

Gastroenteritis

Summary

Acute gastroenteritis is a common infection in childhood. The majority of cases are caused by viruses, while ~20% are bacterial, and a small number are parasitic. Most children have a mild presentation where nausea, vomiting, and diarrhea are not severe enough to prevent adequate oral intake or participation in normal activities. **Severe disease** is characterized by signs of significant dehydration, end-organ damage, fevers $\geq 40^{\circ}\text{C}$, signs of sepsis, bloody or bilious emesis, and toxic appearance. Children with mild-to-moderate gastroenteritis can be diagnosed clinically. Children with severe illness, atypical presentations, or signs of significant dehydration should undergo laboratory studies. Treatment is usually supportive with fluid replacement, antiemetics, and antipyretics. Antimicrobial therapy (empiric or tailored) may be utilized for children with suspected or confirmed bacterial or parasitic infections. Prevention of infectious gastroenteritis involves vaccination of infants against rotavirus, travel vaccines where appropriate, and patient/caregiver education on hand hygiene and food and water hygiene.

Epidemiology

- Common illness in children, causing each year: ^[1]
 - > 1.5 million outpatient visits
 - ~ 200,000 hospitalizations
 - Severe illness is more common in children < 5 years of age. ^[1]
- Epidemiological data refers to the US, unless otherwise specified.

Etiology

- Most cases of gastroenteritis in children are viral gastroenteritis. ^[1]
- ~ 20% of cases are bacterial gastroenteritis. ^[2]
- Parasites (e.g., *Giardia lamblia*) should be considered in children with persistent diarrhea.

Acute gastroenteritis refers to a clinical syndrome of diarrhea (>3 stool episodes in 24 hours) with or without vomiting that generally lasts for several days. In general, diarrhea is caused by a variety of infectious or inflammatory processes in the intestine that directly affect enterocyte secretory and absorptive functions. Gastroenteritis or enteritis has many infectious causes, including viruses, bacteria, and parasites (Table 112.1). Based on pathogenesis, diarrhea can be classified as invasive or inflammatory, or it can be classified as secretory, producing either bloody stools with abdominal cramping and fever or large quantities of watery stool without other symptoms (Table 112.2).

Infectious diarrhea is a leading cause of morbidity and mortality in children around the world. Rates of disease and death vary with age and access to health care, clean water, and sanitation. Gastrointestinal infections are generally acquired via fecal-oral transmission or through ingestion of contaminated food or water. The patient's immune status and environmental exposures (i.e., food, water, travel, antibiotics, child care) help guide the differential diagnosis in the presence of acute gastrointestinal symptoms. Traveler's diarrhea occurs frequently, especially within the first 1-2 weeks of arrival. Epidemiology varies with destination, but in general children are at risk for the same illnesses that affect adult travelers.

Viral gastroenteritis is the most common cause of diarrhea in children globally. These illnesses may be associated with vomiting as well as diarrhea, have incubation periods of hours to days, and are usually self-limited illnesses lasting 3-7 days. **Rotavirus** is the most frequent cause of diarrhea in young children during Winter

TABLE 112.1 Common Pathogenic Organisms Causing Diarrhea and Their Virulence Mechanisms

ORGANISMS	PATHOGENIC MECHANISM(S)
VIRUSES	
Rotaviruses	Damage to microvilli
Caliciviruses (noroviruses)	Mucosal lesion
Astroviruses	Mucosal lesion
Enteric adenoviruses (serotypes 40 and 41)	Mucosal lesion
BACTERIA	
<i>Campylobacter jejuni</i>	Invasion, enterotoxin
<i>Clostridium difficile</i>	Cytotoxin, enterotoxin
<i>Escherichia coli</i>	
Enteropathogenic (EPEC)	Adherence, effacement
Enterotoxigenic (ETEC) (traveler's diarrhea)	Enterotoxins (heat-stable or heat-labile)
Enteroinvasive (EIEC)	Invasion of mucosa
Enterohemorrhagic (EHEC) (includes O157: H7 causing HUS)	Adherence, effacement, cytotoxin
Enterococcal (EAEC)	Adherence, mucosal damage
<i>Salmonella</i>	Invasion, enterotoxin
<i>Shigella</i>	Invasion, enterotoxin, cytotoxin
<i>Vibrio cholerae</i>	Enterotoxin
<i>Vibrio parahaemolyticus</i>	Invasion, cytotoxin
<i>Yersinia enterocolitica</i>	Invasion, enterotoxin
PARASITES	
<i>Entamoeba histolytica</i>	Invasion, enzyme and cytotoxin production; cyst resistant to physical destruction
<i>Giardia lamblia</i>	Adheres to mucosa; cyst resistant to physical destruction
Spore-forming intestinal protozoa	Adherence, inflammation
<i>Cryptosporidium parvum</i>	
<i>Isospora belli</i>	
<i>Cyclospora cayetanensis</i>	
Microsporidia (<i>Enterocytozoon bieneusi</i> , <i>Encephalitozoon intestinalis</i>)	

HUS, Hemolytic uremic syndrome.

