

bacterial infection of the respiratory tract summary

Organism	Microscopy / Stain / Key Tests	Pathogenesis (focus on mechanism of damage)	Diseases & Key Symptoms	Diagnosis	Treatment / Prevention
Streptococcus pneumoniae ⊕	Gram-positive, lancet-shaped diplococci, sometimes in chains. α-hemolytic , optochin sensitive , bile soluble , capsule (Quellung reaction) positive.	Capsule inhibits phagocytosis → persistence. Pneumolysin lyses host cells, activates complement → inflammation. Autolysin releases pneumolysin. IgA protease destroys secretory IgA. → results in alveolar inflammation and consolidation .	Lobar pneumonia : fever, chills, productive cough with rusty sputum , pleuritic pain. Sinusitis , otitis media , meningitis in severe cases.	Sputum Gram stain , culture, optochin sensitivity , Quellung test for capsule swelling.	Amoxicillin / β-lactam + macrolide or fluoroquinolone (depending on setting). Prevention: PCV13 , PPSV23 vaccines. <i>infants → adult</i>
Bordetella pertussis ⊖	Gram-negative coccobacillus, aerobic, encapsulated.	Pertussis toxin (AB type) → ↑cAMP, lymphocytosis, inhibits phagocyte migration. Adenylate cyclase toxin → ↓neutrophil function. Tracheal cytotoxin → kills ciliated epithelial cells → loss of mucociliary clearance → paroxysmal cough.	Whooping cough (pertussis) : • Catarrhal stage (1–2 wk) : mild cough, rhinitis, highly infectious. • Paroxysmal (2–6 wk) : repetitive severe coughs, inspiratory “whoop” , post-tussive vomiting. • Convalescent (weeks–months) : gradual recovery.	PCR , culture, or serology; ↓ lymphocytosis on CBC.	Macrolides (azithromycin) early in infection; prophylaxis for contacts. Prevention: DTaP / Tdap vaccine. <i>children → adult</i>
Mycoplasma pneumoniae	No cell wall , pleomorphic; cannot Gram stain; Giemsa stain or “fried-egg” colonies on Eaton agar. <i>cholesterol</i>	Tip adhesin binds respiratory cilia → ciliary paralysis → impaired clearance. Induces cytokines and lymphocyte infiltration. Autoantibodies (IgM cold agglutinins) against I-antigen on RBCs → hemolytic anemia . ↓	Atypical (“walking”) pneumonia : insidious onset of dry cough, fever, malaise, pharyngitis, diffuse crackles. Possible skin rashes , arthralgia , or neurologic complications . <i>+ thrombocytopenia</i>	PCR (best) , serology (IgM/IgG), cold-agglutinin test , CXR diffuse patchy infiltrates (no lobar consolidation).	Macrolides or tetracyclines (β-lactams ineffective) .
Legionella pneumophila ⊖	Slender pleomorphic Gram-negative rods ; best seen with silver stain ; grows on BCYE agar (needs cysteine & iron) .	Facultative intracellular → multiplies in alveolar macrophages ; inhibits phagolysosome fusion. → Macrophage lysis, necrosis, intense inflammation. → Necrotizing pneumonia and systemic toxicity.	Legionnaires’ disease : high fever (> 39 °C), diarrhea , vomiting , cough, SOB, confusion, hyponatremia . ↓ Pontiac fever : mild flu-like illness without pneumonia.	Urine antigen test , culture on BCYE , PCR , few organisms on Gram stain (many PMNs). <i>neutrophils</i>	Macrolides or fluoroquinolones 10–14 days. Pontiac fever self-limited.
Haemophilus influenzae (esp. type b) ⊖	Gram-negative coccobacillus; requires factor X (hemin) and factor V (NAD) → grows on chocolate agar . <i>* fastidious</i>	Capsule (PRP) resists phagocytosis; IgA protease promotes mucosal invasion. → Epiglottitis : rapid swelling & obstruction; may spread to meninges or middle ear. → <i>rare + children</i>	Epiglottitis : drooling , dysphagia , dysphonia , distress (tripod/sniffing position) , stridor, high fever. + <i>young</i> Also otitis media , pneumonia , meningitis .	Culture on chocolate agar , antigen detection in CSF .	Airway protection (intubation) + ceftriaxone . Prevention: Hib vaccine .
