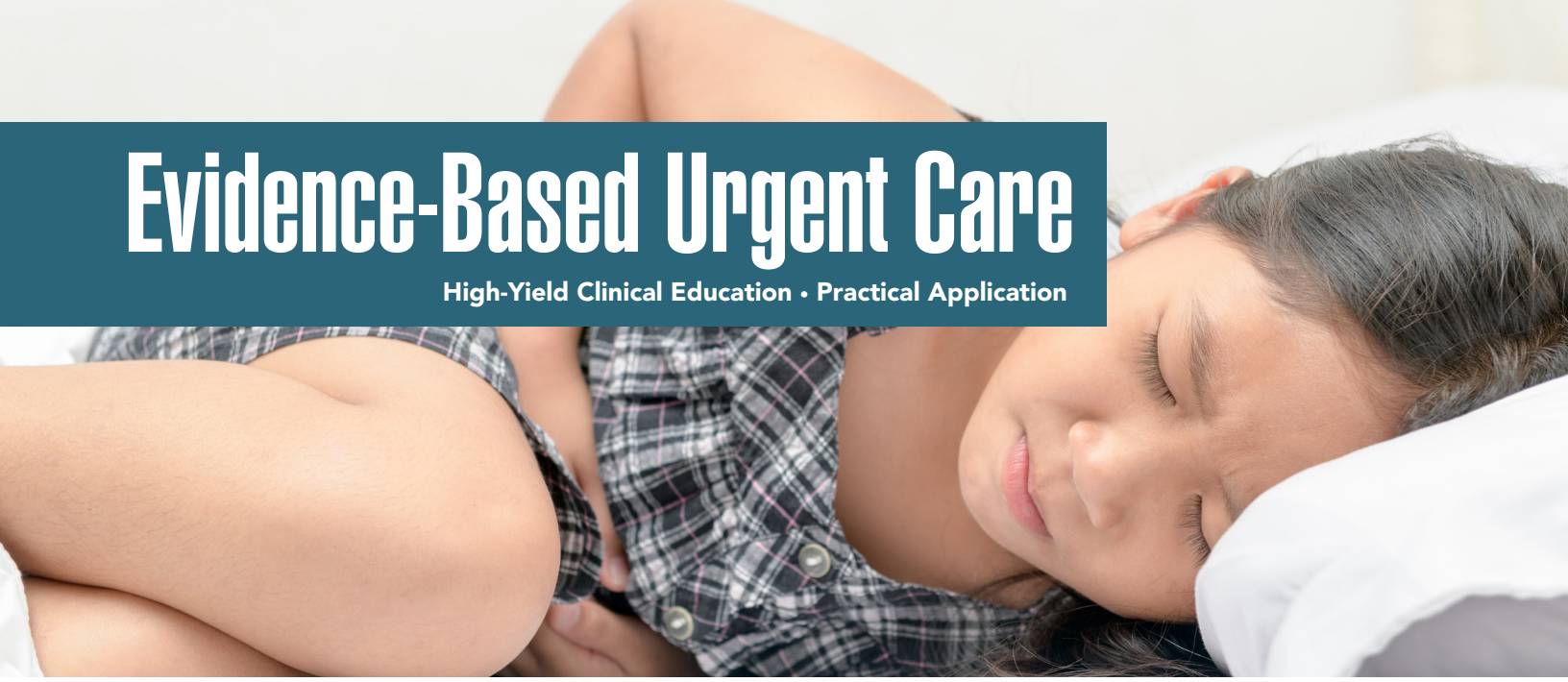

Evidence-Based Urgent Care

High-Yield Clinical Education • Practical Application

PEDIATRIC SPECIAL EDITION

Urgent Care Management of Acute Gastroenteritis in Pediatric Patients

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Although most cases of acute gastroenteritis require minimal medical intervention, dehydration and hypoglycemia may develop in cases of prolonged vomiting and diarrhea. The mainstay of treatment for patients with mild-to-moderate dehydration with acute gastroenteritis is oral rehydration solution. Antiemetics allow for improved tolerance of oral rehydration solution, and, when used appropriately, can decrease the need for intravenous fluids and hospitalization. This course reviews the common etiologies of acute gastroenteritis, discusses more severe conditions that should be considered in the differential diagnosis, and provides evidence-based recommendations for management of acute gastroenteritis in pediatric patients presenting to urgent care.

Prior to beginning this activity, see "CME Information" on page 28.

EB MEDICINE

Case Presentations

CASE 1

An 18-month-old girl who is up to date on her immunizations and has no prior medical history presents with vomiting and diarrhea for the last 3 days…

- She initially had multiple episodes of nonbloody, nonbilious emesis that stopped yesterday.
- On the second day, she had several large-volume, watery, nonbloody stools. Her parents estimate she has had approximately 10 episodes of diarrhea since yesterday. They are unsure of how many wet diapers because she has had so many episodes of diarrhea.
- She has no fever, cough, rhinorrhea, or rash. Her parents report no recent travel, no new animal exposure, and no antibiotic use within the last 6 weeks.
- On examination, she is sitting in her mother's lap, awake and alert, with her eyes open. The girl weighs 12 kg, and her vital signs are: temperature, 37.6°C (99.7°F); heart rate, 165 beats/min; blood pressure, 90/65 mm Hg; respiratory rate, 22 breaths/min; oxygen saturation, 100% on room air.
- Although she is crying during the examination, the girl produces no tears. Her mouth is dry and her eyes appear sunken. Her abdomen is soft, non-distended with no tenderness, no masses, and no hepatosplenomegaly. Her capillary refill is 3 seconds. She has watery, yellow-colored stool in her diaper.
- You wonder whether you should give this child a dose of ondansetron and attempt oral hydration, or start IV hydration. You consider sending her stool for culture and/or ordering laboratory studies...

CASE 2

A 2-year-old boy is brought to the urgent care by his mother, who states that his illness started with vomiting, approximately 4 episodes, that has now resolved. He has had 10 episodes of watery, nonbloody stools in the last 2 days…

- The boy has no past medical history. He attends daycare, and several other children at the daycare center have the same symptoms.
- He is drinking well and has normal urine output.
- On examination, he is playing with his toy cars while sitting on the exam table. His vital signs are within normal limits. He has moist oral mucosa and normal cardiac and lung examinations. His abdomen is soft, with no tenderness elicited.
- You diagnose the boy with acute gastroenteritis and inform his mother that she should continue with aggressive oral hydration. She asks you whether there is any medication you could prescribe that might stop his diarrhea. She also wants to know if there are specific foods he should avoid.
- You wonder if you should prescribe an antidiarrheal agent for this child...

■ Introduction

Nausea, vomiting, and diarrhea are some of the most common complaints of pediatric patients presenting to urgent care (UC). The most common discharge diagnosis for children who present with these symptoms is acute gastroenteritis (AGE). AGE is defined as a decrease in consistency of stools with an increase in frequency, typically 3 or more in 24 hours. Vomiting and abdominal pain do not have to be present for the diagnosis of AGE, but either or both may accompany the diarrhea.[1] Most cases of AGE are due to viral pathogens and are usually mild and self-limited, with no need for major medical intervention. Bacterial and parasitic infections are less common but should be considered in the appropriate clinical context. Antibiotic-associated diarrhea and *Clostridioides difficile* colitis are also possible etiologies of AGE.

This special edition of *Evidence-Based Urgent Care* discusses various etiologies of AGE, details how to determine the level of a patient's dehydration, and reviews practice guidelines and high-quality studies that can inform the UC clinician of the most recent and proven treatments for AGE.

■ Etiology and Pathophysiology

Etiology

AGE is one of the most common diagnoses in the pediatric population. It can affect patients of all ages but tends to be more severe in younger patients. Diarrheal illnesses kill hundreds of thousands of children each year. This occurs largely in overburdened healthcare systems in low-income and middle-income countries (LICs and MICs), where children already suffering from malnutrition can succumb to dehydration.[2,3] In the United States and other high-income countries (HICs), there are far fewer deaths secondary to AGE; however, there are still significant costs, including medical care and time lost from work and school.[4]

Viral Pathogens

Worldwide, viral pathogens are the most common cause of AGE, accounting for up to 80% of cases,[5] with norovirus being the most common viral pathogen worldwide and in the United States.[6] Although rates of rotavirus AGE have declined since implementation of vaccination, it remains a significant cause of diarrheal illness in children.[7-10] Other viruses also cause AGE, such as sapovirus, astrovirus, and enteric adenovirus.[4,11,12] While these viruses vary slightly in their presentation and the time of year they are most prevalent, there are no absolute distinguishing factors, and treatment does not differ.

