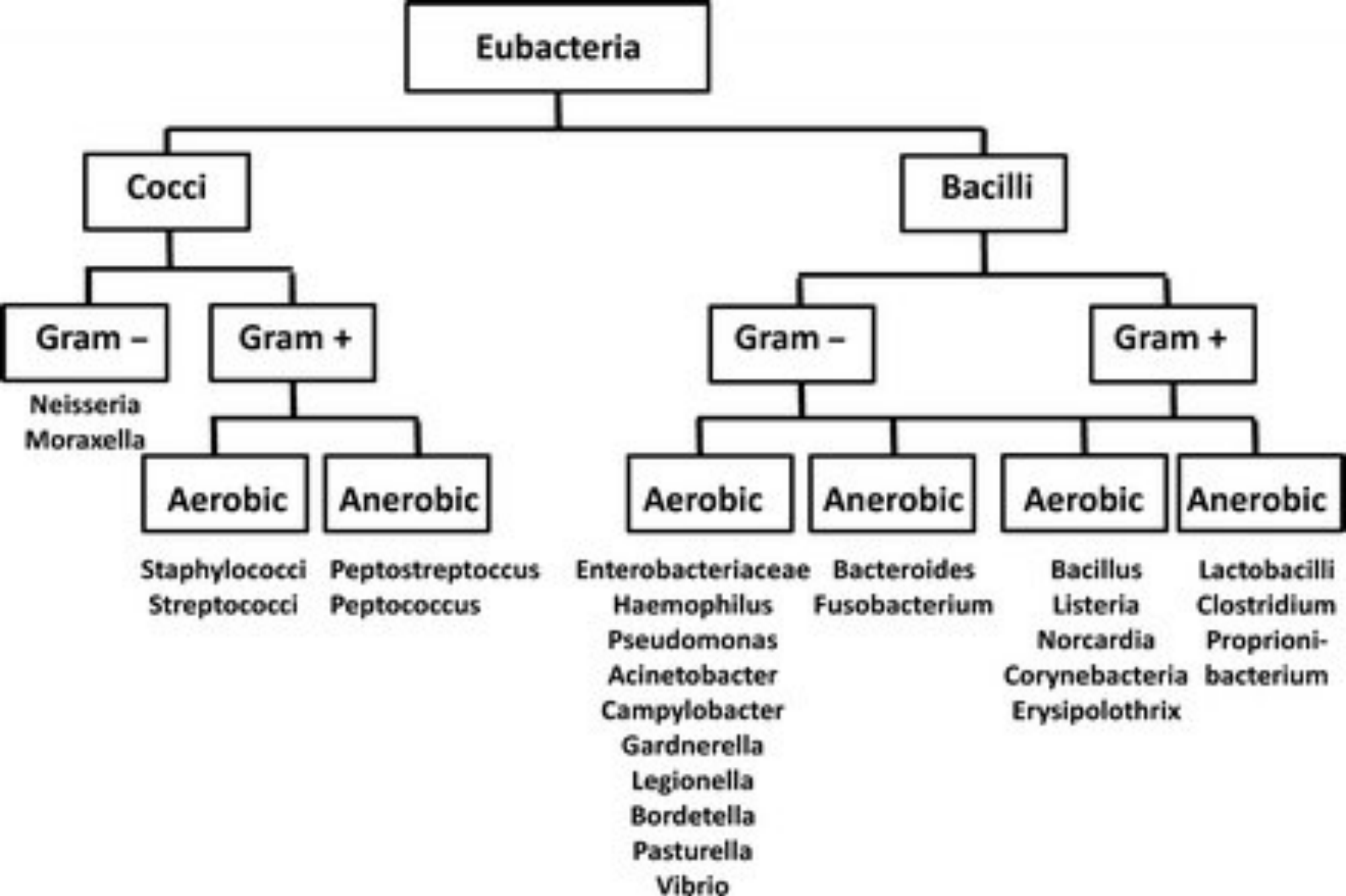
Eubacteria
Cocci
Bacilli
Gram –
Gram +
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Neisseria
Moraxella
Aerobic
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Staphylococci
Streptococci
Peptostreptoccus
Peptococcus
Enterobacteriaceae
Haemophilus
Pseudomonas
Acinetobacter
Campylobacter
Gardnerella
Legionella
Bordetella
Pasturella
Vibrio
Bacteroides
Fusobacterium
Bacillus
Listeria
Norcardia
Corynebacteria
Erysipolothrix
Lactobacilli
Clostridium
Proprioni-
bacterium

Bacteria	Gram Stain	Shape	Environment	Diseases/Infections	Virulence Factors	Additional Notes
Bacillus anthracis	Gram-positive	Rod (long, serpentine chains)	Soil, animal products	Anthrax: cutaneous (95% of cases), inhalation, gastrointestinal	Capsule (poly-d-glutamic acid), edema toxin, lethal toxin	Used in biological warfare; spores not seen in clinical specimens
Bacillus cereus	Gram-positive	Rod	Ubiquitous in the environment	Food poisoning: emetic form (contaminated rice), diarrheal form (meat, vegetables); ocular infections	Enterotoxins, heat-stable toxins	Spores retain malachite green dye; rapid onset and recovery in emetic form
Clostridium difficile	Gram-positive	Rod	Intestinal tract, soil	Pseudomembranous colitis, antibiotic-associated diarrhea	Toxins A and B (cause colon damage)	Common hospital-acquired infection; treated with fecal transplants in severe cases
Clostridium perfringens	Gram-positive	Rod	Soil, water, GI tract	Gas gangrene, cellulitis, myonecrosis, food poisoning	Alpha toxin, theta toxin	Spores rarely observed; causes hemolysis on blood agar
Clostridium tetani	Gram-positive	Rod with terminal spores (drumstick appearance)	Soil, GI tract of animals and humans	Tetanus: spastic paralysis, lockjaw	Tetanospasmin toxin (inhibits inhibitory neurotransmitters)	Rare due to vaccination; spores highly resistant
