

TEXAS CHILDREN'S HOSPITAL
EVIDENCE-BASED OUTCOMES CENTER
Acute Gastroenteritis (AGE)
(Acute Vomiting and/or Diarrhea)
Evidence-Based Guideline

Definition: Acute gastroenteritis (AGE) is a decrease in the consistency of stools (loose or liquid) and/or an increase in the frequency of stools (typically ≥ 3 in 24 hours), with or without fever or vomiting. However, vomiting alone is typical of early presentation. Duration of illness is typically less than 14 days. ⁽¹⁻³⁾

Epidemiology: In the United States, an estimated 9.4 million episodes of foodborne illness, 55,961 hospitalizations, and 1,351 deaths occur each year due to foods consumed that were contaminated with 31 known agents of foodborne disease. ⁽⁴⁾ In February 2006, routine use of a pentavalent human-bovine rotavirus vaccine was recommended. ⁽⁵⁻⁷⁾ Since these recommendations have been implemented, there has been a delayed and shorter season. ^(8,9) In children seen in the Emergency Center at Texas Children's Hospital, pentavalent rotavirus vaccine (RV5) was noted to be highly effective in preventing rotavirus disease. ⁽⁸⁾

Etiology: The most common causes of AGE are infectious agents. In the developed world, viruses are responsible for 70 to 80% of infectious diarrhea cases. Rotavirus and norovirus are the leading viral pathogens with nearly every child in the U.S. being infected with rotavirus by 5 years of age. ^(5,10) Since the introduction of the Rotavirus vaccine, norovirus has become the leading cause of medically attended acute gastroenteritis. ⁽⁹⁾ Various bacterial pathogens account for another 10 to 20% of cases and as many as 10% may be attributable to diarrheagenic *Escherichia coli*. ⁽¹¹⁾ Parasitic organisms such as *Giardia* species cause fewer than 10% of cases. Incidence is affected by climate and season. Other factors that increase the risk of AGE in children include day care attendance and impoverished living conditions with poor sanitation. Community-acquired *Clostridium difficile* infections are on the rise.

Inclusion Criteria

Age ≥ 60 days to 17 years
 Healthy children without underlying conditions
 Clinical findings of AGE

Exclusion Criteria

Toxic appearance
 Episodes of diarrhea lasting >14 days

Differential Diagnosis

Ingestion	Urinary tract infection (UTI)
Food-borne illness	Bowel obstruction
Intussusception	Extra-intestinal infection
Appendicitis	Allergic reaction

Diagnostic Evaluation ⁽¹²⁾

History: Assess for

- Age of child
- Developmentally appropriate behavior
- ≥ 3 loose or watery stools/day
- Onset, frequency, quantity, and character (e.g., black, bloody) of vomiting/diarrhea

- Travel and/or day care exposure
- Dietary changes
- Vaccination status (especially Rotavirus vaccine)
- Last episode of vomiting
- Volume and frequency of urine output
- Use of antibiotics

Rotavirus disease typically begins abruptly. Vomiting often precedes the onset of diarrhea. ⁽⁵⁾ Norovirus is characterized by acute onset of nausea, vomiting, abdominal cramps, and diarrhea. Vomiting can appear alone in norovirus illness. ⁽¹³⁾

Physical Examination

Severity of dehydration (none/mild, moderate, or severe) is the key factor in determining the severity of AGE which is primarily based on the child's dehydration status. Management requires a rapid risk assessment of dehydration. ^(12,14,15)

A complete physical exam should be performed assessing for:

- Weight loss (pre-illness weight minus acute body weight)
- Prolonged capillary refill time (>2 seconds)*
- Dry mucous membranes*
- Absent tears*
- Poor overall appearance*
- Abnormal skin turgor
- Sunken eyes
- Abnormal radial pulse
- Tachycardia (HR >150 ; scale validated in children 1 month to 5 years) ⁽¹⁶⁾
- Abnormal respirations
- Decreased urine output

Accurate body weight is considered the gold standard in determining fluid deficit (pre-illness weight minus acute body weight). ^(12,16)

