Beta-Lactams: Penicillin Family

Antibiotics	Bacteria	Notes
Natural Penicillin (PCN G / PCN V)	↦ Strep ↦ Staph (non-β-lactamase) ↦ Treponema pallidum (syphilis)	DOC for Syphilis
Anti-Staph. Penicillin (Nafcillin / Dicloxacillin)	↦ Staph. aureus (penicillinase-producing) ↦ Some Strep	DOC for MSSA infections
Aminopenicillins (Ampicillin / Amoxicillin)	↦ Streptococcus spp. ↦ Enterococcus faecalis ↦ Enterobacteriaceae (some) ↦ Listeria monocytogenes	DOC for susceptible Enterococcus and Listeria infections
Amoxicillin/clavulanate (Augmentin®)	↦ Strep + Staph. aureus ↦ E. coli + Klebsiella ↦ H. flu + Moraxella catarrhalis ↦ Anaerobes	Mixed infections: (GP+GN+anaerobes) such as Diabetic Foot Ulcers
Ampicillin/sulbactam (Unasyn®)	Similar to Amoxicillin/clavulanate + broader activity against anaerobes (sulbactam = acinetobacter)	Mixed infections: (GP+GN+anaerobes) such as Diabetic Foot Ulcers
Piperacillin/tazobactam (Zosyn®)	Similar to Amoxicillin/clavulanate + Pseudomonas aeruginosa	Same as above PLUS Pseudomonas

Mechanism of Action:
1. Binds to Penicillin Binding Proteins (PBPs) located on the bacterial cell wall
2. PBPs catalyze peptidoglycan synthesize which interferes with bacterial cell wall construction → Bacteria lysis and death
3. Number and type of PBPs vary between different bacteria
4. Time Dependent killing

Beta-Lactam: Cephalosporin

Antibiotics	Bacteria	Drug-of-Choice
1st Generation (Cefazolin / Cephalexin)	↦ Streptococcus + Staph (including some MSSA) ↦ PEK: Proteus, E. coli, Klebsiella pneumoniae	SSTI Surgical prophylaxis
2nd Generation (Cefoxitin / Cefotetan)	Enhanced activity against gram (–) bacteria including ↦ Some anaerobes (B. fragilis) ↦ Streptococcus + Staph (including some MSSA) ↦ H. flu + Enterobacter aerogenes	Intra-abdominal infections Prophylaxis pre-surgery

Beta-Lactam: Cephalosporin (cont)		
2nd Generation (Cefuroxime / Cefaclor)	↦ Streptococcus + Staph (including some MSSA) ↦ H. influenzae + M. catarrhalis + Neisseria (some) ↦ E. coli + K. pneumoniae	URT infections
3rd Generation (Ceftriaxone / Ceftazidime)	Broad spectrum including ↦ Many gram (–) bacteria ↦ Streptococcus + Staph (including some MSSA) ↦ H. influenzae + M. catarrhalis + Neisseria ↦ (Ceftazidime = Pseudomonas)	Meningitis Gonorrhea (Ceftriaxone)
3rd Generation (Cefixime / Cefpodoxime / Cefdinir)	↦ Streptococcus + Staph (including some MSSA) ↦ H. influenzae + M. catarrhalis ↦ Enterobacteriaceae: E. coli + K. pneumoniae	Community-acquired infections
4th Generation (Cefepime)	Broad-spectrum activity including ↦ Pseudomonas aeruginosa ↦ Many gram (–) bacteria ↦ Streptococcus + Staph (including some MSSA)	HAP Febrile neutropenia
5th Generation/Anti-MRSA (Ceftaroline)	Broad spectrum including ↦ MRSA + Streptococcus spp ↦ Some gram (–) bacteria	SSTI CAP

Very safe antibiotics
Less frequent dosing compared to PCNs
Cephalosporins are intrinsically resistant to ALL Enterococci and Listeria species
All agents are metabolized by the kidneys EXCEPT Ceftriaxone (hepatic metabolism; hepatic/renal excretion)

Beta-Lactam: Carbapenems Family		
Antibiotics	**Bacteria**	**Drug-of-Choice**
Imipenem/Cilastatin **Meropenem**	↦ Gram (+) – Not Enterococcus faecium ↦ Gram (–) & Pseudomonas ↦ Anaerobes	↦ DOC for Enterobacter, Serratia and ESBL ↦ Severe hospital-acquired infections ↦ Complicated infections
Ertapenem	↦ Gram (+) cocci ↦ Many Gram (–) rods ↦ Anaerobes ↦ Less active against Pseudomonas and Acinetobacter	↦ CAP ↦ Complicated intra-abdominal infections