Bacterial Pathogens

Bacterial causes of AGE are less common than viral etiologies, but their course tends to be more severe. In patients for whom a bacterial etiology is identified, the most common causes are *Salmonella* spp, *Shigella* spp, and *Campylobacter* spp.[13] Bacterial AGE is more commonly seen in areas of compromised sanitation but can be seen in any environment.

Some bacterial infections require treatment with antibiotics to hasten recovery and decrease bacterial shedding. The preferred antibiotic varies based on bacterial type and resistance patterns. Some bacterial causes of colitis (ie, *Escherichia coli* O157:H7) can cause hemolytic uremic syndrome (HUS) due to bacterial lysis and may be exacerbated by antibiotic administration. For these reasons, antibiotics should not be started in most cases of suspected bacterial AGE until the species has been identified via cultures or polymerase chain reaction–based diagnostic studies.

Antibiotics

A potentially serious complication of antibiotic use is *C difficile* colitis, which may cause severe abdominal pain, voluminous diarrhea, dehydration, and blood loss. The UC clinician should inquire about current and/or recent antibiotic use in all patients who present with vomiting and diarrhea and consider this diagnosis when historically appropriate.[14] Because the rate of asymptomatic carriage is quite high in children aged <12 months, testing for *C difficile* toxin is not recommended in this age group.[15]

Parasites

Giardia and *Cryptosporidium* are rare causes of AGE in immunocompetent children, but both have been associated with waterborne and foodborne outbreaks as well as daycare outbreaks.

Pathophysiology

The etiologies of AGE cause disease via a common end pathway. Infection, gut biome alteration, and even the host's own immune system cause inflammation of the lining of the stomach and intestines, which can lead to abdominal pain, nausea, vomiting, diarrhea, and hematochezia.

■ Differential Diagnosis

Inflammatory Bowel Disease

The diagnosis of inflammatory bowel disease (IBD), which includes Crohn disease and ulcerative colitis, will never be made in UC, as it requires endoscopy and biopsies. However, it is important to remember that new-onset IBD may present with watery or bloody diarrhea. Consider new-onset IBD in older pediatric patients (ie, adolescents) who present with recurrent diarrhea, weight loss, fever, and sometimes joint pain or oral ulcers. Associated gastrointestinal symptoms may include anal fissures or anal skin tags.[16] These patients may require transfer to the ED if they are ill-appearing, or referral to a gastroenterologist if well.

Toxic Megacolon

Toxic megacolon is an acute dilation of the colon that causes diarrhea. It is mainly a complication of IBD but can also result from any inflammatory condition of the colon, including infectious diarrhea, particularly *C difficile* colitis. This condition is characterized by severe, bloody diarrhea, diffuse abdominal pain, and distention with malaise. Patients progress to tachycardia and hypotension. If you suspect this condition or identify the characteristic 6 cm dilation of the colon (particularly transverse) on x-ray,[17] transfer these patients immediately to the ED.

Hemolytic Uremic Syndrome

HUS is another rare but potentially fatal cause of diarrhea in pediatric patients. This triad of microangiopathic hemolytic anemia, acute kidney injury, and thrombocytopenia is a complication of AGE caused by Shiga toxin-producing microbe, most commonly *E coli* O157:H7, although *Shigella dysenteriae* type 1 is another cause. The prodromal AGE is characterized by the typical watery diarrhea, which may be accompanied by vomiting. This progresses to crampy, bloody diarrhea. Acute kidney injury, anemia and thrombocytopenia develop as the bloody diarrhea is resolving. In contrast,

atypical HUS may present with vomiting, decreased urine output, and weight gain.[18] Clinical suspicion for HUS should prompt laboratory evaluation or immediate transfer depending on the patient's appearance and the process, flow, and laboratory capability of your UC.

Allergic Colitis

Allergic colitis in infants due to cows' milk allergy will often present first to the UC. Worried parents will bring in an infant (usually aged <3 months), with concerns for vomiting, poor oral intake, and/or diarrhea and bloody stools. These children are usually very well-appearing with a reassuring physical examination. There is no definitive test that can be performed in the UC or ED for allergies to proteins in cows' milk; however, parents whose children are allergic to cows' milk can usually be reassured and given instructions for elimination of the likely offending protein.[19-21] In food protein-induced enterocolitis syndrome (FPIES), a rare type of allergic colitis that can be triggered by any protein found in food, a more dramatic presentation may occur, with multiple episodes of forceful emesis, pallor, and floppiness, as well as diarrhea.[20,22] These patients will typically appear ill and require resuscitation in the ED, including blood work, imaging, and intravenous (IV) fluids, due to the extent of vomiting and the child's ill appearance on presentation.[20]

Other Diagnoses

Consider a broad differential when first evaluating children with AGE. There are many other diagnoses that can present with diarrhea. **(See Table 1.)** Diagnoses such as appendicitis, intussusception, volvulus, and hepatitis do not usually cause diarrhea alone, but they can all present with this symptom. Many of these disease processes have a much more severe course, with a higher risk of morbidity and mortality.

Table 1. Differential Diagnosis of Conditions That Cause Diarrhea

- Food protein allergy (esophagitis/colitis)
- Acute gastroenteritis
- Appendicitis
- Hepatitis
- Inflammatory bowel disease
- Irritable bowel syndrome
- Small-bowel obstruction
- Intussusception
- Intestinal malrotation/volvulus
- Incarcerated hernia

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■ Urgent Care Evaluation

Patients with signs of shock should be evaluated rapidly and treated upon arrival, recognizing that children in compensated shock may only demonstrate tachycardia with a normal blood pressure. Severely dehydrated patients with tachycardia and hypotension should have IV access established immediately, and isotonic fluids should be administered while arranging for emergent care. In ill-appearing children or children with sleepiness or altered mental status, point-of-care glucose testing should be performed at the bedside and dextrose provided for those who are hypoglycemic. **(See the Treatment section, page 9.)** Children have diminished glycogen stores compared to adults and are more susceptible to developing associated hypoglycemia.

History

The history should focus on the duration of symptoms and should clarify whether both vomiting and diarrhea are present, with a discussion of the number of episodes for each. Many patients present for medical attention very early during AGE, with concerns of more serious pathology; however, diarrhea may not have yet started. Vomiting that has continued for more than 24 to 48 hours without diarrhea is not AGE, and, while it may represent merely gastritis, a broad differential of intracranial, endocrine, gastrointestinal, genitourinary, and other pathology should be considered, and an appropriate review of systems may help narrow the differential. Inquire as to the color of both the emesis and stool, as bilious emesis should be considered obstruction until ruled out, and bloody emesis and bloody stools are a cause for concern for etiologies other than AGE. If abdominal pain is present, ask the patient or parent to describe the location and quality of the pain. The presence or absence of fever can be important, as well as a history of recent travel and sick contacts with similar symptoms. Animal exposure is also important because exposure to reptiles and poultry is linked to salmonella infection. Quantity of urine output should be questioned, though in diapered children, frequent watery stools may make quantification of urine output difficult. Since viral AGE is highly contagious, inquiry should be made regarding possible ill contacts. Finally, the names of medications taken currently and in the last month should be noted.

Physical Examination

As always, the physical examination should begin with a review of the vital signs. Look for fever, tachycardia, and hypotension. Hypotension is usually a late finding in dehydration or may indicate a more severe etiology of the patient's symptoms. Tachypnea may be a sign of respiratory compensation for metabolic acidosis secondary to dehydration and starvation ketoacidosis. Capillary refill should be evaluated, as children often manifest delayed capillary refill (>2 seconds) before hypotension. Children with minimal dehydration (<3% loss of body weight) will have a normal physical examination. Children with mild-to-moderate dehydration (3%-9% loss of body weight) may have slightly sunken eyes, decreased tears, dry mouth, and slightly increased heart rate. Children with severe dehydration (>9% loss of body weight) will likely be lethargic and tachycardic, with no tears, very dry mouth, and prolonged capillary refill.[23]

The abdominal examination should locate any tenderness to palpation, making note if there is no tenderness, diffuse tenderness, or focal tenderness (eg, epigastric, right upper quadrant, or right lower quadrant). AGE tends to cause mild and diffuse abdominal pain; however, sometimes it causes no pain at all. Patients with focal tenderness should be considered to have another diagnosis, such as pancreatitis with epigastric/periumbilical tenderness, cholecystitis or hepatitis with right upper-quadrant tenderness, or appendicitis with right lower-quadrant tenderness.

Skin and eye examinations are also important. Jaundice is not expected in AGE and should raise suspicion for liver, pancreas, or gallbladder disease. A genitourinary examination should be performed in all patients with abdominal pain to evaluate for a testicular/ovarian pathology. Consider a pelvic examination in all sexually active females to evaluate for gynecological mimics of AGE.