Clostridium botulinum	Gram-positive	Rod	Soil, water	Botulism: foodborne (flaccid paralysis), infant botulism (honey), wound botulism	Botulinum toxin (blocks acetylcholine release)	Seven toxin types (A-G); types A, B, E, and F cause human disease

Bacteria	Species	Incubation Period	Diseases	Duration of Disease	Special Features
Escherichia coli	E. coli (e.g., ETEC, STEC, ExPEC)	1–2 days (ETEC), 3–4 days (STEC)	**ETEC**: Traveler's diarrhea, watery diarrhea. **STEC**: Hemorrhagic colitis, hemolytic uremic syndrome (HUS). **ExPEC**: UTIs, neonatal meningitis, septicemia.	3–5 days (ETEC), 4–10 days (STEC)	ETEC produces heat-labile (LT) and heat-stable (ST) toxins.STEC produces Shiga-like toxin.
Salmonella	S. Typhi, S. Paratyphi, S. Enteritidis	6–48 hours (gastroenteritis), 10–14 days (typhoid fever)	**Gastroenteritis**: Nausea, vomiting, non-bloody diarrhea. **Typhoid fever**: Fever, myalgia, anorexia.	2–7 days (gastroenteritis), several weeks (typhoid fever, untreated)	Invades Peyer patches; S. Typhi causes systemic infections and is human-specific.
Shigella	S. dysenteriae, S. flexneri, S. sonnei, S. boydii	1–3 days	Shigellosis (dysentery): Bloody diarrhea, abdominal cramps, fever.	5–7 days, self-limited in most cases	Produces Shiga toxin, damages colonic epithelium, and causes systemic complications like HUS.
Yersinia pestis	Y. pestis	2–7 days	Bubonic plague: Painful lymphadenopathy (bubo), fever. Pneumonic plague: Severe respiratory symptoms.	Rapidly fatal without treatment; bubonic plague can progress to septicemia or pneumonic plague in days.	Zoonotic, transmitted via fleas; highly virulent with historical pandemics like the Black Death.
