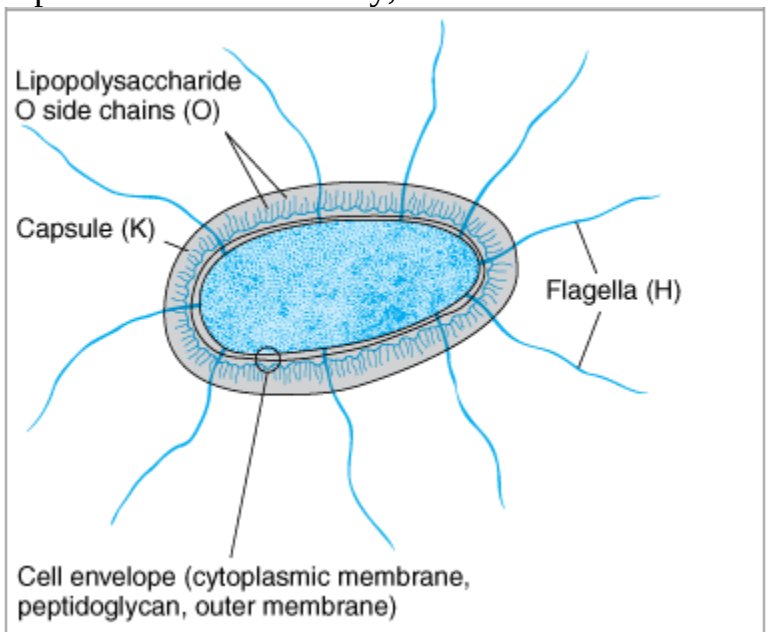
Escherichia coli

Structure and physiology

They are all true facultative anaerobes . They all ferment glucose, and can generate energy by reducing nitrates to nitrites. They all lack cytochrome oxidase (that is, they are oxidase- negative). Typing of strains is based on differences in three structural antigens: O, H, and K . The O antigens (somatic or cell wall antigens) are found on the polysaccharide portion of the LPS. These antigens are heat-stable, and may be shared among different Enterobacteriaceae genera. O antigens are commonly used to serologically type many of the enteric gram-negative rods. The H antigens are associated with flagella; therefore, only flagellated (motile) Enterobacteriaceae such as *E. coli* have them. The K antigens are most often associated with the capsule or less commonly, with the fimbriae.



Urinary Tract Infection

E coli is the most common cause of urinary tract infection and accounts for approximately 90% of first urinary tract infections in young women. The symptoms and signs include urinary frequency, dysuria, hematuria, and pyuria. The pain is associated with upper tract infection. None of these symptoms or signs is specific for *E coli* infection. Urinary tract infection can result in bacteremia with clinical signs of sepsis.

E coli-Associated Diarrheal Diseases

STRAIN	ABBREVIATION	SYNDROME	THERAPY[1]
Enterotoxigenic E. coli	ETEC	Watery diarrhea	Antibiotics may be useful.[2]
Enteropathogenic E. coli	EPEC	Watery diarrhea of long duration, mostly in infants, often in developing countries	Antibiotics may be useful.[2]
Enterohemorrhagic E. coli	EHEC	Bloody diarrhea; Hemorrhagic colitis and hemolytic uremic syndrome (HUS)	Avoid antibiotics because of the possible risk of potentiating HUS.
Enteroinvasive E. coli	EIEC	Bloody diarrhea	Rehydration and correction of electrolyte abnormalities.
Enteroadherent E. coli	EAEC	Persistent watery diarrhea in children and patients infected with HIV	Rehydration and correction of electrolyte abnormalities.

Diagnosis.
Extraintestinal infections are diagnosed by identifying the pathogen in relevant materials. Diagnosis of a urinary tract infection with midstream urine requires determination of the bacterial count to ensure that an infection can be distinguished from a contamination. Counts >–105/ml tend to indicate an infection, <–103/ml a contamination,104/ml could go either way. Specific gene probes are now being used to make identification of intestinal pathogen E. coli bacteria less difficult.

Therapy. Antibiotic therapy must take into consideration the resistance pattern of the pathogen. Aminopenicillins, ureidopenicillins, cephalosporins, 4-quinolones, or cotrimoxazole are useful agents. Severe diarrhea necessitates oral replacement of fluid and electrolyte losses according to the WHO formula: 3.5 g NaCl, 2.5 g $NaHCO_3$, 1.5 g KCl, 20 g glucose per liter of water.