*The presence of ≥ 3 of 4 predicts a fluid deficit $\geq 10\%$. ⁽¹⁶⁾
 Combination of clinical findings improves diagnosis. ^(14,16,17)

Laboratory Tests

Routine laboratory tests are **NOT** recommended for children with mild/moderate dehydration. ^(14,18,19,21-24)

Consider stool studies (stool culture and stool ova and parasites) with bloody stools, prolonged symptoms, suspicion of epidemic, travel exposure, and/or age <3 months. ^(23,25-28)

Consider *C. difficile* if age >2 years, previous use of antibiotics, previous *C. difficile* infection, and/or hospitalization within the last 30 days.

Serum sodium bicarbonate is an unreliable predictor for determining the severity of dehydration. ⁽¹⁴⁾

Consider urinalysis (UA) with micro and culture when concerned for UTI.

Urine Specimen for Urinalysis and Culture[§] ([UTI Guideline](#))

Non-toilet trained children: transurethral catheterization

Toilet trained children: midstream clean catch

[§]Obtained by non-invasive method. If positive, invasive method may be necessary.

Critical Points of Evidence

Evidence Supports

Use of oral rehydration solutions (ORS) for treatment of mild/moderate gastroenteritis if tolerated (29,30)

Using low-osmolarity ORS (270 mmol/L or less) for oral rehydration therapy (31)

Resuming the child's regular age-appropriate diet when tolerated, continuing breastfeeding during rehydration therapy, and restricting fruit juices and carbonated beverages (32-34)

Use of antiemetics in the management of children with AGE who are vomiting (35-41)

Probiotics as adjunctive therapy (42-49)

Use of the Gorelick score to evaluate dehydration (17,20,50-55)

Evidence Lacking/Inconclusive

Administration of IV maintenance fluids at 1.5 or 2 times maintenance (56,57)

Preferred routes of rehydration between nasogastric tube versus IV (30)

Use of specific barrier creams to prevent diaper dermatitis in non-toilet trained children

Evidence Against

Use of ondansetron in patients with prolonged QT or medications that may prolong QT interval (58)

Use of routine lab tests including tests for specific pathogens (14,18-24)

Use of stool studies to predict patient outcomes (23-27,59-62)

Use of anti-motility agents for routine management of acute diarrhea (63)

Using high osmolarity (>300 mmol/L) liquids for oral rehydration therapy (30)

Condition-Specific Elements of Clinical Management

General: The clinical picture of children with acute gastroenteritis is highly variable and determination of etiologies is difficult. The severity of dehydration is an important factor to consider in managing this disease.

Treatment Recommendations

Mild Dehydration, Rehydration

Infants/children should continue their regular diet ± ORS if tolerating oral fluids. (31-33) If a child is vomiting, begin small frequent feedings of ORS 1ml/kg every 5 minutes and consider an antiemetic. (31-40,67)

Moderate Dehydration, Rehydration

Infants/children should be given ORS. (28,29) If a child is vomiting, begin small frequent feedings of ORS 1ml/kg every 5 minutes and consider an antiemetic. (31-40,67) Reassess at 1 hour or until sufficient rehydration is achieved.

Oral Rehydration Therapy Failed or Severe Dehydration

If an infant/child is unable to tolerate oral feeding and/or is at risk for being unable to maintain hydration status, then a bolus of isotonic intravenous fluids (IVF) should be considered. May require up to 3 boluses. Each bolus should be followed by a repeat physical exam. In addition to boluses, maintenance fluid therapy should be considered (See Table I). (64) Consider admission to Observation for continued rehydration if output is greater than intake.

Table I. Maintenance Rates

Holliday-Segar Method (64)
4 mL/kg/h for 1 st 10 kg of body weight
2 mL/kg/h for 2 nd 10 kg of body weight
1 mL/kg/h for each kg over 20 kg

Oral Feeding During Rehydration

Continued administration of ORS for infants/children who are mildly/moderately dehydrated is recommended. An age-appropriate diet includes complex carbohydrates and foods that are low in sugar, fat, and caffeine can be given when tolerated (See Table II).