Determining the Degree of Dehydration

In theory, the degree of dehydration can help guide management and interventions. Ideally, the degree of dehydration is determined by comparing a child's current weight with the pre-illness weight. Because infants have a higher total body water (70%-80%)

compared to older children (total body water of 60%), they must lose more weight to reach the same degree of dehydration as an older child.[24] Parents very rarely know this information, so physical signs such as tear production, mucous membrane appearance, skin turgor, capillary refill, activity level, etc, are more clinically useful. There are many different dehydration scores available, such as the World Health Organization (WHO) scale for dehydration, the Clinical Dehydration Scale (CDS), and the Gorelick scale for dehydration. The WHO scale for dehydration is a 4-point scale that evaluates the patient's general condition, eyes, thirst, and the feel of the patient's skin.[25] The CDS is also a 4-point scale; it includes rating the patient's general appearance, eyes, mucous membranes, and degree of tears.[26,27] The Gorelick scale can be used in either a 4-point format or a 10-point format, with the first 4 characteristics being those in the 4-point scale.[28,29] **(See Table 2.)** A meta-analysis of these scales showed that no single scoring system is best.[30] A more recent study comparing the CDS, Gorelick, and WHO scales found that the CDS was very limited in its ability to diagnose dehydration, and neither the Gorelick nor the WHO scale was highly accurate.[31] In general, these scoring systems can identify children with severe dehydration, but often miss children with mild dehydration and fail to adequately differentiate between children with mild and moderate dehydration.[32] Since the recommended treatment for mild and moderate dehydration is the same—oral rehydration solution (ORS) only—and most clinicians can recognize severe dehydration, the use of these complex scoring systems (some have 12 different clinical findings) are perhaps not routinely needed.[23]

Table 2. The 4- and 10-Point Gorelick Scale for Dehydration for Children Aged 1 Month to 5 Years

Characteristic	No or Minimal Dehydration	Moderate to Severe Dehydration
*General appearance**	Alert	Restless, lethargic, unconscious
*Capillary refill**	Normal	Prolonged or minimal
*Tears**	Present	Absent
*Mucous membranes**	Moist	Dry; very dry
Eyes	Normal	Sunken; deeply sunken
Breathing	Present	Deep; deep and rapid
Quality of pulses	Normal	Thready, weak, or impalpable
Skin elasticity	Instant recoil	Slow recoil; recoil >2 sec
Heart rate	Normal	Tachycardia
Urine output	Normal	Reduced; not passed in many hours

*These items alone comprise the 4-point scale.
Severity of dehydration is determined by the number of clinical signs present.
Scoring for the 4-point scale (italics): presence of ≥ 2 clinical signs indicates ≥5% BWΔ; presence of ≥3 clinical signs indicates ≥ 10% BWΔ.
Scoring for the 10-point scale (all signs/symptoms): presence of ≥ 3 clinical signs indicates ≥ 5% BWΔ; presence of ≥ 7 clinical signs indicates ≥ 10% BWΔ
Abbreviation: BWΔ, body-weight change.

■ Diagnostic Studies

Laboratory Studies

In cases of clear-cut AGE with mild-to-moderate dehydration, there is almost no indication for laboratory testing.[33] If there is no reason to place an IV catheter, there is no reason to collect blood for laboratory studies. Oral rehydration is the mainstay of treatment in these cases. Neither the European Society for Pediatric Gastroenterology, Hepatology and Nutrition nor the United States Centers for Disease Control and Prevention recommend measurement of serum electrolytes in children with mild or moderate dehydration who will be treated with ORS.[1,34]

For children with signs of severe dehydration, a set of electrolytes with blood urea nitrogen (BUN) and creatinine should be obtained, as well as point-of-care blood glucose testing. Laboratory studies should be obtained in all neonates with any level of dehydration and in patients with an altered mental status not explained by their suspected level of dehydration. Children for whom oral rehydration has failed and subsequently receive IV fluids should probably have a set of electrolytes with BUN and creatinine sent.[1] C-reactive protein has not been shown to differentiate viral versus bacterial causes of AGE and is not recommended in obvious cases of AGE.[35]

However, there is little consensus among researchers regarding the utility of these laboratory tests for identifying the level of dehydration. Neither urine ketones nor urine specific gravity correlate with the level of dehydration.[36,37] There is variable evidence for BUN as a marker of dehydration, with high levels likely indicating dehydration and a BUN/creatinine ratio <20 likely indicating no dehydration.[38-40] While serum bicarbonate cannot be used alone to assess for dehydration, decreasing values correlate with increased dehydration levels.[41] Vega and Avner reported that a serum bicarbonate level <17 mEq/L had a sensitivity of 77% for detecting moderate dehydration and a sensitivity of 94% for detecting severe dehydration. Combining a clinical dehydration scale with serum bicarbonate level resulted in 100% sensitivity in detecting severe dehydration.[42] In any case, a clinical assessment of dehydration is made prior to assessing these laboratory values, so their utility is minimal.

For cases in which the diagnosis is uncertain, additional laboratory evaluation is likely warranted. Since most pediatric UCs are limited in their laboratory evaluation capability,[43] this will likely involve transfer to the ED. In cases in which patients appear very well and can maintain their hydration, outpatient follow up can be arranged, either with the primary care provider or a gastroenterologist.

Stool Studies

Stool cultures and other stool studies are not required in most cases of uncomplicated AGE. In children with prolonged (>3 or 4 days) or bloody diarrhea, toxic-appearing children, and children who have recently traveled abroad, stool cultures may be appropriate.[44] In children aged >1 year with frequent, watery stools and recent antibiotic use, consider sending stool for a *C difficile* toxin assay; the diarrhea of *C difficile* colitis is rarely bloody.[45,46] Avoid testing the stool of children aged <1 year for *C difficile*, as these children can be asymptomatic carriers and a positive result is very difficult to interpret.[46]

Stool ova and parasite examinations are typically low-yield tests; however, in children with an appropriate travel history or concern for *Giardia* (recent camping or fresh water exposure), stool should be sent to the laboratory for ova and parasite testing.[47] Toxocariasis and cysticercosis are 2 worm infections that can occur in children living in poverty in the United States.[48] Consider sending stool for ova and parasite

testing in children without a concerning travel history if diarrheal symptoms have been prolonged with negative prior stool cultures and/or there is evidence of weight loss or failure to gain weight.

Imaging Studies

No imaging is required in the workup of uncomplicated AGE. A 2-view x-ray of the abdomen, typically including an anterior-posterior view along with either an upright or left lateral decubitus view, can help evaluate for obstruction. If a diagnosis such as intussusception or appendicitis is likely, transfer to the ED for further evaluation as indicated.

■ Treatment

Oral Rehydration

Oral rehydration is the mainstay of treatment for AGE. For patients who have ongoing vomiting, antiemetics can be administered prior to initiating oral rehydration. Patients with mild-to-moderate dehydration should begin oral rehydration with an appropriately formulated ORS (Pedialyte®, Enfalyte®, or generic formulations of these solutions).[49-51] Use of ORS leads to decreased length of hospitalization for patients with AGE and is equivalent to IV hydration with respect to weight gain and duration of diarrhea.[52] In one meta-analysis of ORS versus IV hydration, it was determined that for every 25 children treated with ORS, 1 treatment would fail and require IV hydration.[53]

ORS is not used as often as it should be in HICs.[54] This is especially true in the United States.[55] UC clinicians need to present ORS as the best way to rehydrate children.[50] In the developed world, it is not recommended for parents to mix their own rehydration solution because mistakes can easily be made, and commercially prepared ORSs are readily available.[56] Other liquids, such as water, juices, sports drinks, soups, etc, are not traditionally recommended for mild-to-moderate dehydration because they do not contain the ideal ratio of sugars and salts to promote intestinal absorption, and they may serve as an osmotic diuretic. However, in a study from Canada, children with minimal dehydration due to AGE were randomized to receive either dilute apple juice followed by whatever fluid they preferred at home or apple-flavored ORS followed by ORS at home. The children in the diluted apple juice group had less treatment failure and less IV fluid administration than the ORS group.[57]

Rehydration should begin slowly, with the child initially consuming only a few milliliters (5 mL to 10 mL) every 5 minutes for the first 30 minutes. Once a child is tolerating that amount over a half hour, then the amount consumed can be increased by 5-mL increments over the next 30 minutes or so. Depending on the degree of dehydration, 50 to 100 mL/kg of ORS should be given over 3 to 4 hours to correct dehydration.[23,58] Oral rehydration can be completed at home once the provider determines patient is able to tolerate ORS in UC. It is important to consider that most dehydrated children will not refuse ORS.[49,59] After they are rehydrated, children can continue taking ORS at maintenance or they can resume taking regular fluids and foods.