Corynebacterium diphtheriae ⊕	Gram-positive club-shaped rods in palisades (Chinese letters) ; volutin granules (metachromatic).	Diphtheria toxin (A-B exotoxin) from lysogenic phage → B binds receptor, A inhibits EF-2 → blocks protein synthesis → local necrosis & fibrin exudate → adherent pseudomembrane . Toxin absorbed systemically → myocarditis , neuritis .	Pharyngeal diphtheria : sore throat, fever, gray pseudomembrane on tonsils/pharynx that bleeds if removed, bull-neck from cervical swelling. <i>usually reversible</i> Complications: myocarditis , paralysis .	Culture , PCR/ELISA for toxin, Elek test for toxigenicity. Elimination: negative results of at least 2 successive cultures of specimens from the nose and throat (or skin) obtained 24 hr apart after completion of therapy.	Antitoxin → ADS immediately + penicillin/erythromycin . Prevention: DTaP toxoid vaccine .
Pseudomonas aeruginosa ⊖	Gram-negative rod, motile , oxidase+ , produces blue-green pigment (pyocyanin/pyoverdin) , fruity odor .	Opportunistic : colonizes damaged tissues (burns, catheters, neutropenia). Pyocyanin generates ROS → tissue necrosis. Exotoxin A inhibits EF-2 (like diphtheria). Phospholipase C , proteases , ExoS/T cause cytotoxicity. Forms biofilms (esp. in CF lungs).	Nosocomial pneumonia , ventilator-associated pneumonia , burn wound infections , UTIs , CF chronic infection , sepsis (ecthyma gangrenosum).	Culture (blue-green colonies, oxidase+).	Antipseudomonal β-lactam + aminoglycoside/FQ ; adjust per sensitivity. <i>Highly resistant</i>
Moraxella catarrhalis ⊖	Gram-negative diplococci , oxidase+ , DNase+ , β-lactamase+ ; “hockey-puck” colonies on chocolate agar. <i>can move the colonies on the agar</i>	Outer membrane proteins mediate adhesion; LOS endotoxin triggers inflammation of mucosa. Opportunistic spread from nasopharynx → sinuses , middle ear , bronchi .	Otitis media (3rd most common), sinusitis , bronchitis , pneumonia (esp. elderly, COPD). Symptoms: ear pain, sinus pressure, productive cough.	Culture (oxidase+ , DNase+ , β-lactamase detection).	Amoxicillin-clavulanate , macrolides , or 2nd/3rd-gen cephalosporins .
Bacillus anthracis ⊕	Large Gram-positive rods in long chains , square ends , non-motile , spores . <i>seen by malachite green stain</i>	Capsule (poly-D-glutamate) resists phagocytosis. Edema toxin (PA + EF) ↑cAMP → edema & shock . <i>protein made capsule</i> Lethal toxin (PA + LF) → macrophage death & cytokine storm → hemorrhage. → Hemorrhagic mediastinitis . <i>toxin on plasmid → pXO₁ / pXO₂</i>	Inhalational anthrax : flu-like prodrome → severe dyspnea , widened mediastinum , bloody pleural effusion , shock; nearly fatal if untreated.	Smear/culture (non-hemolytic gray colonies), PCR , DFA for capsule.	Ciprofloxacin + rifampin + vancomycin . Animal control & vaccination.
Mycobacterium tuberculosis	Acid-fast red rods (Ziehl-Neelsen) ; obligate aerobe , slow growth on Lowenstein-Jensen.	Survives in macrophages by blocking phagolysosome fusion. Cell-mediated immunity → granuloma with caseous necrosis . Reactivation (↓immunity) → cavitary lesions . *	Primary TB : asymptomatic or mild fever, Ghon complex. Secondary TB : chronic cough, hemoptysis, night sweats, weight loss. Can disseminate (miliary TB).	AFB smear , culture, PCR , TST / IGRA . <i>* go back to slide for more details</i>	RIPE regimen (Rifampin, Isoniazid, Pyrazinamide, Ethambutol) ; BCG vaccine .