Klebsiella pneumoniae	K. pneumoniae, K. oxytoca	Variable, generally 1–3 days	Lobar pneumonia (currant jelly sputum), UTIs, soft tissue infections, septicemia.	Duration depends on treatment; pneumonia can persist for weeks without therapy.	Major cause of nosocomial infections, forms biofilms, and is highly antibiotic-resistant.
Proteus mirabilis	P. mirabilis, P. vulgaris	Variable, typically 1–2 days	UTIs, kidney stones (struvite and apatite crystals).	Chronic if untreated due to repeated stone formation and persistent UTIs.	Produces urease, increases urine pH, and causes swarming motility on agar.

Bacteria	Characteristics	Diseases	Virulence Factors	Transmission	Special Features
Actinomyces	Non–spore-forming, Gram-positive rods, facultatively or strictly anaerobic.	Actinomycosis: Chronic granulomatous lesions, abscesses, sinus tracts.	Filamentous forms; slow-growing; endogenous infections (no person-to-person spread).	Endogenous from mucosal surfaces.	Found in mouth, GI tract, female genital tract; resemble fungi in morphology.
Nocardia	Weakly acid-fast, aerobic, Gram-positive rods forming branched filaments.	Bronchopulmonary disease, cutaneous nocardiosis (mycetoma), brain abscesses.	Catalase, superoxide dismutase, cord factor to evade phagocytosis.	Inhalation, traumatic skin introduction.	Found in soil; grows aerial hyphae in culture; exogenous infections.
Lactobacillus	Facultatively anaerobic, Gram-positive rods, produce lactic acid.	Rarely causes disease; opportunistic infections: bacteremia, endocarditis, septicemia in immunocompromised.	Fermentation produces lactic acid, maintaining vaginal pH.	Endogenous flora.	Dominant in female genital tract, probiotics, used in yogurt and cheese production.
Propionibacterium	Gram-positive rods, common skin commensal.	Acne vulgaris, opportunistic infections with prosthetic devices.	Produces lipases, triggering inflammation.	Endogenous flora of skin, oropharynx, genital tract.	Renamed as *Cutibacterium acnes*; opportunistic pathogen in prosthetic infections.
Listeria monocytogenes	Short, nonbranching, facultatively anaerobic rods, motile at room temperature.	Foodborne listeriosis, neonatal meningitis, septicemia, gastroenteritis.	Internalin for adhesion, listeriolysin O, phospholipase C for phagosome escape; ActA for actin-mediated movement.	Ingestion of contaminated food; vertical (mother-to-child).	Intracellular pathogen; moves via actin polymerization, tumbling motility, and weak beta-hemolysis on blood agar.
Corynebacterium diphtheriae	Pleomorphic, non-motile, catalase-positive Gram-positive rods.	Diphtheria: Respiratory (pseudomembranes, airway obstruction), cutaneous diphtheria.	Diphtheria toxin: A-B exotoxin inhibits protein synthesis by ADP-ribosylating elongation factor-2 (EF-2).	Respiratory droplets, skin contact.	Humans are the only reservoir; preventable by vaccination.
Mobiluncus	Anaerobic, Gram-variable, curved rods.	Associated with bacterial vaginosis.	Lacks endotoxin but has Gram-positive cell wall.	Endogenous vaginal flora.	Rare in healthy women; abundant in bacterial vaginosis.
Bifidobacterium/Eubacterium	Anaerobic, Gram-positive rods.	Clinically insignificant contaminants.	Commensal organisms.	Normal flora of oropharynx, intestine, vagina.	Rarely cause disease.