For infants, the use of breastmilk or formula should continue on demand.

Admission Criteria

Unable to maintain hydration status via oral route

Consults and Referrals

Consultation with a Gastroenterology specialist and/or Infectious Disease is appropriate for chronic diarrhea or *C. difficile* infection.

Infection Control

Contact precautions are required for all children with diarrhea.

Other Therapy Alternatives

In children, antibiotic therapy is typically not required for most cases of dysentery and should be driven by stool culture results.

If UTI is suspected, refer to [UTI Guideline](#).

If the patient is not responding to fluid therapy, auscultate heart and lung sounds and evaluate for heart failure. Refer to [Acute Decompensated Heart Failure Guideline](#).

Depending on stool culture results Antibiotic treatment is indicated for infants <6 months.

Consider the use of antiemetic for treatment of nausea and vomiting (34-40)

Use probiotics for treatment of diarrhea (See Table III.) Effective organism and dosing for treatment of acute gastroenteritis:

- *Saccharomyces boulardii* of at least 250 mg per day (equivalent to 5 billion colony forming units per day), (42,43,46)
- *Lactobacillus GG* at 10 billion colony forming units per day (41,42,45,47)
- *Lactobacillus reuteri* of at least 100 million colony forming units per day. (44,48)

In non-toilet trained children, maintain skin integrity with episodes of frequent diarrhea with frequent diaper changes and skin care.

Caregiver Education

Encourage frequent hand-washing for the patient, family, and caregivers (65, 66)

Encourage continued breastfeeding with infants (31)

Limit exposure to other children (e.g., day care)

Encourage fluid intake until symptoms resolve.

Advance to regular diet once tolerated.

In incontinent children, maintain skin integrity with frequent diaper changes.

Discharge Criteria

Sufficient rehydration achieved

Tolerating oral fluids

Appropriate support system (e.g., primary care physician [PCP], caregivers)

Follow-Up Care

Children diagnosed with AGE with persistent or worsening symptoms (e.g., decreased urine output, diarrhea, and/or vomiting returns) should follow up with their PCP

Prevention

Importance of strict hand-washing (65,66)

Rotavirus vaccine per recommended immunization schedule (5)