Children who tolerate fluids in the UC and are discharged home must continue to drink, and parents must be aware of the need to replace fluid losses from continued vomiting and diarrhea. A rough calculation of the amount of ORS needed to replace emesis and diarrhea is 10 mL/kg for each episode of emesis or diarrhea.[60]

Antiemetics

Ondansetron has become the most used 5-HT3 antagonist in the United States, though several others are used in other settings. Ondansetron selectively binds 5-HT3 both peripherally on the vagal nerve terminals and centrally in the chemoreceptor trigger zone. While ondansetron is not well studied in UC, numerous studies over the last decade have shown that ondansetron is safe and effective for AGE treatment in the ED. Presumably this evidence translates well to UC. Vomiting children who are given ondansetron prior to an oral challenge are less likely to fail oral rehydration, require IV hydration, and be admitted to the hospital.[44,61-65] Children treated with ondansetron also leave the ED sooner than those who are not given ondansetron prior to oral challenge.[66,67] Additionally, ondansetron was found to be cost-effective compared to usual care (ORT) in the after-hours primary care setting[68] and increase parental satisfaction with care in the primary care setting.[69] IV ondansetron, if available in the UC, should be administered to children who require IV fluids. Two studies of children receiving IV fluids for AGE after failed oral challenge showed a higher rate of complete resolution of vomiting and a lower admission rate in the IV ondansetron group versus the placebo group.[70,71]

Dosages and Administration Routes for Ondansetron

Ondansetron can be given via oral, IV, or intramuscular (IM) routes (IM is approved in children aged ≥12 years). In children with mild-to-moderate dehydration due to AGE with continued nausea and vomiting, strongly consider giving a single oral, weight-based dose approximately 15 to 30 minutes prior to attempting oral rehydration. Most studies recommend the following oral pediatric dosing guidelines for ondansetron: children weighing <15 kg: 2 mg; children weighing 15 kg to 30 kg: 4 mg; children weighing ≥30 kg: 8 mg.[72,73]

Ondansetron has not been approved for use for vomiting in AGE, but it is considered an evidence-based off-label use. For this purpose, it is well studied in children and infants as young as 6 months of age, but evidence for infants younger than this is lacking. Oral disintegrating tablets are probably the best tolerated, although the oral solution is acceptable as well. Some hospitals will not allow oral disintegrating tablets to be cut in half; in these situations, or if the oral disintegrating tablets or oral solution are not available or tolerated, the IV preparation can be given orally.[74] For children with severe dehydration in whom IV hydration will be started immediately, IV ondansetron can be given (0.15 mg/kg, max 8 mg).

Side Effects of Ondansetron

Ondansetron does have potential side effects that must be considered. The United States Food and Drug Administration (FDA) issued a safety communication in 2011 for the potential of QT prolongation with ondansetron. This was associated with the IV dose of 32 mg, which was subsequently removed from the label; however, the FDA states that investigation into this side effect is ongoing.[75] Multiple studies have shown that a single dose of ondansetron for AGE-associated vomiting in the pediatric population is low-risk.[65,69,76,77] Nevertheless, providers should exercise caution in using ondansetron for vomiting in patients with a history of prolonged QT.

Some studies have shown an increased number of diarrheal episodes in children who receive ondansetron.[78] However, in at least 2 studies, this amounted to only 1 more episode of diarrhea, which is not clinically significant.[61,79]

A concern of some clinicians is the fear of masking a more serious alternative diagnosis. While this is always possible, a large retrospective review published in 2010

did not find that the use of ondansetron in suspected AGE led to an increased risk of masking a more serious illness.[80]

Prescription Ondansetron

The evidence for prescribing ondansetron for home treatment of vomiting associated with AGE is mixed. Benari et al found in their retrospective cohort that ondansetron prescription for AGE was associated with a reduction in 72-hour ED return (adjusted odds ratio [aOR] 0.84; 95% confidence interval [CI] 0.75-0.93).[81] However, Mclaren et al found no difference in ED return or admission when children were prescribed ondansetron for home use (aOR 1.12; 95% CI 0.92- 1.33) or admission after ED revisit (aOR 0.81; 95% CI 0.51-1.27).[82] Similarly, Gray et al found no difference in ED return for patients with AGE who received an ondansetron prescription versus those who did not (6% with prescription, 5% without; $P = 0.66$).[83] Concerns about the cost-effectiveness of home treatment and potential adverse effects prompted initiation of the DOSE-AGE trial, a randomized, placebo-controlled, double-blinded clinical trial being conducted in 6 Canadian pediatric EDs; this trial is ongoing, with an estimated completion date in 2023.[84]

While medications such as promethazine and metoclopramide are used for nausea and vomiting in other settings, these medications have no place in the treatment of AGE.[1,85]

Nasogastric and Intravenous Hydration

Some children will continue to vomit even after administration of antiemetics or will refuse to take adequate liquids by mouth due to fear of vomiting, disability, or stubbornness, in which case supplemental IV or nasogastric (NG) hydration is indicated. Depending on the capability of the UC, hydration may be initiated in the UC setting prior to transfer or admission.

In some countries, children with mild-to-moderate dehydration will have a NG tube placed, and rehydration solution will be given via this route. In the United States and many other countries, an NG tube is considered the option of last resort for rehydration due to AGE; children who fail oral rehydration after antiemetics typically have an IV catheter placed and IV fluids administered, even though rehydration via NG tube is associated with fewer complications and shorter ED and inpatient hospital stays.[44] In a study comparing NG hydration to IV hydration, there were only 2 failed attempts at NG tube insertion, but there were at least 27 failed attempts at IV catheter insertion.[86]

Another consideration is whether the UC has the capability of providing NG hydration. The American Academy of Pediatrics considers IV supplies and IV fluids essential equipment in the pediatric UC setting, whereas NG tubes are suggested.[87] Most pediatric UCs have IV hydration capability,[43] while the proportion of pediatric UCs with NG hydration capability is unknown.

Intravenous Fluid Resuscitation

For children presenting to the UC with AGE and severe dehydration, rapid resuscitation with IV fluids is crucial while arranging for emergent transport. When the IV catheter is placed, blood work should be obtained to evaluate electrolytes and renal function. In addition, a rapid bedside glucose test should be obtained, as hypoglycemia often complicates severe dehydration. One study demonstrated that the duration of vomiting seems to be an important risk factor for hypoglycemia in children aged <5 years; those with hypoglycemia had a mean of 2.6 days of vomiting compared to 1.6 days in the nonhypoglycemic group.[88] Consider metabolic disorders in young children with

unexpected or recurrent hypoglycemia. In children with severe dehydration, most emergency clinicians would start with a 20 mL/kg normal saline (NS) bolus of fluids (or lactated Ringer's solution). In children with stable blood pressure and normal capillary refill, infusion over 30 to 60 minutes is appropriate. In severely dehydrated patients who are very ill/toxic-appearing, the IV fluid bolus should be administered over 10 to 15 minutes, if possible. This rapid bolus may be administered via the push-pull method, with a 3-way stopcock, or via the detach-reattach method.

Treatment of Hypoglycemia

The definition of hypoglycemia varies, because symptoms of hypoglycemia can occur at a wide range of glucose levels. In the ill child, a glucose <60 mg/dL is diagnostic of hypoglycemia and should be treated promptly. If the child is tolerating oral fluids, oral treatment options include fruit juice (4 ounces = 15 gm of dextrose) and glucose gel. For those not tolerating oral intake, IV dextrose is indicated. Although D10 is preferable, D25 is more commonly available in pediatric UC settings[43] and can be given at 2 to 4 mL/kg.

Rapid Versus Standard Rehydration

Freedman et al examined a rapid rehydration protocol versus standard rehydration (60 mL/kg/hr vs 20 mL/kg/hr of NS) and found no difference regarding time to rehydration or prolonged treatment time. However, there was a significant difference in median time to discharge, with the rapid group staying longer in the ED (6.3 vs 5.0 hrs).[89] A 2016 systematic review evaluated 3 studies comparing standard versus rapid IV hydration protocols and determined that there was no superiority of rapid (60 mL/kg/hr) compared to standard (20 mL/kg/hr) IV hydration.[90] A 2018 systematic review and meta-analysis showed no difference in treatment failure or readmission rate between the two methods of rehydration.[91]

Antidiarrheal Agents

While antiemetics have been effective in decreasing vomiting, an equally effective and safe antidiarrheal agent has yet to be developed. In many LICs and MICs, it is the persistence of diarrhea that contributes the most to dehydration in AGE. This is less common in HICs, most likely due to the better baseline nutritional status of children in these countries. However, even in HICs there is a desire to find a better antidiarrheal medication, as time missed from school and work is extremely costly.

