tract in both normal and compromised hosts (Table 186-1). These virulence genes define ExPEC and, for the most part, are distinct from those that enable intestinal pathogenic strains to cause diarrheal disease (Table 186-2). All age groups, all types of hosts, and nearly all organs and anatomic sites are susceptible to infection by ExPEC. Even previously healthy hosts can become severely ill or die when infected with ExPEC; however, adverse outcomes are more common among hosts with comorbid illnesses and host defense abnormalities. The diversity and the medical and economic impact of ExPEC infections are evident from consideration of the following specific syndromes.

Extraintestinal Infectious Syndromes • ***URINARY TRACT INFECTION*** The urinary tract is the site most frequently infected by ExPEC. An exceedingly common infection among ambulatory patients, UTI accounts for 1% of ambulatory care visits in the United States and is second only to lower respiratory tract infection among infections responsible for hospitalization. UTIs are best considered by clinical syndrome (e.g., uncomplicated cystitis, pyelonephritis, and catheter-associated UTIs) and within the context of specific hosts (e.g., premenopausal women, compromised hosts; Chap. 162). *E. coli* is the single most common pathogen for all UTI syndrome/host group combinations. Each year in the United States, *E. coli* causes 80–90% of an estimated 6–8 million episodes of uncomplicated cystitis in premenopausal women. Furthermore, 20% of women with an initial cystitis episode develop frequent recurrences.

Uncomplicated cystitis, the most common acute UTI syndrome, is characterized by dysuria, urinary frequency, and suprapubic pain. Fever and/or back pain suggests progression to pyelonephritis. Even with appropriate treatment of pyelonephritis, fever may take 5–7 days to resolve completely. Persistently elevated or increasing fever and neutrophil counts should prompt evaluation for intrarenal or perinephric abscess and/or obstruction. Renal parenchymal damage and loss of renal function during pyelonephritis occur primarily with urinary obstruction, which can be preexisting or, rarely, occurs de novo in diabetic patients who develop renal papillary necrosis as a result of kidney infection. Pregnant women are at unusually high risk for developing pyelonephritis, which can adversely affect the outcome of pregnancy. As a result, prenatal screening for and treatment of asymptomatic bacteriuria are standard. Prostatic infection is a potential complication of UTI in men. The diagnosis and treatment of UTI, as detailed in Chap. 162, should be tailored to the individual host, the nature and site of infection, and local patterns of antimicrobial susceptibility.

ABDOMINAL AND PELVIC INFECTION The abdomen/pelvis is the second most common site of extraintestinal infection due to *E. coli*. A wide variety of clinical syndromes occur in this location, including acute peritonitis secondary to fecal contamination, spontaneous bacterial peritonitis, dialysis-associated peritonitis, diverticulitis, appendicitis, intraperitoneal or visceral abscesses (hepatic, pancreatic, splenic), infected pancreatic pseudocysts, and septic cholangitis and/or cholecystitis. In intraabdominal infections, *E. coli* can be isolated either alone or (as often occurs) in combination with other facultative and/or anaerobic members of the intestinal flora (Chap. 159).

PNEUMONIA *E. coli* is not usually considered a cause of pneumonia (Chap. 153). Indeed, enteric GNB account for only 1–3% of cases of community-acquired pneumonia, in part because these organisms only transiently colonize the oropharynx in a minority of healthy individuals. However, rates of oral colonization with *E. coli* and other GNB increase with severity of illness and antibiotic use. Consequently, GNB are a more common cause of pneumonia among residents of LTCFs and are the most common cause (60–70% of cases) of hospital-acquired pneumonia (Chap. 168), particularly among postoperative and ICU patients (e.g., ventilator-associated pneumonia). Pulmonary infection is usually acquired by small-volume aspiration but occasionally occurs via hematogenous spread, in which case multifocal nodular infiltrates can be seen. Tissue necrosis, probably due to bacterial cytotoxins, is common. Despite significant institutional variation, *E. coli* is generally the third or fourth most commonly isolated GNB in hospital-acquired pneumonia, accounting for 5–8% of episodes in both U.S.-based and Europe-based studies. Regardless of the host, pneumonia due to ExPEC is a serious disease, with high crude and attributable mortality rates (20–60% and 10–20%, respectively).

MENINGITIS (See also Chap. 164) *E. coli* is one of the two leading causes of neonatal meningitis, the other being group B *Streptococcus*. Most *E. coli* strains that cause neonatal meningitis possess the K1 capsular antigen and derive from a limited number of meningitis-associated clonal groups. Ventriculomegaly commonly occurs. After the first month of life, *E. coli* meningitis is uncommon, occurring predominantly in the setting of surgical or traumatic disruption of the meninges or in the presence of cirrhosis. In patients with cirrhosis who develop meningitis, the meninges are presumably seeded as a result of poor hepatic clearance of portal vein bacteremia.

CELLULITIS/MUSCULOSKELETAL INFECTION *E. coli* contributes frequently to infections of decubitus ulcers and occasionally to infections of ulcers and wounds of the lower extremity in diabetic patients and other hosts with neurovascular compromise. Osteomyelitis secondary to contiguous spread can occur in these settings. *E. coli* also causes cellulitis or infections of burn sites and surgical wounds (accounting for ~10% of surgical site infections), particularly when the infection originates

TABLE 186-2 INTESTINAL PATHOGENIC *E. COLI*

Pathotype	Epidemiology	Clinical Syndrome[a]	Defining Molecular Trait	Responsible Genetic Element[b]
STEC/EHEC/STEAEC	Food, water, person-to-person; all ages, industrialized countries	Hemorrhagic colitis, hemolytic-uremic syndrome	Shiga toxin	Lambda-like Stx1- or Stx2-encoding bacteriophage
ETEC	Food, water; young children in and travelers to developing countries	Traveler's diarrhea	Heat-stable and labile enterotoxins, colonization factors	Virulence plasmid(s)
EPEC	Person-to-person; young children and neonates in developing countries	Watery diarrhea, persistent diarrhea	Localized adherence, attaching and effacing lesion on intestinal epithelium	EPEC adherence factor plasmid pathogenicity island (locus for enterocyte effacement [LEE])
EIEC	Food, water; children in and travelers to developing countries	Dysentery	Invasion of colonic epithelial cells, intracellular multiplication, cell-to-cell spread	Multiple genes contained primarily in a large virulence plasmid
EAEC	?Food, water; children in and travelers to developing countries; all ages, industrialized countries	Traveler's diarrhea, acute diarrhea, persistent diarrhea	Aggregative/diffuse adherence, virulence factors regulated by AggR	Chromosomal or plasmid-associated adherence and toxin genes

Abbreviations: EAEC, enteroaggregative *E. coli;* EHEC, enterohemorrhagic *E. coli*; EIEC, enteroinvasive *E. coli*; EPEC, enteropathogenic *E. coli*; ETEC, enterotoxigenic *E. coli*; STEAEC, Shiga toxin–producing enteroaggregative *E. coli*; STEC, Shiga toxin–producing *E. coli*. [a] Classic syndromes; see text for details on disease spectrum. [b] Pathogenesis involves multiple genes, including genes in addition to those listed.