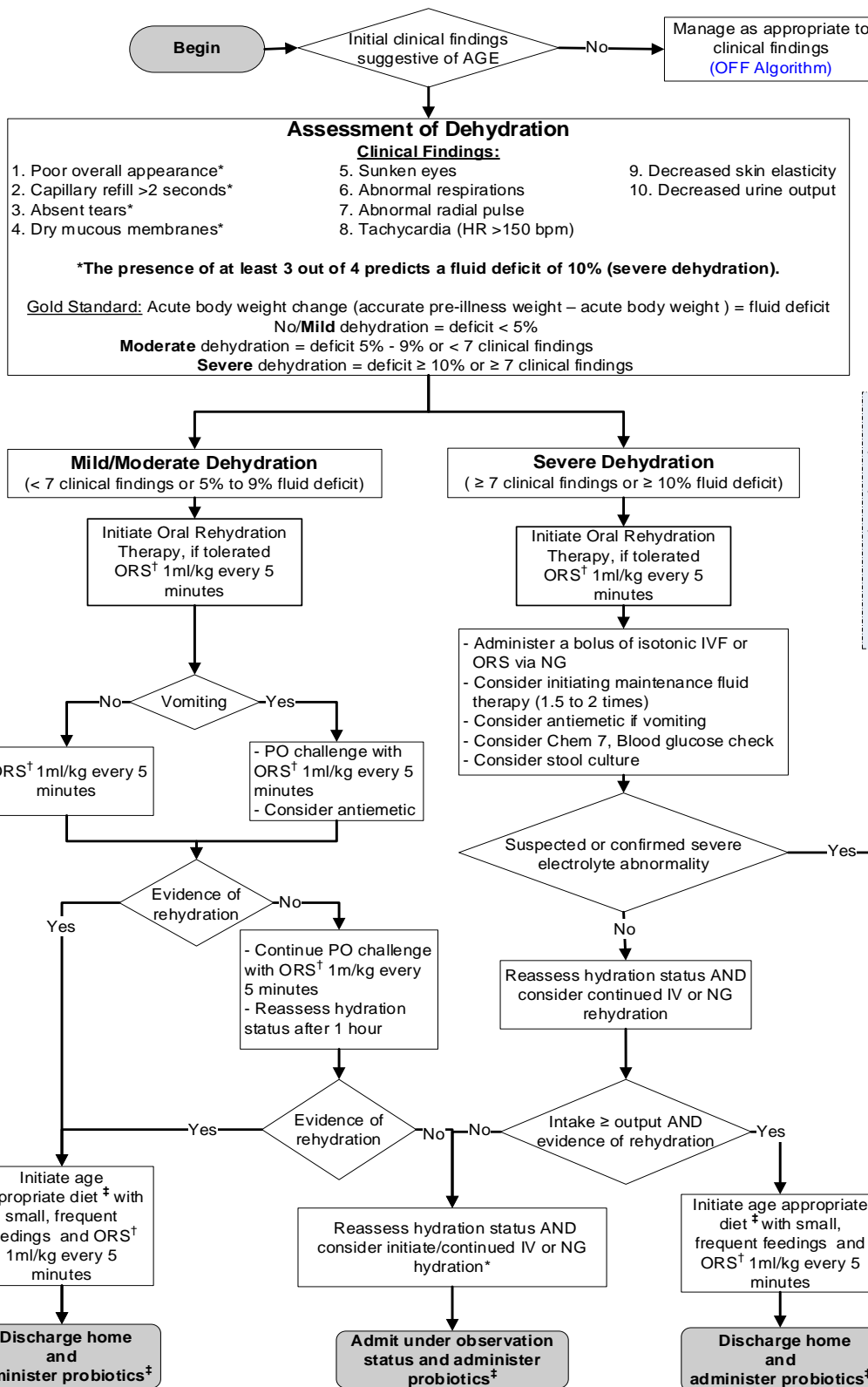
Measures

- # of children who received rotavirus vaccine prior to this illness
- Predictive accuracy of dehydration assessment scoring
- % of children receiving antibiotics inappropriately
- % of positive stool cultures when stool cultures are obtained
- Unscheduled visits to the Emergency Center/PCP during the course of this illness
- # of unnecessary diagnostic tests performed (e.g., labs, stool cultures) when criteria not met
- Results and treatment indications of stool cultures

TCH Evidence-Based Outcomes Center Clinical Algorithm for Acute Gastroenteritis (AGE)

Guideline Exclusion Criteria:

- <60 days or >17 years
- history of underlying conditions
- toxic appearance
- episodes of diarrhea lasting > 14 days



†Oral Rehydration Therapy

- Goal is 50-100ml/kg over 3-4 hours
- 1ml/kg every 5 minutes using an ORS
- Diluted apple juice for kids > 1 year of age, Pedialyte or Oral Rehydration Salt Solution recommended

Serum sodium bicarbonate is an unreliable predictor for determining the severity of dehydration.

** If patient is not responding to fluid therapy, listen to heart and lung sounds and consider evaluation for Heart Failure.*

Note: Stool cx and ova and parasite testing not routinely recommended.
 See EC Stool Testing Guideline

‡Regular Age Appropriate Diet
 This diet includes complex carbohydrates and foods that are low in sugar, fat and caffeine.
Use dietary supplements (probiotics) containing live bacteria or yeast with caution in immunocompromised patients.

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Clinical standards are developed for 80% of the patient population with a particular disease. Each practitioner must use his/her clinical judgment in the management of any specific patient.

Table II. AGE Diet Suggestions

Acute Gastroenteritis: Diet Suggestions

For the next 2 weeks at home, children should return to eating a regular healthy diet. Sometimes, greasy and high sugar foods are not tolerated well and should be avoided.

- For infants: Resume breastfeeding or drinking formula
- For toddlers and older: Resume formula or milk, and age appropriate foods (i.e. pureed foods, solids)

Stay hydrated by drinking enough fluids, especially water, throughout the day.