Loperamide

Loperamide (Imodium®) is available over the counter in the United States. It cannot be used in children aged <2 years because it causes drowsiness and ileus; it is strongly discouraged in children of all ages, due to reports of death secondary to paralytic ileus.[52] There are also reported cases of abuse.[92,93]

Bismuth Subsalicylate

The salicylate portion of bismuth subsalicylate (PeptoBismol®, Kaopectate®) acts as an antisecretory agent. It also has antimicrobial effects through direct action on the bacterial cell wall. Several studies have shown decreased duration of diarrhea when bismuth subsalicylate is used. However, it must be administered every 4 hours, and there is concern about salicylate toxicity if it is used incorrectly; therefore, it is not recommended for use in children as an antidiarrheal agent.[52]

Probiotics, Prebiotics, and Synbiotics

Probiotics are nonpathogenic organisms that work by regulating the gut biome and help to lessen inflammatory pathways.[94] Numerous lower-quality studies in the past have shown that probiotics help decrease stool volume and frequency in AGE, as well as other conditions.[44,52,95-101] However, in the last several years, several high-quality randomized controlled trials have been published that show little benefit. Schnadower et al looked at a 5-day course of *Lactobacillus rhamnosus* GG at a dose of 1×10^5 colony-forming units given twice daily or matching placebo. The study found no difference in the presence of moderate to severe gastroenteritis between the groups within 14 days after enrollment, and no significant difference in the duration of diarrhea, duration of vomiting, daycare absenteeism, or rate of household transmission.[102] Similarly, Freedman et al found no difference in presence of moderate to severe gastroenteritis, duration of diarrhea, or return for care between patients who received a 5-day course of a combination probiotic product containing *Lactobacillus rhamnosus* R0011 and *L helveticus* R0052, at a dose of 4.0×10^4 colony-forming units twice daily, and patients who received placebo.[103] In 2020, Freedman et al also found no effect of probiotic (vs placebo) on either gastroenteritis symptoms or viral load.[104]

Prebiotics (food products that promote the growth and activity of bacteria that reside in the gut[105]) and synbiotics, a combination of probiotics and prebiotics, are less well studied in the treatment of AGE, but some studies show these products may shorten the duration of diarrhea.[106] Probiotics, prebiotics, and synbiotics are widely available over the counter in the United States. Parents who inquire about using these products for their child with AGE should be informed of the mixed evidence, but low risk, of these products.

Zinc

Zinc supplementation should be strongly considered when treating diarrhea in children who may have zinc deficiency. While zinc deficiency is rare in the United States, it should be considered in children who are recent immigrants from LICs and MICs because supplementation significantly reduces diarrhea duration in children with underlying zinc deficiency.[1]

■ Special Populations

Most young infants who present to UC with the chief complaint of diarrhea and/or vomiting will end up with a relatively benign diagnosis. However, patients aged <12 months should always be approached with a very broad differential. The most serious diagnosis to consider is intestinal malrotation and volvulus. Most children with malrotation will present within the first year of life, with about half diagnosed within the first month. Clinicians should inquire about the color of the emesis; bilious emesis should make malrotation and volvulus the presumed diagnosis until proven otherwise. Infants with formula- or milk-colored emesis may have benign reflux, intussusception, protein allergy (cows' milk or other), urinary tract infection (especially if fever is present), or pyloric stenosis (forceful vomiting, progressively worsening emesis, very hungry infant after vomiting).[107] AGE could still be the ultimate diagnosis in this age group, but other entities should be considered. Because AGE requires the presence diarrhea for diagnosis, these more severe conditions deserve particular attention in the patient who is vomiting without diarrhea.

Another consideration in infants is methemoglobinemia. Although the pathogenesis is poorly understood, this complication may be more common than previously thought. The typical infant who acquires diarrhea-related methemoglobinemia is small (<10th

percentile for body weight), young (aged <3 months), and has had a longer course of diarrhea (≥7 days).[108] Patients with prior abdominal surgeries who present with vomiting require extra consideration and evaluation. These children are at risk for intestinal obstruction due to adhesions, and this possibility should be addressed. Inquire about bowel movements, abdominal pain, and abdominal distension. A single dose of an antiemetic can be given prior to an oral challenge, but if vomiting continues, further investigation should follow. If these children are discharged home with a prescription for an antiemetic, strict return precautions must be given to patients and their caregivers.

Finally, children with chronic medical problems (eg, diabetes, heart disease, renal disease, and cystic fibrosis) warrant a more thorough evaluation when they present with symptoms of AGE. Children with diabetes need at least a finger-stick glucose test and urinalysis to evaluate for diabetic ketoacidosis. Children with cardiac and renal disease are more sensitive to dehydration and will often need measurement of electrolytes and administration of IV fluids much earlier in their course of AGE than a child without cardiac or renal disease. Patients with cystic fibrosis are also more sensitive to dehydration due to AGE; these children are also at risk for pancreatitis due to their exocrine dysfunction and *C difficile* colitis due to chronic antibiotic administration. Any child with a known or suspected metabolic disorder with vomiting and/or diarrhea should receive evaluation and treatment in consultation with their endocrinologist and/or geneticist. Since these symptoms can herald metabolic crisis, early IV access, fluid resuscitation, and transfer should be strongly considered.

■ Controversies and Cutting Edge

Despite the advances in medicine and hygiene in the last 100 years, AGE continues to cause much morbidity and mortality. Physicians and scientists are continuously looking for new medications and treatment regimens that might help reduce this burden. Some of these new ideas have proven to be more useful in the developing world, while others may have a great impact worldwide.

Racecadotril

Racecadotril is an antidiarrheal drug that has been shown in a few studies to reduce the duration and frequency of diarrhea in infants and children. It is an enkephalinase inhibitor and results in decreased secretion of water and electrolytes into the intestines. The Cochrane Database of Systematic Reviews, in their examination of 7 randomized controlled trials with 1140 participants, found this drug to be safe but not helpful in reducing the duration of diarrhea.[109] In contrast, a review and meta-analysis of 58 trials from 9 countries, including 6 in comparison to placebo, found that racecadotril reduced the duration of diarrhea in AGE and was more tolerable than loperamide.[110] This medication is available in Europe, South America, and parts of Asia, but is not approved by the United States FDA at this time.

Gelatin Tannate

Gelatin tannate has sparked interest as a possible antidiarrheal treatment in AGE. It is a tannic acid suspension in a gelatin solution that can alter the gut microbiome, decrease intestinal wall permeability, and reduce inflammation. In a prospective, single-blinded, randomized study from Italy, children who drank ORS with added gelatin tannate had significantly fewer bowel movements at 72 hours and 31 hours shorter duration of diarrhea compared to those given plain ORS.[111] In this study, the only adverse effect reported was nausea approximately 20 minutes after taking the gelatin tannate. In

contrast, a randomized, placebo-controlled, double-blinded control trial of 72 children aged <5 years with AGE showed no difference between gelatin tannate and placebo in decreasing number or duration of diarrhea stools.[112] Gelatin tannate is currently not commercially available it the United States.

Bimodal Release Ondansetron

Bimodal release ondansetron is currently being studied, and has shown promising benefits in adults in adolescents, with antiemetic effects extending 24 hours out from a single dose.[113]

■ Disposition

Most patients seen in the UC who are diagnosed with AGE will be discharged home. For children with severe dehydration, those with a questionable diagnosis, those who are unable to tolerate oral hydration or have hypoglycemia refractory to oral treatment, transfer or admission for continued treatment and evaluation is necessary. The parents/caregivers of children who are discharged will need explicit discharge instructions with anticipatory guidance. Parents/caregivers must understand that they will need to continue to replace fluid losses due to vomiting and diarrhea, as well as provide maintenance hydration.

Children who are breast-fed should continue to breast-feed during their illness, and there should be no recommendations to eliminate specific foods from a child's diet upon discharge home.[49,114] The traditional BRAT (bananas, rice, applesauce, toast) diet does not lead to decreased stool output and can lead to further weight loss.[115] Studies have demonstrated that children fed their regular diet have shorter hospitalizations, decreased duration of symptoms, and return to their pre-illness weight sooner than children who are diet-restricted.[58,116] The intestinal lining needs the nutrients found in a regular, well-balanced diet in order to regenerate damaged cells.[117] A lactose-free diet should be considered only in cases when a child's diarrheal output increases dramatically after consuming milk-based products.[58] Parents should be advised to take their children to the ED if they are not able to tolerate any oral fluids, have significantly decreased urine output (<3 urine outputs in a 24-hour period), or have significantly decreased activity level or changes in mentation.