Beta-Lactam: Carbapenems Family (cont)

Meropenem/Vaborbactam	Same as ABOVE PLUS	↦ Complicated UTIs
Imipenem/Cilastatin/Relebactam	↦ Resistant gram (–) such as CRE	↦ HAP/VAP

Carbapenems are very broad spectrum (similar in activity to Piperacillin/Tazobactam) and usually used for hospital acquired/serious/resistant infections

1) Usually used for hospital acquired organisms that have developed resistance to other cell wall inhibitors (aka, Extended Spectrum Beta Lactamase Producers)

2) Reserve to use for resistant infections

Beta-Lactam: Monobactam Family

Antibiotics	Bacteria	Drug-of-Choice
Aztreonam	↦ ONLY Gram (–) including Neisseria, H. flu, Enterobacteriaceae, and Pseudomonas ↦ No anaerobes	↦ Alternative agent for GRAM (-) infections in those with PCN allergies ↦ Mainly for hospital related infections, critically ill, or sepsis.

Narrower spectrum of activity compared to other beta-lactams

1) ONLY Gram (-) activity, no anaerobes

2) No cross reactivity with other beta-lactams

3) Can be used safely in those with PCN allergies

Vancomycin and Glycopeptides

Antibiotics	Bacteria	Drug-of-Choice
Vancomycin	↦ ONLY gram (+) including MRSA and sensitive Enterococci ↦ PO for C. diff	↦ For either resistant infections or beta-Lactam allergies ↦ Must monitor levels: AUC/MIC ratio ↦ PO can be used for C. diff infections
Televancin	↦ Only Gram (+) including MRSA and sensitive Enterococci ↦ DOES NOT cover VRE	↦ Potentially can be used for Vancomycin-resistant S. aureus (VRSA) ↦ Increase mortality when used for HAP with renal impairment ↦ Contraindicated in pregnancy
Dalbavancin	↦ Only Gram (+) including MRSA and sensitive Enterococci	↦ Skin/Soft Tissue Infections (SSTIs)
Oritavancin	↦ Only Gram (+) including MRSA and sensitive Enterococci ↦ COVERS VRE	↦ Skin/Soft Tissue Infections (SSTIs)

1) Only has Gram (+) Activity

2) Mainly used to cover either Beta-Lactam Resistant Infections (MRSA, PCN resistant Strep pneumo, Amp resistant Enterococcus) OR

3) Alternative for Gram (+) infections in those with Beta-Lactam allergies

Daptomycin vs. Polymyxin (Colistin)

Daptomycin	ONLY Gram (+) and for resistance infection including ↦ MRSA/MSSA/VISA/VRSA ↦ Enterococci (include VRE) ↦ Streptococcus	↦ Alternative agent for GRAM (-) infections in those with PCN allergies ↦ Mainly for hospital related infections, critically ill, or sepsis.

Daptomycin vs. Polymyxin (Colistin) (cont)

Colistin	Resistant Gram (–) infections including Pseudomonas	For resistant Gram (-) infections

Daptomycin: Cannot use for pneumonia due to inactivation by lung surfactant
Polymyxin: Old class of drugs that have gained new popularity for resistant Gram (-) infections

Macrolide Family

Antibiotics	Bacteria	Drug-of-Choice
Erythromycin	↦ Gram (+) ↦ Gram (–) ↦ Atypical organisms ↦ Mycobacterium sp.	↦ CAP / Sinusitis / Otitis Media ↦ Atypical infections ↦ Lyme's disease
Clarithromycin	↦ Gram (+) ↦ Gram (–) ↦ Atypical organisms ↦ Mycobacterium sp. ↦ BETTER H.flu coverage	↦ CAP / Sinusitis / Otitis Media ↦ Atypical infections ↦ Lyme's disease ↦ Mycobacterial infections
Azithromycin	↦ Gram (+), but less activity ↦ Gram (–) ↦ Atypical organisms ↦ Mycobacterium sp. ↦ BETTER H.flu coverage	↦ CAP / Sinusitis / Otitis Media ↦ Atypical infections ↦ Lyme's disease ↦ Mycobacterial infections ↦ Frequently used as one time dose (1 g) for Chlamydia treatment.