- Avoid caffeine (tea, energy drinks)
- Avoid all carbonated (bubbly drinks such as sodas, carbonated waters)
- Avoid any sweet drinks (fruit juice, lemonade, fruit punch, even diluted beverages)
- Avoid sports drinks

It is OK to have sugar-free liquids (Crystal Light, sugar free popsicles). It is also OK to have “hydration solutions” such as Infalyte, Pedalyte, and Drip Drops.

Regular Healthy Age-Appropriate Diet

Food Group	Tip	Suggestions
Fruit	Select fresh, frozen, canned, and dried fruit more often than juice	Banana, apple slices, cantaloupe, watermelon, pears, grapes, kiwi, mango, strawberries
Vegetables	Aim for variety every day; pick vegetables from several subgroups: dark green, red & orange, beans and peas, starchy, and other veggies	Steamed broccoli, sweet potato, spinach, squash, green beans, peas, mushrooms, bell peppers, cucumber
Dairy	Include fat-free and low-fat dairy foods every day	2% milk (whole milk if under 2 years), cheese, yogurt, cottage cheese, smoothies
Protein Foods	Aim for variety—choose seafood, lean meat and poultry, beans, peas, nuts, and seeds each week	Turkey, baked fish, peanut butter, nuts, tuna, black beans, lentils, eggs, tofu
Grains	Make at least half your grains whole grains	Whole grain cereal, whole wheat bread, whole grain crackers, rice, pasta, museli, oatmeal

<https://www.myplate.gov/>

Table III. Probiotics Recommendations

Recommended Probiotic Products Meeting Efficacy Criterion for Acute Gastroenteritis					
Brand Name	Active Ingredient	Amount	Preparation	Dose	Administration
Culturelle® Capsules	Lactobacillus rhamnosus GG	10 billion CFUs per capsule	Capsule	1 capsule daily	Swallow whole
Culturelle® Kids Chewable Tablets	Lactobacillus rhamnosus GG	5 Billion CFUs per chewable tablet	Chewable Tablet	2 tablets daily	Chew tablet
Culturelle® Kids Packets	Lactobacillus rhamnosus GG	5 Billion CFUs per packet	Granules	2 packets daily	Empty packet into cool food or drink. Mix until dissolved. Do not add to warm or hot food or beverage.
Florastor® Capsules	Saccharomyces boulardii lyo	250 mg per capsule	Capsule	1-3 capsules daily	For immediate administration, capsules may be: <ul style="list-style-type: none"> • Swallowed whole • Emptied directly onto tongue and followed by 4 oz of water/juice • Sprinkled over semi-solid food (i.e. applesauce, yogurt, etc.) • Dissolved in liquid
Florastor® Kids Packets with tutti-frutti flavoring	Saccharomyces boulardii lyo	250 mg per packet	Powder	1-3 packets daily	For immediate administration, packets may be: <ul style="list-style-type: none"> • Emptied directly onto tongue and followed by 4 oz of water/juice • Sprinkled over semi-solid food (i.e. applesauce, yogurt, etc.) • Dissolved in liquid
Fleet® Pedia-Lax Probiotic Yums Chewable Tablet	Lactobacillus reuteri DSM 17938	100 million CFUs per tablet	Chewable Tablet	1 tablet daily	Chew tablet

Note: Use dietary supplements (probiotics) containing live bacteria or yeast with caution in immunocompromised patients. The following products do not meet the efficacy criterion to reduce the duration of symptoms of acute gastroenteritis: yogurt, kefir, Nature's Bounty® Advanced Probiotic 10, Align®, Bacid®, Floranex®, Garden of Life® Raw Probiotics Powder for Kids, Lactinex®, Lacto-Pectin®, Megadophilus®, MoreDophilus®, Pearls®, RisaQuad®, Superdophilus®, Ultimate Flora® Kids Probiotic Supplement, VSL® #3 (or Junior), or Zarbee's Naturals® Children's Probiotic Supplement. If the product in question is not listed, please review the active ingredients to see if it contains the recommended probiotic strains and amount of culture forming units.