Antiemetics, such as ondansetron, do not need to be prescribed on discharge. Most children with AGE will recover completely with only ORS at home. While the use of ondansetron has not resulted in the masking of more serious illness,[80] there is minimal literature on discharge prescription for pediatric AGE.

Antibiotics should be prescribed only for children with proven *C difficile* colitis or cases where a bacterial pathogen (non–*E coli* O157:H7) is identified and diarrheal symptoms are persistent. These cases will be evident in the rare case that a UC clinician ordered stool studies. First-line treatment for *C difficile* colitis in children is to discontinue any antimicrobials the child is on.[45,118] If the child is no longer on the antibiotic and/or symptoms are moderate, metronidazole (30 mg/kg/day oral, divided into 4 doses; max 2 g daily) should be started. For children with severe symptoms or with a second recurrence, oral vancomycin (40 mg/kg/day, divided into 4 doses; max 2 g daily) is appropriate. Children in the latter category will likely require hospital admission.[15] Some causes of bacterial AGE should not be treated with antibiotics secondary to HUS, and others require only treatment in the very ill child.[119,120] **(See Table 3, page 16.)** Consultation with a pediatric infectious disease specialist may be needed.

Most children seen in the UC for AGE should be advised to follow up with their primary care provider. Since most cases are viral in nature and self-limited, further workup will not be needed. Children who have prolonged symptoms or symptoms such as weight loss or failure to gain weight should be seen by a pediatric gastroenterologist. Children with mild cases of *C difficile* colitis and most cases of infant allergic colitis can also be managed by a general pediatrician. More complex cases of these entities will likely require specialist follow-up.

Table 3. Antibiotic Therapy for Bacterial Gastroenteritis

Pathogen	Indication for Antibiotic Therapy	Drug of Choice[a]	Alternative Agents
Shigella spp	Proven or suspected shigellosis	Oral: azithromycin (12 mg/kg on day 1, followed by 6 mg/kg for 4 days); Parenteral, IV, IM: ceftriaxone (50 mg/kg for 2-5 days)[b]	Cefixime (8 mg/kg/day); ciprofloxacin[c] PO (20-30 mg/kg/day). For a known susceptible strain: TMP/SMX[b] (8 mg/kg/day of TMP) or ampicillin (100 mg/kg/day) or nalidixic acid (55 mg/kg/day)
Salmonella spp (non–typhoidal)	Antibiotic therapy is indicated only in high-risk children[d] to reduce the risk of bacteremia and extraintestinal focal infections	Ceftriaxone (50-100 mg/kg/day)	Azithromycin (10 mg/kg/day); ciprofloxacin[c] PO (20-30 mg/kg/day); for a known susceptible strain, TMP/SMX[d] (8 mg/kg/day of TMP)
Campylobacter spp	Antibiotic therapy is recommended mainly for the dysenteric *Campylobacter* gastroenteritis and is most efficacious when started within 3 days after onset of the disease	Azithromycin (10 mg/kg/day for 3 days, or a single dose of 30 mg/kg)	Doxycycline (>8 years) or ciprofloxacin (>17 years), when susceptible
Shiga toxin-producing *Escherichia coli*	Antibiotic therapy is not recommended	—	—
Enterotoxigenic *Escherichia coli*	Antibiotic therapy is recommended, mainly for traveler's diarrhea	Azithromycin (10 mg/kg/day for 3 days)	Cefixime (8 mg/kg/day for 5 days); TMP/SMX[d] (8 mg/kg/day of TMP); ciprofloxacin[d] PO (20-30 mg/kg/day); rifaximin (>12 years, 600 mg/day, for 3 days)
Vibrio cholerae	Antibiotic therapy is recommended for confirmed or suspected case by travel history	Azithromycin (10 mg/kg/day for 3 days, or a single 20 mg/kg dose)	Doxycycline (>8 years), ciprofloxacin (>17 years), or TMP/SMX[d] (when susceptible)
Clostridium difficile	Antibiotic therapy is recommended for moderate and severe cases	Metronidazole (30 mg/kg/day for 10 days)	Vancomycin PO (40 mg/kg/day)

PO = per os.

[a]Depends on local antibiotic susceptibility profile, which should be monitored.

[b]TMP/SMX, trimethoprim–sulfamethoxazole.

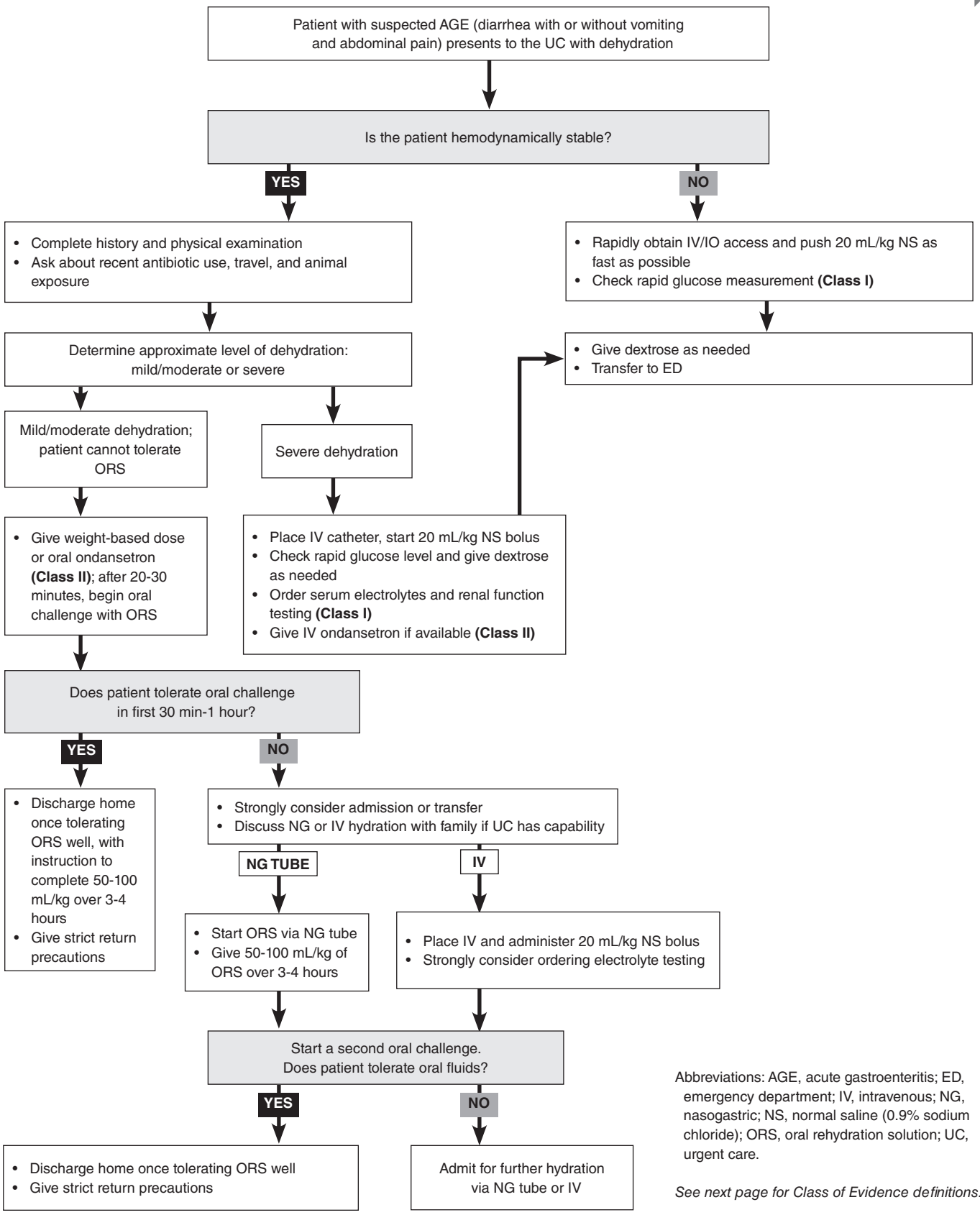
[c]Ciprofloxacin is usually not recommended in the pediatric age group, but it can be used in children aged <17 years when an alternative is not feasible.

[d]Please view article for more details on treatment regimens including medication doses and alternative medications.