TABLE 112.2 Mechanisms of Infectious Diarrhea

PRIMARY MECHANISM	DEFECT	STOOL EXAMINATION	EXAMPLES	COMMENTS
Secretory	Decreased absorption, increased secretion: electrolyte transport	Watery, normal osmolality	Cholera, toxigenic <i>Escherichia coli</i> (EPEC, ETEC); carcinoid, <i>Clostridium difficile</i> , cryptosporidiosis (in AIDS)	Persists during fasting; bile salt malabsorption also may increase intestinal water secretion; no stool leukocytes
Mucosal invasion	Inflammation, decreased mucosal surface area and/or colonic reabsorption, increased motility	Blood and increased WBCs in stool	Celiac disease, <i>Salmonella</i> infection, shigellosis, amebiasis, yersiniosis, <i>Campylobacter</i> infection	Dysentery (blood, mucus, and WBCs)

Clinical features

- Symptoms of infectious gastroenteritis in children are similar to adults and typically include:
 - Nausea and vomiting
 - Fever
 - Abdominal pain
 - Diarrhea
- In children, additional clinical features that raise concern for severe illness include:^[1]
 - Fever $\geq 40^{\circ}\text{C}$ or tachypnea
 - Signs of poor peripheral perfusion
 - Bloody or bilious emesis
 - Petechiae
 - Altered mental status or excessive crying/fussiness

Gastroenteritis may be accompanied by systemic findings, such as fever, lethargy, myalgias, and abdominal pain. **Viral diarrhea** is characterized by watery stools with no blood or mucus. Vomiting may be present and dehydration may be prominent, especially in infants and younger children. Fever, when present, is low grade.

Dysentery is enteritis involving the colon and rectum, with blood and mucus, possibly foul-smelling stools, and fever. *Shigella* is the prototypical cause of dysentery, which must be differentiated from infection with EIEC, EHEC, *E. histolytica* (**amebic dysentery**), *C. jejuni*, *Y. enterocolitica*, and nontyphoidal *Salmonella*. Gastrointestinal bleeding and blood loss may be significant.

A chief consideration in management of a child with diarrhea is assessing the degree of dehydration as evident from clinical signs and symptoms, ongoing losses, and daily requirements (see Chapter 33). The degree of dehydration dictates the urgency of the situation and the volume of fluid needed for rehydration. Mild to moderate dehydration can usually be treated with oral rehydration; severe dehydration usually requires intravenous rehydration and may even require admission to an intensive care unit.

Diagnostics

- Diagnosis is usually clinical.
- Consider diagnostic studies for infectious gastroenteritis in children with:^[1]
 - Severe gastroenteritis
 - Immunocompromise
 - Recent international travel or local outbreak
 - Symptoms lasting > 1 week
- Assess for signs of significant dehydration; if present, order diagnostic studies for dehydration.^{[1][3]}

Clinical dehydration scale for acute gastroenteritis in children ≤ 5 years of age ^{[1][4][5]}		
	Clinical feature	Points
Appearance/behavior	Normal	0
	Thirsty, restless, and/or lethargic but irritable with stimuli	1
	Cold, sweaty, drowsy, limp, or unarousable	2
Eyes	Normal	0
	Mildly sunken	1
	Extremely sunken	2
Mucous membranes	Moist	0
	Tacky or sticky	1
	Dry	2
Tear production	Present	0
	Decreased	1
	Absent	2
Interpretation • Total score 0: no dehydration • Total score 1–4: mild dehydration • Total score ≥ 5 : moderate to severe dehydration		

Initial laboratory evaluation of moderate to severe diarrhea includes electrolytes, blood urea nitrogen, creatinine, and urinalysis for specific gravity as an indicator of hydration. Stool specimens should be examined for mucus, blood, and leukocytes, which indicate colitis in response to bacteria that diffusely invade the colonic mucosa. Patients infected with Shiga toxin-producing *E. coli* and *E. histolytica* generally have minimal fecal leukocytes.

