pyrimethamine + leucovorin + sulfadiazine                                      | SMX/TMP                                                                                                                  | Same as treatment; reduced doses |

An illustration featuring a central globe of the Earth, showing continents in yellow and oceans in blue. The globe is held by five stylized hands of different colors: light blue, light orange, light green, light pink, and light yellow. The hands are positioned around the globe, with fingers pointing towards it, symbolizing global unity and stewardship. The background is white.

# **Antimicrobial Stewardship**

# (Not so) Shocking Facts

01

Reports from 2010: >73 billion antibiotic doses are prescribed worldwide yearly

02

In the United States, children receive an average of 2.7 courses by age 2 and 10.9 by age 10

03

More than 50% of women receive antibiotics during pregnancy or perinatally

04

The CDC reports that at least 28% of antibiotics prescribed in the outpatient setting are unnecessary

# Antimicrobial Stewardship

- **Antimicrobial stewardship:** efforts to coordinate interventions designed to optimize antimicrobial use and ensure the best clinical outcomes while minimizing unintended consequences
  - Combat rising antimicrobial resistance
  - Reduce healthcare costs
  - Improving patient outcomes

## New National Estimate\*

Each year, antibiotic-resistant bacteria and fungi cause at least an estimated:



**2,868,700**  
infections



**35,900** deaths



*Clostridioides difficile*\*\* is related to antibiotic use and antibiotic resistance:



**223,900**  
cases



**12,800** deaths

**AND INCREASES  
IN INFECTIONS  
CAUSED BY:**



**315%**

Erythromycin-resistant  
invasive group A strep



**124%**

Drug-resistant  
*Neisseria gonorrhoeae*



**50%**

ESBL-producing  
Enterobacteriaceae

# Why?

Inconsistency in adoption of CDC recommended strategies to minimize infection spread

Challenges in preventing spread of germs in non-hospital settings

Emerging threats from outside of the United States

Spread of resistant threats in the food supply, animals

Limited outpatient stewardship efforts

# The Threats

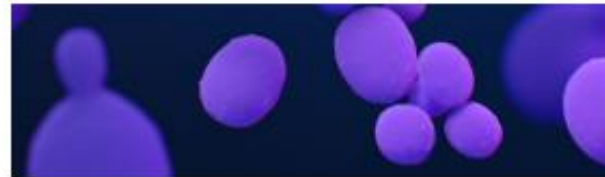


## Urgent Threats

These germs are public health threats that require urgent and aggressive action:



CARBAPENEM-RESISTANT  
***ACINETOBACTER***



***CANDIDA AURIS***



***CLOSTRIDIoidES DIFFICILE***



CARBAPENEM-RESISTANT  
***ENTEROBACTERIACEAE***



DRUG-RESISTANT  
***NEISSERIA GONORRHOEAE***

# The Threats

## Serious Threats

- Drug-resistant *Campylobacter*
- Drug-resistant *Candida*
- Extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae
- Vancomycin-resistant *Enterococci* (VRE)
- Multidrug-resistant *Pseudomonas aeruginosa* (*P. aeruginosa*)
- Drug-resistant nontyphoidal *Salmonella*
- Drug-resistant *Salmonella* serotype Typhi
- Drug-resistant *Shigella*
- Methicillin-resistant *Staphylococcus aureus* (MRSA)
- Drug-resistant *Streptococcus pneumoniae* (*S. pneumoniae*)
- Drug-resistant Tuberculosis (TB)

## Concerning Threats

- Erythromycin-resistant group A *Streptococcus*
- Clindamycin-resistant group B *Streptococcus*

## Watch List

- Azole-resistant *Aspergillus fumigatus* (*A. fumigatus*)
- Drug-resistant *Mycoplasma genitalium* (*M. genitalium*)
- Drug-resistant *Bordetella pertussis* (*B. pertussis*)



Available data show an alarming increase in resistant infections starting during hospitalization, growing at least 15% from 2019 to 2020.

- Carbapenem-resistant *Acinetobacter* (↑78%)
- Antifungal-resistant *Candida auris* (↑60%)\*
- Carbapenem-resistant Enterobacterales (↑35%)
- Antifungal-resistant *Candida* (↑26%)
- ESBL-producing Enterobacterales (↑32%)
- Vancomycin-resistant Enterococcus (↑14%)
- Multidrug-resistant *P. aeruginosa* (↑32%)
- Methicillin-resistant *Staphylococcus aureus* (↑13%)

The COVID-19 pandemic did not help

1935 – prontosil rubrum (sulfa)  
1942 – benzyl penicillin  
1944 – streptomycin, 1<sup>st</sup> AG  
1948 – chlortetracycline – 1<sup>st</sup> tetracycline  
1949 – chloramphenicol

1960 – methicillin  
1960 – metronidazole  
1961 – trimethoprim  
1964 – gentamicin  
1964 – cephalothin – 1<sup>st</sup> ceph  
1967 – nalidixic acid – 1<sup>st</sup> FQ  
1968 – clindamycin

1980s – 17 cephalosporins, 5 penicillins  
1985 – imipenem – 1<sup>st</sup> carb  
1986 – aztreonam – 1<sup>st</sup> mono  
1987 – ciprofloxacin

2000 – linezolid – 1<sup>st</sup> oxazolidinone  
2003 – daptomycin  
2005 – tigecycline  
2005 – doripenem  
2009 – telavancin – 1<sup>st</sup> lipoglycopeptide