Can be used safely with PCN allergies

Macrolide Family

Antibiotics	Bacteria	Drug-of-Choice
Erythromycin	↦ Gram (+) ↦ Gram (–) ↦ Atypical organisms ↦ Mycobacterium sp.	↦ CAP / Sinusitis / Otitis Media ↦ Atypical infections ↦ Lyme's disease
Clarithromycin	↦ Gram (+) ↦ Gram (–) ↦ Atypical organisms ↦ Mycobacterium sp. ↦ BETTER H.flu coverage	↦ CAP / Sinusitis / Otitis Media ↦ Atypical infections ↦ Lyme's disease ↦ Mycobacterial infections
Azithromycin	↦ Gram (+), but less activity ↦ Gram (–) ↦ Atypical organisms ↦ Mycobacterium sp. ↦ BETTER H.flu coverage	↦ CAP / Sinusitis / Otitis Media ↦ Atypical infections ↦ Lyme's disease ↦ Mycobacterial infections ↦ Frequently used as one time dose (1 g) for Chlamydia treatment.

Can be used safely with PCN allergies

Tetracyclines Family

Antibiotics	Bacteria	Drug-of-Choice
Tetracycline **Doxycycline** **Minocycline**	Gram (+) ↦ MRSA & Streptococcus Some Gram (-) ↦ Atypical infections ↦ Chlamydia/gonorrhea ↦ Tick borne disease	↦ Tick or spider bites ↦ Lyme's Disease ↦ CAP ↦ SSTI, esp. MRSA ↦ Atypical respiratory infections
Tigecycline	Gram (+) ↦ MRSA & Streptococcus ↦ VRE Some Gram (-) Some Anaerobe Atypical infections	↦ Chlamydia/gonorrhea ↦ Tick borne disease ↦ Complicated IAI ↦ Skin/soft tissue infections ↦ MRSA/VRE infections
Eravacycline **Omadacycline**	Gram (+) ↦ MRSA & Streptococcus ↦ VRE Some Gram (-) Some Anaerobe Atypical infections	↦ SSTI ↦ CAP ↦ Complicated intra-abdominal infection (IAI)

Spectrum of Activity: Very Broad- Gram-positive (including MRSA), Gram-negative, Rickettsia and other Tick borne diseases, Chlamydia, some protozoa
Omadacycline, Eravacycline, and Tigecycline also cover enterococci (including VRE)

Aminoglycosides Family

Antibiotics	Bacteria	Drug-of-Choice
Tobramycin **Gentamicin** **Amikacin**	↦ Gram (-) + Pseudomonas ↦ Gram (+) → Synergy dosing for Enterococcal infective Endocarditis ↦ Amikacin only covers mycobacterium sp.	↦ Resistant G- infections ↦ Synergy with beta-lactam/glycopeptide in entero-coccal endocarditis
Plazomicin	↦ Gram (-) + Pseudomonas ↦ Gram (+) → Synergy w/ with a beta-lactam/glycopeptide for Entero-coccal infective Endocarditis ↦ CRE	↦ Resistant G- infections, including UTI ↦ Plague

Spectrum of Activity
1) Mostly Gram (-), mycobacterium, synergy for Gram + infections when used with a beta-lactam or glycopeptide
2) Most frequently used now for resistant gram – infections or in combination with an extended spectrum beta-lactam (additional coverage for resistant Gram (-) infections) in serious infections such as neutropenic fever or sepsis

Oxazolidinones Family

Antibiotics	Bacteria	Drug-of-Choice
Linezolid	ALL Gram (+) organisms ↦ MsSA/MRSA/VISA/VRSA ↦ Enterococci (VRE) ↦ Streptococcus Some Atypicals	↦ SSTIs ↦ Suspected MRSA / VRE infections
Tedizolid	Same as ABOVE PLUS ↦ Gram (-) anaerobes	↦ SSTIs

Spectrum of Activity: Gram + (MRSA + VRE) , some atypical organisms, Mycobacterium sp., and Nocardia

Others Protein Synthesis Inhibitors

Antibiotics	Bacteria	Drug-of-Choice
Lincosamide (Clindamycin)	↦ Gram (+) → MSSA + some MRSA ↦ Anaerobes (esp. mouth) including Peptostreptococcus, Bacteroides, Prevotella, and Fusobacterium Strep + Staph infections	↦ DOC for Pelvic Inflammatory Disease (PID) ↦ Used in combo with PCN for toxin producing strains for Clostridium perfringens and S. pyogenes; commonly occurs with necrotizing fasciitis ↦ Alternative for G+ infections with PCN allergy ↦ Dental infections, IAI, and Pelvic infections ↦ Can be used topically for acne
Pleuromutilin (Lefamulin)	↦ Gram (+) organisms ↦ Gram (-) organisms (limited) ↦ Atypicals	↦ CAP
Streptogramins (Quinupristin/Dalfopristin)	↦ Gram (+) organisms ↦ MSSA/MRSA ↦ Strep ↦ Enterococcus (VRE)	