Bacteria	Morphology/Characteristics	Diseases/Clinical Manifestations	Transmission/Reservoir	Pathogenesis/Virulence Factors	Diagnosis	Treatment
Campylobacter	- Curved, gram-negative rods (0.2-0.5 µm x 0.5-5.0 µm).- Motile with single polar flagella.- Microaerophilic (requires 5-7% O_2 and 5-10% CO_2).- Grows better at 42°C than at 37°C.	- Gastroenteritis: diarrhea (may be bloody), fever, abdominal pain.- Complications: **Guillain-Barré syndrome** (immune-mediated neuropathy), reactive arthritis.	- Zoonotic (reservoirs: poultry, cattle, sheep, dogs, etc.).- Transmission via contaminated food (especially poultry), water, or unpasteurized milk.- Rarely person-to-person.	- Lipooligosaccharides (LOS): molecular mimicry with gangliosides, leading to Guillain-Barré syndrome.- Gastric acid-sensitive; infection promoted by reduced gastric acidity.- Causes mucosal damage in the jejunum, ileum, and colon.	- Growth on selective media (Campy-BAP) under microaerophilic conditions.- Positive oxidase and catalase tests.- Curved rods on microscopy.	- Supportive care for mild cases.- Antibiotics (e.g., azithromycin, fluoroquinolones) for severe or prolonged cases.- Avoid raw/undercooked poultry.
Helicobacter	- Spiral-shaped gram-negative rods.- Highly motile (corkscrew motion).- Microaerophilic.- Produces **urease** enzyme (breaks down urea to ammonia and CO_2 to neutralize stomach acid).	- **Acute gastritis**: nausea, vomiting, hypochlorhydria.- **Chronic gastritis**: confined to gastric antrum or entire stomach.- Peptic ulcers: gastric and duodenal ulcers.- **Complications**: gastric cancer, MALT lymphoma.	- Human reservoir (colonization persists unless treated).- Fecal-oral or oral-oral transmission.- Contaminated food/water in some cases.	- **Urease**: protects against gastric acid.- **CagA (cytotoxin-associated gene)**: disrupts epithelial cytoskeleton.- **VacA (vacuolating cytotoxin)**: damages epithelial cells.- Mucinase, phospholipases: localized tissue damage.- Chronic inflammation: increased cancer risk.	- **Invasive**: Histology of gastric biopsy (gold standard).- **Non-invasive**: Urease breath test, stool antigen test, or serology.- Sensitivity of non-invasive tests >95%.	- Triple therapy: Proton pump inhibitor + clarithromycin + amoxicillin or metronidazole.- Eradication reduces gastritis, ulcers, and cancer risk.
Vibrio	- Curved, gram-negative rods.- Facultative anaerobes.- Polar flagella (highly motile).- Requires NaCl for growth (halophilic).- Tolerates pH 6.5-9.0 but sensitive to gastric acid.	- **Cholera** (V. cholerae O1, O139): severe watery diarrhea ("rice-water" stools), dehydration, electrolyte loss.- Gastroenteritis (non-cholera Vibrio species).	- Marine and estuarine environments (e.g., shellfish).- Spread via contaminated water, food (raw seafood), especially in poor sanitation settings.- Not person-to-person.	- **Cholera toxin (ctxA, ctxB genes)**: A-B toxin causes hypersecretion of electrolytes and water via activation of adenylate cyclase.- Toxin co-regulated pilus (TCP): adherence to intestinal epithelium.- Lipopolysaccharides (LPS): contributes to inflammation.- Requires high infectious dose (>10^8 organisms) to overcome gastric acidity.	- Culture on selective media (TCBS agar).- Toxin immunoassays.- PCR for ctx genes.- Stool microscopy ("rice-water" appearance).	- Aggressive fluid and electrolyte replacement.- Antibiotics (e.g., doxycycline, azithromycin) for severe cases.- Ensure safe drinking water and sanitation.
Bacteroides	- Pleomorphic gram-negative rods.- Stimulated by bile (e.g., Bacteroides fragilis).- Polysaccharide capsule.- LPS has low endotoxin activity.	- **Intra-abdominal infections** (e.g., peritonitis).- Skin and soft-tissue infections.- Bacteremia.- Chronic sinusitis, otitis media, and periodontal infections (polymicrobial).	- Endogenous flora of mucosal surfaces (GI tract, respiratory tract).- Spread by trauma, surgery, or disease to sterile sites.	- Capsule: inhibits phagocytosis.- **B. fragilis toxin**: zinc metalloprotease disrupts intestinal epithelium, causing diarrhea.- Often causes polymicrobial infections.	- Anaerobic culture.- Gram stain of clinical specimens.- Detection of B. fragilis toxin in stool (for diarrhea).	- Surgical drainage if necessary.- Antibiotics (e.g., metronidazole, beta-lactamase inhibitors, carbapenems).