2021\* – sulopenem  
Phase 3  
Cefepime/taniborbactam  
Cefepime/enmetazobactam  
Cefepime/zidebactam  
Tebipenem  
Gepotidacin  
Zoliflodacin  
Ridinilazole

1930s-1940s

1950s

1960s

1970s

1980s

1990s

2000s

2010s

2020s

1950 – penicillin G  
1952 – erythromycin – 1<sup>st</sup> macrolide  
1955 – tetracycline  
1955 – vancomycin – 1<sup>st</sup> glycopeptide  
1958 – colistin – 1<sup>st</sup> polymyxin

1970s – 9 cephs  
1972 – amoxicillin, minocycline  
1975 – tobramycin  
1976 – amikacin

1990s – 8 cephs  
1990 – clarithromycin  
1991 – azithromycin  
1992 – pip/tazo  
1993 – levofloxacin  
1994 – cefepime  
1996 – meropenem  
1999 – quinupristin/dalfopristin, moxifloxacin

2010 – ceftaroline  
2011 – fidaxomicin  
2014 – dalbavancin, oritavancin, tedizolid, ceftolozane/tazo  
2015 – ceftaz/avibactam  
2017 – delafloxacin, mero/vaborbactam  
2018 – plazomicin, omadacycline, eravacycline  
2019 – imi/relebactam, lefamulin, cefiderocol

| Hospital Core Elements                                                                                                                                                                                                                | Priorities for Hospital Core Element Implementation                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Hospital Leadership Commitment</b>                                                                                                                                                                                                 |                                                                                                                                                                                                                                                        |
|  Dedicate necessary human, financial, and information technology resources.                                                                          | Antibiotic stewardship physician and/or pharmacist leader(s) have antibiotic stewardship responsibilities in their contract, job description, or performance review.                                                                                   |
| <b>Accountability</b>                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                        |
|  Appoint a leader or co-leaders, such as a physician and pharmacist, responsible for program management and outcomes.                                | Antibiotic stewardship program is co-led by a physician and pharmacist.*                                                                                                                                                                               |
| <b>Pharmacy/Stewardship Expertise</b>                                                                                                                                                                                                 |                                                                                                                                                                                                                                                        |
|  Appoint a pharmacist, ideally as the co-leader of the stewardship program, to help lead implementation efforts to improve antibiotic use.           | Antibiotic stewardship physician and/or pharmacist leader(s) have completed infectious diseases specialty training, a certificate program, or other training on antibiotic stewardship.                                                                |
| <b>Action</b>                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                        |
|  Implement interventions, such as prospective audit and feedback or preauthorization, to improve antibiotic use.                                     | Antibiotic stewardship program has facility-specific treatment recommendations for common clinical condition(s) and performs prospective audit/feedback or preauthorization.                                                                           |
| <b>Tracking</b>                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                        |
|  Monitor antibiotic prescribing, impact of interventions, and other important outcomes, like <i>C. difficile</i> infections and resistance patterns. | Hospital submits antibiotic use data to the NHSN Antimicrobial Use Option.                                                                                                                                                                             |
| <b>Reporting</b>                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                        |
|  Regularly report information on antibiotic use and resistance to prescribers, pharmacists, nurses, and hospital leadership.                       | Antibiotic use reports are provided at least annually to target feedback to prescribers. In addition, the antibiotic stewardship program monitors adherence to facility-specific treatment recommendations for at least one common clinical condition. |
| <b>Education</b>                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                        |
|  Educate prescribers, pharmacists, nurses, and patients about adverse reactions from antibiotics, antibiotic resistance, and optimal prescribing.  | No implementation priority identified.                                                                                                                                                                                                                 |

# Updated Joint Commission requirements for accreditation

**New accreditation requirements →**  
Implemented January 2023



**12 new and revised** requirements to decrease unnecessary antimicrobial utilization in the hospital setting

- Including critical access hospitals



# Stewardship Tactics

Prospective Audit  
and Feedback  
(PAF)

Preauthorization  
protocols

Institutional  
Guidelines,  
Protocols,  
Ordersets

# Prospective Audit and Feedback (PAF)

Process most commonly involves an ID physician or a clinical pharmacist with ID training reviewing active antimicrobial prescriptions to identify opportunities to enhance the safety and/or effectiveness of therapy

Widely recognized as one of the most effective antibiotic stewardship practices

Viewed as a core component of many hospital ASPs

# Outcomes of Successful PAF

## **8-year, pharmacist-led PAF program:**

- Decreased rates of MRSA
- Increased *Pseudomonas aeruginosa* susceptibility to carbapenems
- Decreased antimicrobial therapy duration
- Decreased number of days on IV therapy
- Increased cost savings

# Preauthorization

Institutional process requiring approval from an antimicrobial stewardship team before prescribing certain antimicrobials



Implementation requires integration into EHR and clinical staff education



## Benefits

Reduction in inappropriate usage of novel or broad-spectrum antibiotics

Cost savings

Institutional commitment to antimicrobial stewardship

Enhance the effectiveness of both PAF and preauthorization

Can optimize antibiotic selection and duration for common indications

Can include guidance on diagnostic approaches (especially empirically)

Based on national guidelines, optimized based on local antibiograms

## Institutional Guidelines

# Members of the Stewardship Team



Infectious Diseases  
trained Physicians,  
Pharmacists, APPs



Infection Prevention and  
Microbiology colleagues



Nurses



**We're all  
stewards!**





**Questions?**



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