

Antibiotics for Treatment of Pneumonias

1. B-Lactam antibiotics(Penicillins)

MOA: Inhibitors of bacterial cell wall synthesis.

Drug Name(s)	Antimicrobial spectrum	Notable Side Effects
Ampicillin/Sulbactam OR Amoxicillin/Clavulanate**	-Gram positive cocci, anaerobes, enterococci, Listeria monocytogenes - β-lactamase negative strains of gram negative cocci and bacilli such as Haemophilus influenzae, E. coli, proteus mirabilis and Salmonella sp. - Acinetobacter is treated better with ampicillin/salbactam.	1. Hypersensitivity reactions (0.7-10% of patients): (maculopapular rash, urticaria, fever, bronchospasm, vasculitis, serum sickness, angioneurotic edema, exfoliative dermatitis and anaphylaxis (0.05%)). 2. Toxic nonallergic skin rash in patients with infectious mononucleosis given ampicillin (100% of patients).
Piperacillin/Tazobactam (Anti-pseudomonal)	Pseudomonas aeruginosa pneumonia, Enterobacter, and indole positive Proteus(in combination with aminoglycosides or fluoroquinolones). Methicillin-sensitive S. aureus (MSSA). NOTE: Piperacillin contains 2 mEq Na ⁺ / gram.	3. Superinfection: pseudomembranous colitis due to Clostridium difficile and diarrhea, vaginal candidiasis with extended spectrum penicillins. 4. Heart failure with antipseudomonal penicillins due to Na ⁺ overload >hypokalemia 5. Bone marrow depression, granulocytopenia and hepatitis – oxacillin, nafcillin.
Oxacillin & Nafcillin	Favored for methicillin-sensitive Staphylococcal infections.	5. Oral lesions, fever, interstitial nephritis, eosinophilia, hemolytic anemia and vasculitis

****Therapeutic uses:**

1. Upper respiratory tract infection caused by Streptococcus pyogenes, Streptococcus pneumoniae, H. influenzae (sinusitis, otitis media, acute exacerbation of chronic bronchitis and epiglottitis).
2. Urinary tract infection due to E. coli.
3. Meningitis due to: a. H. influenzae, Streptococcus pneumoniae, Neisseria meningitidis. b. Listeria monocytogenes in immunocompromised patients (excellent activity).

2. B-Lactam antibiotics (Cephalosporins)

MOA: Inhibitors of bacterial cell wall synthesis (similar to Penicillins).

Drug Name(s)	Key Indications / Therapeutic Uses	Notable Side Effects
Second-Gen (Cefuroxime)	-Sinusitis, otitis and lower respiratory tract infections caused by <i>Haemophilus influenzae</i> and <i>Moraxella catarrhalis</i> . -Community acquired pneumonia by β -lactamase producing <i>Haemophilus influenzae</i> , <i>Klebsiella</i> and penicillin resistant pneumococc.	1. Hypersensitivity reactions are the most common(~ 5-10% cross-sensitivity with penicillins) 2. Bone marrow depression granulocytopenia. 3. Nephrotoxicity, including interstitial nephritis and even tubular necrosis especially with preexisting renal disease or in the presence of other nephrotoxic agents.
Third-Gen (Ceftazidime)	Specifically for <i>Pseudomonas aeruginosa</i> (in combination with aminoglycosides).	4. Local irritation can produce severe pain after IM injection and thrombophlebitis after IV injection . 5. Serious bleeding: hypoprothrombinemia, thrombocytopenia & platelet dysfunction.
Fourth-Gen (Cefepime)	<i>Psuedomonas</i> , <i>Enterobacteriaceae</i> , <i>Staphylococcus aureus</i> , <i>Streptococcus pneumoniae</i> (including penicillin-resistant), <i>Haemophilus influenzae</i> .	

3. Carbapenems & Monobactams

MOA: Inhibitors of bacterial cell wall synthesis.