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Guideline Preparation

This guideline was prepared by the Evidence-Based Outcomes Center (EBOC) team in collaboration with content experts at Texas Children's Hospital. Development of this guideline supports the TCH Quality and Patient Safety Program initiative to promote clinical guidelines and outcomes that build a culture of quality and safety within the organization.

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Development Process

This guideline was developed using the process outlined in the EBOC Manual (2021). The literature appraisal documents the following steps:

- Review Preparation
 - PICO questions established
 - Evidence search confirmed with content experts
- Review of Existing Internal and External Guidelines
 - TCH Acute Gastroenteritis Clinical Guideline, Cincinnati Evidence-Based Care Guideline Prevention and Management of Acute Gastroenteritis, NICE Guideline on Diarrhoea and vomiting caused by gastroenteritis, and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition/European Society for Pediatric Infectious Diseases Evidence-Based Guideline for the Management of Acute Gastroenteritis in Children in Europe.
- Literature Review of Relevant Evidence
 - Searched: PubMed, Cochrane Library, CINAHL, and Up to Date.
- Critically Analyze the Evidence
 - 11 systematic reviews and meta-analyses, 8 randomized controlled trials, 29 non-randomized studies.
- Summarize the Evidence
 - Materials used in the development of the guideline, evidence summary, and order sets are maintained in an Acute Gastroenteritis evidence-based review manual within EBOC.

Evaluating the Quality of the Evidence

Published clinical guidelines were evaluated for this review using the **AGREE II** criteria. The summary of these guidelines are included in the evidence summary. AGREE II criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence using a 4-point Likert scale. The higher the score, the more comprehensive the guideline.

This guideline specifically summarizes the evidence *in support of* or *against* specific interventions and identifies where evidence is

lacking/inconclusive. The following categories describe how research findings provide support for treatment interventions.

"Evidence Supports" the guideline provides clear evidence from well-designed randomized controlled trial(s) (RCT[s]) that the benefits of the intervention exceed harm.

"Evidence Against" provides clear evidence from more than one well-done RCT that the intervention is likely to be ineffective or that it is harmful.

"Evidence Lacking/Inconclusive" indicates there is currently insufficient data or inadequate data to support or refute a specific intervention.

The **GRADE** criteria were utilized to evaluate the body of evidence used to make clinical recommendations. The table below defines how the quality of the evidence is rated and how a strong versus weak recommendation is established. The evidence summary reflects the critical points of evidence.

Recommendation	
STRONG	Desirable effects clearly outweigh undesirable effects or vice versa
WEAK	Desirable effects closely balanced with undesirable effects
Quality	Type of Evidence
High	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies
Moderate	Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
Low	Evidence for at least 1 critical outcome from observational studies, RCTs with serious flaws or indirect evidence
Very Low	Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence

Recommendations

Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The Content Expert Team and EBOC team remain aware of the controversies in the management of acute gastroenteritis in children. When evidence is lacking, options in care are provided in the clinical standard and the accompanying order sets (if applicable).

Approval Process

Clinical standards are reviewed and approved by hospital committees as deemed appropriate for its intended use. Clinical standards are reviewed as necessary within EBOC at Texas Children's Hospital. Content Expert Teams are involved with every review and update.

Disclaimer

Practice recommendations are based upon the evidence available at the time the clinical standard was developed. Clinical standards (guidelines, summaries, or pathways) **do not** set out the standard of care and are not intended to be used to dictate a course of care. Each physician/practitioner must use his or her independent judgment in the management of any specific patient and is responsible, in consultation with the patient and/or the patient's family, to make the ultimate judgment regarding care.

Version History

Date	Comments
Feb 2009	Original guideline completed
Mar 2016	Updated
Jun 2017	Added links to Heart Failure Guideline
Aug 2019	Algorithm updated with link to EC stool testing guideline
July 2021	ORT revised to 1ml/kg q 5 mins for guideline & algorithm; note added for cautious use of probiotics in immunocompromised patients