Klebsiella

K pneumoniae is present in the respiratory tract and feces of about 5% of normal individuals. It causes a small proportion (about 1%) of bacterial pneumonias. *K pneumoniae* can produce extensive hemorrhagic necrotizing

consolidation of the lung. It occasionally produces urinary tract infection and bacteremia with focal lesions in debilitated patients. Other enterics also may produce pneumonia. *K pneumoniae* and *Klebsiella oxytoca* cause hospital-acquired infections. Two other klebsiellae are associated with inflammatory conditions of the upper respiratory tract: *Klebsiella ozaenae* has been isolated from the nasal mucosa in ozena, a fetid, progressive atrophy of mucous membranes; and *Klebsiella rhinoscleromatis* from rhinoscleroma, a destructive granuloma of the nose and pharynx.

Proteus—*Proteus* species produce infections in humans only when the bacteria leave the intestinal tract. They are found in urinary tract infections and produce bacteremia, pneumonia, and focal lesions in debilitated patients or those receiving intravenous infusions. *P mirabilis* causes urinary tract infections and occasionally other infections. *Proteus vulgaris* and *Morganella morganii* are important nosocomial pathogens.

Proteus species produce urease, resulting in rapid hydrolysis of urea with liberation of ammonia. Thus, in urinary tract infections with *Proteus*, the urine becomes alkaline, promoting stone formation and making acidification virtually impossible. The rapid motility of *Proteus* may contribute to its invasion of the urinary tract.

Strains of *Proteus* vary greatly in antibiotic sensitivity. *P mirabilis* is often inhibited by penicillins; the most active antibiotics for other members of the group are aminoglycosides and cephalosporins.

Serratia—*S marcescens* is a common opportunistic pathogen in hospitalized patients. *Serratia* (usually nonpigmented) causes pneumonia, bacteremia, and endocarditis—especially in narcotics addicts and hospitalized patients. Only about 10% of isolates form the red pigment (prodigiosin) that has long characterized *Serratia marcescens. S marcescens* is often multiply resistant to aminoglycosides and penicillins; infections can be treated with third-generation cephalosporins.

Diagnostic Laboratory Tests

Specimens

Specimens include urine, blood, pus, spinal fluid, sputum, or other material, as indicated by the localization of the disease process.

Smears

The Enterobacteriaceae resemble each other morphologically. The presence of large capsules is suggestive of *Klebsiella*.

Culture

Specimens are plated on both blood agar and differential media. With differential media, rapid preliminary identification of gram-negative enteric bacteria is often possible (see Chapter 47).

Immunity

Specific antibodies develop in systemic infections, but it is uncertain whether significant immunity to the organisms follows.

Treatment

No single specific therapy is available. The sulfonamides, ampicillin, cephalosporins, fluoroquinolones, and aminoglycosides have marked antibacterial effects against the enterics, but variation in susceptibility is great, and laboratory tests for antibiotic susceptibility are essential. Multiple drug resistance is common and is under the control of transmissible plasmids.

Certain conditions predisposing to infection by these organisms require surgical correction, eg, relief of urinary tract obstruction, closure of a perforation in an abdominal organ, or resection of a bronchiectatic portion of lung.

Treatment of gram-negative bacteremia and impending septic shock requires rapid institution of antimicrobial therapy, restoration of fluid and electrolyte balance, and treatment of disseminated intravascular coagulation.

Various means have been proposed for the prevention of traveler's diarrhea, including daily ingestion of bismuth subsalicylate suspension (bismuth subsalicylate can inactivate *E coli* enterotoxin in vitro) and regular doses of tetracyclines or other antimicrobial drugs for limited periods. Because none of these methods are entirely successful or lacking in adverse effects, it is widely recommended that caution be observed in regard to food and drink in areas where environmental sanitation is poor and that early and brief

treatment (eg, with ciprofloxacin or trimethoprim-sulfamethoxazole) be substituted for prophylaxis.

Enterobacter aerogenes

This organism has small capsules, may be found free-living as well as in the intestinal tract, and causes urinary tract infections and sepsis.

Treatment

No single specific therapy is available. The sulfonamides, ampicillin, cephalosporins, fluoroquinolones, and aminoglycosides have marked antibacterial effects against the enterics, but variation in susceptibility is great, and laboratory tests for antibiotic sensitivity are essential. Multiple drug resistance is common and is under the control of transmissible plasmids.