Viral polymerase chain reaction (PCR)—also called the nucleic acid amplification test (NAAT)—assays may be used if the diagnosis will alter management. Bacterial stool cultures are recommended for patients with fever, profuse diarrhea, and dehydration or if HUS or pseudomembranous colitis is suspected. If the stool test result is negative for blood and leukocytes and there is no history to suggest contaminated food ingestion, a viral etiology is most likely. Stool evaluation for parasitic agents should be considered for acute dysenteric illness, especially in returning travelers, and in protracted cases of diarrhea in which no bacterial agent is identified. The diagnosis of *E. histolytica* is based on identification of the organism in the stool. Serological tests are useful for diagnosis of extraintestinal amebiasis, including amebic hepatic abscess. Giardiasis can be. Diarrhea can be caused by infection, toxins, gastrointestinal allergy (including allergy to milk or soy proteins), malabsorption defects, inflammatory bowel disease, celiac disease, or any injury to enterocytes. Acute enteritis may mimic other acute diseases, such as intussusception and acute appendicitis, which are best identified by diagnostic imaging. Many noninfectious causes of diarrhea produce chronic diarrhea, with persistence for more than 14 days. Persistent or chronic symptoms may require tests for malabsorption or invasive studies, including endoscopy and small bowel biopsy.

! Diagnosis of viral gastroenteritis in children is usually clinical; diagnostic studies for infectious gastroenteritis are not routinely indicated.^[1]

Differential diagnoses

Gastrointestinal causes [6]

- [Gastrointestinal causes of acute abdomen](#)  
- [Inflammatory bowel disease](#)
- Congenital disorders with [diarrhea](#)  [7]
- [Intussusception](#)
- [Functional diarrhea](#)  [8]
- [Antibiotic-associated diarrhea](#)



Extra-intestinal causes [1]

- [Pneumonia](#)
- [Meningitis in children](#)
- [Otitis media](#)
- [UTI in children and adolescents](#)
- [Toxic shock syndrome](#)

Treatment

[Treatment of infectious gastroenteritis in children](#) is generally supportive.

All patients [1][3]

- Determine the need for admission, e.g., patients with:
 - [Admission criteria for dehydration](#)
 - [Severe gastroenteritis](#)
 - Inability to manage symptoms at home 
 - [Barriers to follow up](#)
- Provide symptomatic treatment.
 - Give antipyretics and antiemetics as needed.
 - Antidiarrheal medications are not routinely used.  [1][2][9]
 - Probiotics are not routinely recommended but may reduce the duration of [diarrhea](#) for immunocompetent patients.  [2]
- Consider antimicrobial therapy for select patients.  [2]
 - See “[Empiric antibiotics for bacterial gastroenteritis](#).”
 - See “[Treatment of giardiasis](#).”
- Optimize nutrition.
 - Maintain adequate oral intake through breastfeeding or age-appropriate foods.  [10][2]
 - [Zinc supplementation](#) is recommended for patients with [malnutrition](#) or in low-income regions. [2]
- Educate patients and/or caregivers on preventing onward transmission of gastroenteritis.

Mild to moderate gastroenteritis [1][2]

- Encourage fluid intake.
 - [Breastfed infants](#): Continue giving [breastmilk](#).
 - All other children: Consider apple juice diluted with water in a 50:50 mix followed by preferred fluids.  [1]
- Give oral rehydration solution (ORS) if signs of moderate dehydration are present. [1]
- Advise caregivers to seek medical assistance if [signs of significant dehydration](#) develop.

 [Breastmilk should not be withheld in order to give ORS.](#) [1][11]

Severe gastroenteritis or children with admission criteria for dehydration [1][2]

- Admit to hospital and initiate [contact precautions](#).
- Identify patients in [shock](#) and start [IV fluid resuscitation](#).
- Initiate [treatment of dehydration](#) and [electrolyte repletion](#) with either [IV fluids](#) or [ORS](#).

Diarrhea can be caused by infection, toxins, gastrointestinal allergy (including allergy to milk or soy proteins), malabsorption defects, inflammatory bowel disease, celiac disease, or any injury to enterocytes. Acute enteritis may mimic other acute diseases, such as intussusception and acute appendicitis, which are best identified by diagnostic imaging. Many noninfectious causes of diarrhea produce chronic diarrhea, with persistence for more than 14 days. Persistent or chronic symptoms may require tests for malabsorption or invasive studies, including endoscopy and small bowel biopsy.