Fluoroquinolones Family

Antibiotics	Bacteria	Drug-of-Choice
Ciprofloxacin	↦ Mostly Gram (+) ↦ Some Gram (–) → Pseudomonas, but not as good as other agents ↦ Atypical organisms	↦ UTIs ↦ GNR bacteremia, bone/joint infections, hospital related infections ↦ Alternative for GNR infections in those w/ beta-lactam allergies ↦ DON'T use for respiratory infections

Fluoroquinolones Family (cont)

Levofloxacin	↦ Mostly Gram (+) ↦ Some Gram (–) → Pseudomonas, but not as good as other agents ↦ Atypical organisms	↦ UTIs / CAP / SSTIs / Sinusitis ↦ GNR bacteremia, bone/joint infections, and hospital related infections ↦ Alternative for GNR infections in those w/ beta-lactam allergies ↦ Alternative for mycobacterial infections
Delafloxacin	↦ Gram (+): MRSA ↦ Some Gram (-) →Pseudomonas ↦ Atypical organisms	↦ SSTIs
Moxifloxacin	↦ Mostly Gram (+) ↦ Some Gram (-) → Not as good as other agents ↦ Atypical organisms ↦ Anaerobic coverage	↦ CAP / SSTIs

Spectrum of Activity: Varies by Agent, but broad spectrum (Gram +, Gram -, Atypical)
1) Respiratory FQ: Levofloxacin, Delafloxacin, Moxifloxacin ("Let's Do Meditation")
2) Pseudomonas: Levofloxacin, Ciprofloxacin, Delafloxacin ("Let's Cancer Die")
3) Anaerobes: Moxifloxacin
4) MRSA: Delafloxacin ("MR Del is like Modella beer")

Rifamycins Family

Antibiotics	Bacteria	Drug-of-Choice
Rifampin	↦ Mycobacterium species ↦ Gram (+) → MRSA	↦ Never use as solo agent
Rifabutin	↦ Mycobacterium species	↦ Less DDIs → Preferred drug for patients on antiretrovirals
Rifapentine	↦ Mycobacterium species	
Rifaximin	↦ Gram (+) ↦ Gram (-) → Enterobacteriaceae	↦ Only active in GI tract ↦ Can't use to treat systemic infections

Spectrum of Activity
• Rifampin, Rifabutin, Rifapentine → Mycobacterium species
• Rifampin: Gram + (MRSA); never use ALONE
• Rifaximin: Gram +, Gram – such as Enterobacteriaceae; ONLY active in the GI tract

Miscellaneous Nucleic Acid Synthesis Inhibitors

Antibiotics	Bacteria	Drug-of-Choice
Metronidazole	↦ Gram (+) ↦ Gram (–) ↦ Anaerobes ↦ Protozoa	↦ In combo with other agents to cover anaerobes ↦ Bacterial vaginosis ↦ H. pylori treatment ↦ Crohn's disease ↦ Giardia infections

Miscellaneous Nucleic Acid Synthesis Inhibitors (cont)

Nitrofurantoin	↦ Gram (+) → Staph	↦ Lower UTIs
Fosfomycin	↦ Gram (–) → Enterococcus (VRE) + GNR ↦ Fosfomycin covers ESBL	

Metronidazole: Gram – and + anaerobes and protozoa

Nitrofurantoin: Staphylococcus, Enterococcus (including VRE) and GNRs (not pseudomonas)

Fosfomycin: Staphylococcus, Enterococcus (including VRE) and GNRs including many resistant one such as ESBL

Sulfonamides Family

Antibiotics	Bacteria	Drug-of-Choice
Sulfonamides (Sulfamethoxazole/trimethoprim)	↦ Some streptococcus sp. ↦ Staphylococcus (MRSA) ↦ Enterobacteriaceae, Listeria, and Nocardia ↦ Pneumocystis jiroveci	↦ DOC for Nocardia and Pneumocystis jiroveci ↦ UTIs / SSTIs (MRSA) ↦ Treatment of/prevention of infection in immunocompromised