Reprinted from: Alfredo Guarino, Shai Ashkenazi, Dominique Gendrel, et al, European Society for Pediatric Gastroenterology, Hepatology, and Nutrition/European Society for Pediatric Infectious Diseases Evidence-Based Guidelines for the Management of Acute Gastroenteritis in Children in Europe: Update 2014, *Journal of Pediatric Gastroenterology and Nutrition*, Volume 59, Issue 1, page 132-152, http://journals.lww.com/jpgn/fulltext/2014/07000/European_Society_for_Pediatric_Gastroenterology,.26.aspx

Abbreviations: IM, intramuscular; IV, intravenous.

Clinical Pathway for Urgent Care Management of Pediatric Patients With Suspected Acute Gastroenteritis



Abbreviations: AGE, acute gastroenteritis; ED, emergency department; IV, intravenous; NG, nasogastric; NS, normal saline (0.9% sodium chloride); ORS, oral rehydration solution; UC, urgent care.

See next page for Class of Evidence definitions.

Class of Evidence Definitions

Each action in the clinical pathways section of *Evidence-Based Urgent Care* receives a score based on the following definitions.

Class I
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

Level of Evidence:
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

Class II
- Safe, acceptable
- Probably useful

Level of Evidence:
- Generally higher levels of evidence
- Non-randomized or retrospective studies: historic, cohort, or case control studies
- Less robust randomized controlled trials
- Results consistently positive

Class III
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments

Level of Evidence:
- Generally lower or intermediate levels of evidence
- Case series, animal studies, consensus panels
- Occasionally positive results

Indeterminate
- Continuing area of research
- No recommendations until further research

Level of Evidence:
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling

Risk Management Pitfalls in Management of Pediatric Patients With Gastroenteritis

1. **"She vomited 10 times over the last 24 hours, with 5 episodes of diarrhea. Even though she didn't appear dehydrated on examination, her mother was very worried, so I sent a set of electrolytes and a stool culture."** In children with mild or short-term gastroenteritis, electrolytes and stool cultures are of little clinical value. Electrolytes will rarely affect the management of children with mild-to-moderate dehydration. Viral infections are the most common cause of AGE, so stool cultures are not needed.

2. **"Even though her parents said she hadn't urinated in 18 hours, I didn't think she could be severely dehydrated because she was drinking fluids right in front of me, without vomiting."** Even when the vomiting in AGE stops, children can still lose significant volume through diarrhea. Observe skin turgor, weight loss, capillary refill, decreased urine output, tear production, and other signs of dehydration.

3. **"I didn't find out that the patient had hypoglycemia until the electrolyte panel came back."** If you are starting IV hydration in a child that you suspect has severe dehydration, point-of-care glucose testing should be performed rather than waiting for the formal metabolic panel. Young children have low glucose reserves and can easily develop hypoglycemia when they are dehydrated. Hypoglycemia should be treated promptly.

4. **"ORS tastes bad, so I gave my moderately dehydrated patient soda for his oral challenge after giving him a dose of ondansetron."** Sugary drinks do not have the correct formulation of electrolytes to allow for optimal absorption of water and electrolytes and may cause worsening diarrhea. These fluids are appropriate in children with either no or minimal dehydration due to AGE. One recent study suggests that dilute apple juice is another option for rehydration in children who are not dehydrated or those with minimal dehydration.[57]

5. **"The child was slightly tachycardic but had no other signs of dehydration on examination and had only been sick for a few hours. It was late at night, and the child was sleeping, so we gave IV fluids immediately."** Almost all children with mild-to-moderate dehydration due to AGE can rehydrate via the enteral route. IV placement is painful, IV fluids are more expensive, and the complication rate is higher than from enteral rehydration.

6. **"I prescribed azithromycin for my patient who had diarrhea for the last 4 days because I was afraid she might have a bacterial infection."** In all well-appearing children and most ill children, antibiotics should not be started until there is confirmation of a bacterial pathogen in the stool. Most cases of AGE are caused by viruses, and in many cases of bacterial AGE, antibiotics are not needed or may prolong or worsen symptoms. Initiating antibiotics unnecessarily may harm the patient and potentially contribute to antibiotic resistance.

7. **"I told the mother to stop breast-feeding her son for a couple of days and to give lots of rice and bananas to bulk up his stools."** Breast-feeding should continue during episodes of AGE. There is no evidence to support the idea that a BRAT diet leads to quicker resolution of diarrhea compared to a regular diet.

8. **"I sent a stool sample for culture since it was bloody, but I didn't think about *C difficile* as a possibility. I didn't know about the recent history of 2 different courses of antibiotics for otitis media in the last month."** In children aged >2 months, it is always good to ask about recent antibiotic use. *C difficile* colitis may resolve on its own, but it often requires treatment with oral antibiotics.

9. **"She had been vomiting for the last 3 days. I just assumed that she had the AGE that everyone else was coming in with lately. It turns out she had acute pancreatitis."** Most cases of vomiting alone will be early AGE; however, there are many other serious entities that will also cause vomiting. Prolonged vomiting (ie, for more than 24-48 hours) without diarrhea is concerning. Look carefully for signs and symptoms that might suggest other diagnoses, such as severe abdominal pain, jaundice, polyuria/polydipsia, bilious emesis, abdominal distension, etc.

10. **"My patient came back 2 days later with severe dehydration. She looked great when I discharged her. I thought the parents would know what to bring her back for."** Don't assume that parents know or recognize signs of dehydration. Counsel them that if vomiting and diarrhea continue, they must be able to replace the fluid losses as well as give maintenance fluids. If they cannot, they should return for further medical care."

■ Summary

AGE in children is most commonly due to viral infections. Viral AGE tends to have a mild and self-limited course that requires only oral hydration with an appropriately formulated ORS. An antiemetic, such as ondansetron, is safe and effective and can aid in oral rehydration by treating persistent nausea and vomiting. Even children with moderate dehydration can usually be rehydrated adequately with ORS given by mouth or NG tube. Some children with AGE may develop severe dehydration and require IV hydration and admission to the hospital. Children with suspected severe dehydration should have a rapid glucose measurement, as hypoglycemia often

accompanies dehydration due to AGE. For children who require IV fluids, NS at 20 mL/kg is fully supported by the literature. Laboratory studies including blood work and stool studies are not needed in most cases of AGE but should be considered in certain circumstances. Protein allergies should be in the differential diagnosis in young infants presenting with vomiting and diarrhea. *C difficile* colitis should be considered in children aged >12 months who have a recent history of antibiotic use. The evidence for probiotics in the setting of AGE is mixed, and clinicians should participate in shared decision making regarding use of these products.

■ Time- and Cost-Effective Strategies

- To address nausea/vomiting due to presumed AGE, give a dose of an antiemetic (eg, ondansetron) early to children who present to the UC with these symptoms. Most of these children will have only mild-to-moderate dehydration and should be rehydrated with ORS only. IV ondansetron should be given to patients who require IV fluids, as these patients are then more likely to tolerate oral fluids and may be discharged home.
- ORS should be the first fluid offered to children with mild-to-moderate dehydration secondary to AGE. IV fluids are indicated only in severe dehydration or in children who are unable to take ORS enterally.
- Laboratory studies are generally not indicated in mild-to-moderate dehydration due to AGE. In children with concerns for severe dehydration, a rapid bedside glucose measurement should be performed. Although hypoglycemia uncommon in these patients, it should be corrected quickly if present.
- Probiotics may or may not be prescribed or recommended for children with AGE early in the course of their illness. Risks and benefits can be discussed on a case-by-case basis.

■ Critical Appraisal of the Literature

There are many randomized controlled trials related to pediatric AGE. The most common topics include the use of antiemetics, the ideal IV fluid for resuscitation, and the utility of probiotics. While many of these studies come to similar conclusions about the utility of various treatments, several involve relatively few subjects. The American Academy of Pediatrics now endorses the United States Centers for Disease Control and Prevention guidelines published in 2003.[121] The studies by Roslund et al and Ramsook et al are robust randomized trials of oral ondansetron use in AGE.[61,78] High-quality randomized controlled trials of the use of probiotics in AGE were also reviewed.[102-104] There is also a guideline for the treatment of AGE in children that was developed and published in 2014 by the European Society for Pediatric Gastroenterology, Hepatology and Nutrition and the European Society for Pediatric Infectious Diseases.[1] These recommendations were also endorsed by the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition.