Drug Name(s)	Key Indications / Therapeutic Uses	Notable Side Effects
Imipenem & Meropenem	-Drugs of choice for Enterobacter - <i>P. aeruginosa</i> resistant to other drugs. -Febrile neutropenic patients in combination with aminoglycosides . -Intra-abdominal and gynecological infections -Highly penicillin-resistant strains of pneumococci. -Mixed aerobic and anaerobic nosocomial organisms. - Urinary tract infections, lower respiratory infections, skin and soft tissue infections, bone and joint infections.	1. Nausea, vomiting and diarrhea 2. Seizures with high doses or in patients with CNS lesions or renal insufficiency (less with meropenem and ertapenem). 3. Hypersensitivity reactions, with some cross-sensitivity with other β -lactams. 4. Local reactions at infusion sites. NOTE: Meropenem more activity against gram negative aerobes , less activity against gram positive.
Aztreonam (Monobactam)	Active against <i>Enterobacteriaceae</i> and <i>P. aeruginosa</i> , <i>H. influenzae</i> and gonococci No activity against Gram-positive & anaerobes.	Skin rash, elevated serum aminotransferases (potential hepatitis), local reactions at site of injection, GIT upset , thrombocytopenia ,neutropenia.

4. Aminoglycosides

MOA: Bactericidal inhibitors of protein synthesis.

Drug Name(s)	Key Indications / Therapeutic Uses	Notable Side Effects
Gentamicin, Amikacin, Tobramycin	Gram-negative enteric bacteria(pseudomonas, proteus, enterobacter, acinetobacter,klebsiella, serratia) Often combined with B-lactams for synergism against Gram-positives(enterococci, streptococci)	Ototoxicity (tinnitus/hearing loss) when therapy is continued for more than 5 days, Nephrotoxicity , and neuromuscular junction block (respiratory paralysis). hypersensitivity reactions rare, pain at the injection site , contraindicated during pregnancy.

5. Fluoroquinolones

MOA: Block DNA synthesis by inhibiting topoisomerase II (DNA gyrase) and IV.

Drug Name(s)	Therapeutic Uses+>>>	Antimicrobial spectrum	Notable Side Effects
Levofloxacin, Ciprofloxacin, Moxifloxacin	-Used for upper and lower respiratory tract infections (levofloxacin, gatifloxacin, gemifloxacin, moxifloxacin) Levofloxacin: Streptococcus pneumoniae Ciprofloxacin: Pseudomonas aeruginosa Moxifloxacin: anaerobic bacteria	-excellent gram negative activity (Enterobacteriaceae, Pseudomonas, Neisseria, Haemophilus and Campylobacter) -good activity against gram positive bacteria -atypical pneumonia (Mycoplasma and Chlamydia) -intracellular pathogens (Legionella and Mycobacteria.)	-Nausea, vomiting, diarrhea -Headache, dizziness, insomnia, skin rash, abnormal liver function tests -Photosensitivity(lomefloxacin & pefloxacin) -QTc prolongation → arrhythmias (gatifloxacin, levofloxacin, gemifloxacin, moxifloxacin) -Hyperglycemia associated with gatifloxacin (even with oral hypoglycemics) -Damage of growing cartilage → arthropathy Contraindicated under 18 years -Tendonitis and tendon rupture (Adult) -Contraindicated in pregnancy

اللهم صل وسلم وبارك على نبينا محمد وعلى آله وصحبه أجمعين

6. Others: Macrolides, Tetracyclines, & Glycopeptides

Group / Drug	MOA	Key Indications	Side Effects
Macrolides (Erythromycin, Azithromycin)	Bacteriostatic inhibitors of protein synthesis.	Drug of choice for corynebacterial infections including diphtheria, sepsis, and erythrasma. -Chlamydia infections of the respiratory, neonatal, ocular, and genital systems. -Community-acquired pneumonia caused by Mycoplasma, Legionella, and pneumococcus. -Alternative to penicillin for streptococcal, pneumococcal, and susceptible staphylococcal infections in allergic patients. -Emergence of resistance make them less attractive first line agents for pharyngitis, skin and soft tissue infections and pneumonia. -Treatment for Legionnaire's disease.	-Acute cholestatic hepatitis (erythromycin estolate) involving intrahepatic obstruction, fever, jaundice, and impaired function. -Allergic reactions: fever, eosinophilia, and rashes. - Epigastric distress, anorexia, nausea, vomiting, and diarrhea. - Increased GI motility/colic due to stimulation of motilin receptors (erythromycin). -Interactions: Erythromycin inhibits CYP3A4, increasing levels of theophylline, methylprednisolone, cyclosporine, and oral anticoagulants. -Increased bioavailability of digoxin (not seen with azithromycin).
Tetracyclines (Doxycycline, Minocycline, Tigecycline)	Inhibit microbial protein synthesis.	-Active against many Gram-positive and Gram-negative bacteria, anaerobes, rickettsiae, chlamydiae, mycoplasma, L forms, and amebae. -Alternative to macrolides for pneumonia caused by chlamydiae and mycoplasma.	-Hypersensitivity: drug fever and skin rash. -GIT: nausea, vomiting, and diarrhea. -Superinfections: Pseudomonas, Proteus, S. aureus, Coliforms, Clostridia, and Candida. -Bone & Teeth: Fluorescence, discoloration, and enamel dysplasia in fetal teeth; fetal bone deformity or growth inhibition. -Similar bone/teeth damage in children below 8 years of age. -Liver toxicity(hepatic necrosis)and kidney toxicity(renal tubular acidosis). -Local tissue toxicity: Thrombophlebitis (IV) and local pain (IM). -Photosensitivity and vestibular reactions (dizziness, vertigo, nausea, vomiting).