Mycoplasma	- Smallest free-living bacteria.- No cell wall; sterol-containing membrane.- Pleomorphic (coccoid to rods).	- Respiratory: tracheobronchitis, "walking pneumonia" (primary atypical pneumonia).- Urogenital: nongonococcal urethritis, pelvic inflammatory disease (e.g., M. genitalium).	- Respiratory droplets (M. pneumoniae).- Sexual contact (M. genitalium).	- Absence of cell wall: resistant to beta-lactam antibiotics.- Adheres to respiratory epithelium (P1 adhesion protein).- Evades immune system via antigenic variation.	- PCR (most sensitive).- Culture (slow and rarely used).- Microscopy and antigen tests are not reliable.	- Macrolides (e.g., azithromycin).- Tetracyclines (e.g., doxycycline).- Fluoroquinolones for resistant cases.- Supportive care for mild cases.

Bacteria	Gram Stain	Shape	Environment	Diseases/Infections	Virulence Factors	Additional Notes
Pseudomonas	Gram-negative	Rod (straight/slightly curved, motile)	Soil, water, hospital environments	Opportunistic infections: pulmonary (e.g., necrotizing pneumonia), burn wounds, UTIs, otitis externa, eye infections, bacteremia, endocarditis	Adhesins (flagella, pili, LPS, alginate), Exotoxin A, phospholipase C, antibiotic resistance mechanisms	Produces pyocyanin (blue-green pigment), fruity odor, resistant to many antibiotics and disinfectants
Legionella	Gram-negative	Rod (pleomorphic)	Water systems (e.g., cooling towers, whirlpool spas, misters, showerheads)	Pontiac fever (flu-like illness), Legionnaires' disease (severe pneumonia)	Facultative intracellular bacteria, survive in macrophages, cytokine-mediated inflammation	Requires BCYE agar for growth, nutritionally fastidious, survives in moist environments
Moraxella	Gram-negative	Diplococci	Upper respiratory tract	Otitis media, sinusitis, exacerbations of COPD	Oxidase-positive, strictly aerobic	Colonization peaks in young children, nosocomial pathogen in adults
Bordetella	Gram-negative	Coccobacilli (small, fastidious)	Human respiratory tract (no environmental or animal reservoir)	Pertussis (whooping cough)	Pertussis toxin (A-B toxin), adenylate cyclase activation, cilia paralysis	Requires special media for growth; vaccine-preventable (inactivated toxin, filamentous hemagglutinin)
Haemophilus influenzae	Gram-negative	Rod (pleomorphic)	Human mucosal membranes (respiratory tract)	Meningitis, epiglottitis, cellulitis, otitis media, sinusitis, pneumonia	Polysaccharide capsule (antiphagocytic), PRP antigens, X and V factor dependency	Vaccines with conjugated PRP antigens have reduced invasive infections significantly
Haemophilus aegyptius	Gram-negative	Rod (pleomorphic)	Human mucosal membranes (eyes)	Acute purulent conjunctivitis	Not specified	Also called Koch-Weeks bacillus
Haemophilus ducreyi	Gram-negative	Rod (pleomorphic)	Human genital mucosa	Chancroid (painful genital ulcer)	Not specified	Commonly diagnosed in men, presents with tender papule and erythematous base

Bacteria	Gram Stain	Shape	Transmission/Environment	Diseases/Infections	Virulence Factors	Additional Notes
Neisseria gonorrhoeae	Gram-negative	Diplococci	Sexual contact	Gonorrhea: urethritis, cervicitis, disseminated infections (e.g., gonococcemia, septic arthritis)	Pili, porins, outer membrane proteins, lipooligosaccharides (LOS), IgA protease	Fastidious, grows only on enriched media (e.g., chocolate agar); always clinically significant
Neisseria meningitidis	Gram-negative	Diplococci	Nasopharynx colonization; aerosolized droplets	Meningitis, meningococcemia (septicemia), Waterhouse-Friderichsen syndrome	Polysaccharide capsule, pili, endotoxins, outer membrane proteins	Causes disease in immunocompromised individuals or those lacking specific antibodies