Case Conclusions

CASE 1

For the 18-month-old girl who has had 3 days of vomiting and diarrhea…

Given her history and physical examination, you decided that this patient very likely has severe dehydration. Based on her tachycardia, dry lips, sunken eyes, and lack of tears, you placed an IV and started a 20 mL/kg bolus of NS, while arranging for transport to the closest pediatric ED. You sent a blood sample for electrolytes, BUN, and creatinine. At the same time, you obtained a rapid glucose test, which revealed a value of 45 mg/dL. Since the patient was awake and alert, you decided to try glucose gel first, which she tolerated. Transport arrived in 20 minutes and repeated the glucose test, with a result of 70 mg/dL.

CASE 1

For the 2-year-old boy with multiple episodes of diarrhea over the past 2 days…

The patient was well-appearing, with no signs of dehydration on examination. The numerous sick contacts at daycare made the diagnosis of viral AGE most likely. You informed the boy's mother that antidiarrheal agents, such as loperamide, are not recommended in this age group. You also explained that although the BRAT diet had been previously recommended by clinicians as the best diet for patients with diarrhea, studies have shown that an early return to an age-appropriate diet leads to quicker resolution of symptoms of AGE. You advised her to have her child return to his regular diet. She asked about probiotics, which she had heard can help with diarrhea. You explained that there is limited evidence that probiotics will help but they are unlikely to cause harm. The boy was discharged home with strict return precautions, including a description of concerning signs of dehydration.

References

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study, such as the type of study and the number of patients in the study is included in bold type following the references, where available. The most informative references cited in this paper, as determined by the author, are noted by an asterisk (*) next to the number of the reference.

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CME Questions

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1. **What is the most common cause of AGE in children in the United States?**
   a. Norovirus
   b. *Shigella sonnei*
   c. *Campylobacter*
   d. Rotavirus

2. **You are seeing an 18-month-old boy who has had vomiting and diarrhea for the last 36 hours. His parents state he has had approximately 10 episodes of vomiting and 10 episodes of watery diarrhea. They cannot quantify his urine output. He is drinking very little and appears very tired. His weight today is 11 kg. His parents state that at a well-child visit last week his weight was 12.5 kg. What is his dehydration level?**
   a. He is not dehydrated.
   b. Mild dehydration (3%-5% dehydration)
   c. Moderate dehydration (6%-9% dehydration)
   d. Severe dehydration (>9% dehydration)

3. **You are seeing a 5-year-old boy with 2 days of vomiting and diarrhea. His parents say that he has not been able to keep down any fluids in the last 24 hours. Based on his physical examination, you determined that he has severe dehydration. In addition to placing an IV and giving a rapid bolus of 0.9% sodium chloride (normal saline [NS]), what laboratory test should be performed immediately?**
   a. Rapid glucose measurement
   b. Urinalysis
   c. C-reactive protein
   d. Stool culture

4. **What is the best oral fluid to give a child with mild-to-moderate dehydration due to viral AGE?**
   a. A smoothie
   b. Commercially prepared oral rehydration solution (ORS)
   c. Water
   d. Ginger ale

5. **A 2-year-old boy with little to no dehydration due to suspected viral AGE has stopped vomiting after a dose of oral ondansetron but refuses ORS. What is the best next step in the care of this patient?**
   a. Let him drink his fluid of choice.
   b. Check a rapid glucose level.
   c. Place an IV and start a 20 mL/kg bolus of normal saline.
   d. Place an IO catheter and start maintenance fluids.

6. **A 2-year-old girl is brought in by her parents with the chief complaint of vomiting for the last 4 hours, with a total of 6 episodes. They state that she has no other symptoms. Her physical examination is normal. The girl vomited right before you came into the examination room. What should be your first step in the management of this patient?**
   a. Give a weight-based dose of oral ondansetron and then wait 20 to 30 minutes before starting an oral challenge.
   b. Immediately start an IV and give a 20 mL/kg NS bolus.
   c. Immediately start an oral challenge with orange juice.
   d. Discharge the patient home with instructions to let the child sleep and try oral rehydration in the morning.

7. **What is the preferred IV solution to give a hemodynamically stable child with severe dehydration due to AGE?**
   a. 30 mL/kg 5% dextrose in NS given over 1 hour
   b. 20 mL/kg NS given over 1 hour or less
   c. 60 mL/kg NS given over 1 hour
   d. 20 mL/kg 5% dextrose in NS given over 1 hour

8. **You are discharging a 4-year-old boy who came to the UC with complaints of vomiting and diarrhea. He is well hydrated on examination and has tolerated ORS after a dose of ondansetron. The family asks if you could prescribe probiotics for his diarrhea. What is your recommendation?**
   a. Discuss risks and benefits and participate in shared decision making.
   b. Start over-the-counter loperamide.
   c. Start *Lactobacillus rhamnosus* GG 3 times per day.
   d. Do not start probiotics, as they are likely to be harmful.

9. **What diet recommendations should you make to the parents of a child you are discharging from the UC with the diagnosis of AGE?**
   a. Stop breastfeeding until the diarrhea has stopped.
   b. No solids should be given until vomiting has stopped for 24 hours.
   c. Give a BRAT diet until diarrhea has resolved.
   d. Provide a regular, age-appropriate diet.

10. **You are seeing a 5-year-old girl whom you suspect may have *C difficile* colitis. She has had 3 days of watery diarrhea (about 4 times per day) and is currently on day 7/10 of clindamycin for an abscess on her right thigh. Her parents say she has been drinking well with normal urine output. What is your first step in management?**
   a. Start oral metronidazole 30 mg/kg/day divided 4 times per day.
   b. Start oral vancomycin 40 mg/kg/day divided 4 times per day.
   c. Discontinue the clindamycin.
   d. Continue clindamycin and add the probiotic *S boulardii*.

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Date of Original Release: April 15, 2022. Date of most recent review: April 1, 2022. Termination date: April 15, 2025.

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Target Audience: This enduring material is designed for urgent care physicians, physician assistants, nurse practitioners, and residents.

Goals: Upon completion of this activity, you should be able to: (1) identify areas in practice that require modification to be consistent with current evidence in order to improve competence and performance; (2) develop strategies to accurately diagnose and treat both common and critical ED presentations; and (3) demonstrate informed medical decision-making based on the strongest clinical evidence.

CME Objectives: Upon completion of this article you should be able to: (1) Describe the ideal treatment strategy for mild-to-moderate dehydration due to gastroenteritis; (2) explain how antiemetics can decrease healthcare costs; and (3) discuss the role of antibiotic therapy in management of bacterial acute gastroenteritis.

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Points & Pearls

PEDIATRIC SPECIAL EDITION

Urgent Care Management of Acute Gastroenteritis in Pediatric Patients

Points

- Diarrhea, with or without vomiting, must be present for the diagnosis of acute gastroenteritis.
- Consider other etiologies in patients in whom vomiting has continued more than 24 to 48 hours without diarrhea or in patients with focal abdominal tenderness.
- Most cases of AGE are due to viral pathogens and require minimal medical intervention; however, the course of bacterial causes of AGE tend to be more severe.
- Do not order laboratory testing in cases of clear-cut AGE with mild-to-moderate dehydration. For patients with signs of severe dehydration, blood urea nitrogen, creatinine, and point-of-care blood glucose are helpful.
- Order stool cultures in children with prolonged AGE (>3-4 days) or bloody diarrhea, toxic-appearing children, and children who have recently traveled abroad.
- Children aged <12 months are often asymptomatic carriers of *Clostridioides difficile*; thus, testing for *C difficile* toxin in this age group is not recommended.
- Since hemolytic uremic syndrome can occur due to bacterial lysis, do not start antibiotics for suspected bacterial AGE unless the species has been identified; exceptions include very ill and hemodynamically unstable patients.
- Antiemetics allow for improved tolerance of oral rehydration solution, and, when used appropriately, can decrease the need for intravenous fluids and hospitalization.

Pearl

Studies do not support any single scoring system for determining the degree of a patient's dehydration. Instead, look for clinical signs of dehydration, including tear production, mucous membrane appearance, skin turgor, capillary refill, activity level, if the eyes appear sunken, the quality of pulses, heart rate, and urine output.

- Ondansetron has been shown to be safe in children; however, do not give ondansetron to patients with known or family history of prolonged QT.
- A rough calculation of the amount of oral rehydration solution needed to replace emesis and diarrhea is 10 mL/kg for each episode of emesis or diarrhea.
- Rapid intravenous rehydration at 60 mL/kg/hr has not been shown to be superior to standard rehydration at 20 mL/kg/hr.
- Recommend to patients that they return to a regular diet as soon as tolerated. The traditional BRAT (bananas, rice, applesauce, toast) diet does not lead to decreased stool output and can lead to further weight loss. Patients who are breast-fed should continue to be breast-fed.
- Do not prescribe or recommend over-the-counter loperamide or bismuth subsalicylate as antidiarrheal agents for children.