Most infectious causes of diarrhea in children are self-limited. Antibiotics are not generally useful and may be a risk factor in the development of HUS when *E. coli* O157:H7 is present. Management of viral and most bacterial causes of diarrhea is primarily supportive and consists of correcting dehydration and ongoing fluid and electrolyte deficits.

Hyponatremia is common; hypernatremia is less common. Metabolic acidosis results from losses of bicarbonate in stool, lactic acidosis results from shock, and phosphate retention results from transient prerenal-renal insufficiency. Traditionally therapy for 24 hours with oral rehydration solutions alone is effective for viral diarrhea. Therapy for severe fluid and electrolyte losses involves intravenous hydration. Less severe degrees of dehydration (<10%) in the absence of excessive vomiting or shock may be managed with oral rehydration solutions containing glucose and electrolytes. Ondansetron may be administered to reduce emesis when this is persistent.

Antibiotic therapy may be necessary for high-risk patients or those with severe disease or bacteremia. Antibiotic treatment of *Shigella* may reduce the duration of symptoms and decrease transmission of infection. Azithromycin is first-line oral therapy for children. Many *Shigella sonnei* isolates, the predominant strain affecting children, are resistant to amoxicillin and trimethoprim-sulfamethoxazole. Fluoroquinolone resistance in *Salmonella* and many other gram-negative organisms is increasing in many parts of the world. *Salmonella* is treated with antibiotics in children less than 3 months of age.

Treatment of traveler's diarrhea is generally supportive, although antibiotics can be indicated in instances of bloody diarrhea or a febrile illness, in which case azithromycin is a recommended choice for children. Due to lack of consistent access to health care in many areas, providing a prescription to a family in advance of travel to a high-risk area such as in Asia, Africa, or South America may be considered.

Treatment of *C. difficile* (pseudomembranous colitis) includes discontinuation of the inciting antibiotic and oral metronidazole or vancomycin. *E. histolytica* dysentery is treated with metronidazole followed by a luminal agent, such as iodoquinol. The treatment of *G. lamblia* is metronidazole, tinidazole, or nitazoxanide.

COMPLICATIONS AND PROGNOSIS

The major complication of gastroenteritis is dehydration and hypovolemic shock. Seizures may occur with high fever, especially with *Shigella*. Intestinal abscesses can form with *Shigella*, *Yersinia*, and *Salmonella* infections, leading to intestinal perforation, a life-threatening complication. Severe vomiting associated with gastroenteritis can cause esophageal tears or aspiration pneumonia.

Deaths resulting from diarrhea reflect the principal problem of disruption of fluid and electrolyte homeostasis, which can lead to dehydration, electrolyte imbalance, hemodynamic instability, and shock. Diarrheal diseases cause approximately 10% of childhood deaths worldwide.

PREVENTION

The most important means of preventing childhood diarrhea is the provision of clean, uncontaminated water and proper hygiene in growing, collecting, and preparing foods. Good hygienic measures, especially appropriate handwashing with soap and water, are the best means of controlling person-to-person spread of most organisms causing gastroenteritis. Poultry products should be considered potentially contaminated with *Salmonella* and should be handled and cooked appropriately. Families should also be aware of the risk of acquiring salmonellosis from household reptile pets. Transmission of *Salmonella* from reptiles can be prevented by thorough handwashing after handling the animals or their cages. Children under 5 years of age and immunocompromised persons should avoid contact with reptiles.

Immunization against rotavirus infection is recommended for all children beginning at 6 weeks of age, with the first dose by 14 weeks 6 days and the last dose by 8 months (see [Chapter 94](#)). Two typhoid vaccines are licensed in the United States: an oral live-attenuated vaccine (Ty21a) for children 6 years of age and older and a capsular polysaccharide vaccine (ViCPS) for intramuscular administration for children 2 years of age and older. These are recommended for travelers to endemic areas of developing countries or for household contacts of *S. typhi* chronic carriers.

The risk for traveler's diarrhea, caused primarily by ETEC, may be minimized by avoiding uncooked food and untreated drinking water. Symptomatic self-treatment for mild diarrhea with an **oral rehydration solution** is recommended for children at least 6 years of age and adults. Self-treatment of moderate diarrhea and fever with a fluoroquinolone is recommended in adults. Similarly, children can receive azithromycin. Prompt medical evaluation is indicated for disease persisting more than 3 days, bloody stools, fever above 102°F (38.9°C) or chills, persistent vomiting, or moderate to severe dehydration.