Treponema pallidum	Gram-negative	Spirochete	Sexual contact, transplacental, or contaminated blood transfusions	Syphilis: primary (chancres), secondary (disseminated rash), tertiary (neurosyphilis, cardiovascular)	No traditional endotoxins, motility, ability to evade immune response	Cannot be cultured in vitro, thin structure requires darkfield or immunofluorescence microscopy
Borrelia burgdorferi	Gram-negative-like	Spirochete	Tick bites (hard ticks like Ixodes)	Lyme disease: erythema migrans (rash), systemic dissemination (e.g., arthritis, neurological symptoms)	Outer surface proteins (Osps), motility	Poorly stained with Gram stain; diagnosed via serology or microscopy
Rickettsia spp.	Gram-negative	Rod (obligate intracellular)	Arthropod vectors (ticks, lice, fleas, mites)	Spotted fever group: Rocky Mountain spotted fever; Typhus group: epidemic typhus	Intracellular growth, endotoxin production, ability to infect endothelial cells	Damage caused by blood vessel leakage; diagnosed with Giemsa stain
Bartonella henselae	Gram-negative	Coccobacilli or bacilli	Cat scratches, bites, flea exposure	Cat-scratch disease: regional lymphadenopathy, skin lesions	Facultative intracellular growth, ability to persist in host tissues	Requires prolonged incubation (2–6 weeks); transmitted by fleas, ticks, and mosquitoes
Chlamydia trachomatis	Gram-negative-like	Coccoid	Sexual contact, vertical transmission, contaminated surfaces (trachoma)	Trachoma (blindness), cervicitis, urethritis, pelvic inflammatory disease, neonatal conjunctivitis	Elementary bodies (infectious), reticulate bodies (replicative), intracellular replication	Obligate intracellular pathogen, cannot be grown on agar; major cause of preventable blindness worldwide

Category	Pathogens Mentioned	Associated Diseases/ Infections	Additional Notes
Hospital-Acquired Infections	**Staphylococcus aureus** (including MRSA), **Clostridium difficile**, **Klebsiella spp.**, **E. coli**	Central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), surgical site infections (SSI), ventilator-associated pneumonia (VAP)	S. aureus (leading in SSIs), C. difficile (GI infections, top pathogen in HAIs), multidrug resistance common
	Acinetobacter spp., **Pseudomonas spp.**, **Enterococcus spp.**	Respiratory and bloodstream infections in ICU settings	Frequently opportunistic, multidrug resistance observed
Zoonotic Diseases	**Bacillus anthracis**, **Salmonella spp.**, **Brucella spp.**, **Yersinia pestis**	Anthrax, salmonellosis, brucellosis, plague	Zoonotic bacterial pathogens often transmitted from animals
	Campylobacter spp., **Bartonella henselae**, **Vibrio spp.**	Campylobacteriosis, cat-scratch disease, fish-associated zoonoses (e.g., Vibrio cholerae, V. vulnificus)	Vibrio infections associated with aquatic environments
	Mycobacterium spp.	Tuberculosis (M. tuberculosis), non-tuberculous infections (e.g., aquarium-associated mycobacterial infections)	Includes zoonotic infections from aquatic and terrestrial animals
Emerging Pathogens	**Methicillin-resistant Staphylococcus aureus (MRSA)**, **Vancomycin-resistant Enterococci (VRE)**	Healthcare-associated infections	Highlight the challenge of multidrug-resistant pathogens
	Multidrug-resistant E. coli, **Carbapenemase-producing Gram-negative bacteria**	Urinary tract infections, bloodstream infections	Resistance limits treatment options
Zoonotic Viruses and Parasites	Rabies virus, Influenza virus, **Toxoplasma gondii**, **Giardia spp.**	Rabies, zoonotic influenza, toxoplasmosis, giardiasis	Emerging zoonotic threats increase with habitat destruction and population density