Group / Drug	MOA	Key Indications	Side Effects
Vancomycin	Cell wall synthesis inhibitor.	-Oral: Pseudomembranous colitis caused by <i>C. difficile</i> . -IV: MRSA infections (sepsis/endocarditis). -Staphylococcal and streptococcal infections in penicillin-allergic patients. -Enterococcal endocarditis (with gentamicin). -Meningitis from highly penicillin-resistant pneumococci (with cefotaxime, ceftriaxone, or rifampin). <i>-Therapeutic concentrations: peak 20-40~mg/L, trough 5-10~mg/L.</i>	-"Red man" or "red neck" syndrome: Infusion-related flushing from histamine release. -Ototoxicity and nephrotoxicity. -Neutropenia and drug fever. -Phlebitis at the injection site.
Linezolid	Inhibits initiation of protein synthesis. -It is primarily bacteriostatic, except for streptococci where it is bactericidal.	-Against gram positive organisms: Staphylococci, streptococci, enterococci, gram positive anaerobic cocci, gram positive rods (<i>Corynebacteria</i> , <i>Listeria monocytogenes</i>). -vancomycin-resistant <i>Staphylococcus aureus</i> , <i>Enterococcus faecium</i> , nosocomial pneumonia, community-acquired pneumonia and skin infection. -It should be reserved for infections caused by multi-drug resistant gram positive bacteria.	-Gastrointestinal upset and headache. -Thrombocytopenia and neutropenia. -Weak MAO inhibition. -Allergy/rash.
Polymyxins Polymyxin B, Polymyxin E (Colistin)	Cationic detergents; disrupt cell membranes.	Salvage therapy for MDR <i>Acinetobacter baumannii</i> , <i>Pseudomonas aeruginosa</i> , and <i>Klebsiella pneumonia</i> .	Nephrotoxicity, Severe hypocalcemia, hypomagnesemia, and hypokalemia follow renal injury, Neurotoxicity, Allergic reactions, <i>Clostridium difficile</i> associated diarrhea, Rhabdomyolysis.

Main Causative Microorganisms for pneumonia:

1. Streptococcus pneumonia (community acquired)
2. Mycoplasma pneumonia + other atypical bacteria (community acquired)
3. Gram-negative aerobic bacilli, S. aureus, and multidrug-resistant (MDR) pathogens.
Pseudomonas aeruginosa, Acinetobacter, E. coli, Klebsiella spp, Enterobacter spp, Proteus sp, Citrobacter, Bacillus, and Serratia (Hospital acquired)
4. Anaerobic bacteria following aspiration of gastric or oropharyngeal contents.



اللهم اجعل أجر هذا العمل صدقة جارية عن روح عمر عطيه عوده المرابي

اللَّهُمَّ اغْفِرْ لَهُ وَارْحَمْهُ، وَاعْفُ عَنْهُ وَعَافِهِ، وَأَكْرِمْ نُزُلَهُ، وَوَسِّعْ مُدْخَلَهُ، وَ
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اللَّهُمَّ أبدله داراً خيراً من داره، وأهلاً خيراً من أهله، وأدخله الجنة، وأعذه من
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اللهم اغفر لحينا وميتنا وشاهدنا وغائبنا وصغيرنا وكبيرنا وذكرنا وأنثانا اللهم
من أحييته منا فأحيه على الإسلام ومن توفيته منا فتوفه على الإيمان اللهم لا
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