

# Pediatric Vomiting and Diarrhea — Causes and Therapy

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**Pediatric gastrointestinal disturbances are common, often simple to manage and yet, unfortunately, life-threatening in some instances. Sometimes, seemingly innocuous vomiting can be a harbinger of a serious underlying disease. This article expounds on various pathophysiological aspects of pediatric vomiting and diarrhea and expatiates on the rapid aggressive treatment of accompanying dehydration.**



## Pediatric Vomiting

Vomiting is a **symptom** rather than a diagnosis. It can be secondary to gastrointestinal causes or, rarely, secondary to distant organ systems, such as vomiting secondary to increased intracranial pressure. This symptom, with associated complaints and examination findings aided by a **meticulous history**, is often crucial in determining the cause of the vomiting and developing a treatment plan.

Various etiologies leading to vomiting can be considered according to the child's age.

Age	Possible cause
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Infants	To be distinguished from regurgitation – spontaneous expulsion of gastric contents. Possible differentials for vomiting include gastroenteritis, gastroesophageal reflux disease (GERD), food allergy, milk protein intolerance, overfeeding, or an inborn error of metabolism.
Neonates	Gastrointestinal (GI) obstruction related to congenital malformation, sepsis, sinusitis, or otitis media.
Children, adolescents	Gastroenteritis, systemic infections, toxic ingestions, appendicitis, ulcers, pancreatitis, migraine, medications, pregnancy, intracranial pathology, or otitis media.

The cause of vomiting could also be associated with the system involved in the underlying cause.

System	Cause
Metabolic	Inborn errors of metabolism, urea cycle disorders
Intoxication	Medication, aspirin
Endocrine	Diabetic ketoacidosis (DKA), Addisonian crisis
Sepsis	Pneumonia, otitis media, meningitis, urinary tract infection (UTI)
Intracranial disease	Brain tumors, hydrocephalus, raised intracranial pressure
Gastro-intestinal	Infection: appendicitis, hepatitis, pancreatitis, gastroenteritis Motility disorders: pyloric stenosis, achalasia Inflammation: GERD, duodenal ulcers, food allergy Anatomical obstruction: intestinal malrotation, volvulus, intussusception, obstructed a hernia

## Etiopathogenesis

Vomiting is a **vagal mediated reflex** and actually a protective mechanism. It is mediated by peripheral receptors and central controlling units. The central processing units are situated in the medulla near the obex of the fourth ventricle.

Vomiting is composed of nausea, retching, and conscious expulsion of gastrointestinal contents. It is a culmination of synchronized contraction of intercostals muscles, diaphragm, and abdominal muscles with the sequential relaxation of the esophageal sphincter.

## Diagnosis of Pediatric Vomiting

Vomiting is a symptom and a potential harbinger of an underlying serious disorder.

An extensive medical **history**, followed by a **relevant clinical examination**, can help identify the system involved. Details from the patient's history should help with a localized relevant examination.

Salient points to be covered in the patient's medical history include:

- Demographic details of the patient: age, sex, place of residence (important in cases of epidemics and food poisoning)
- Onset/duration/progress of complaints
- Association with food intake
- Any other associated complaints: fever, earache, headache, abdominal pain, dysphagia
- Review of systems, past medical and surgical history, drug intake, drug allergy, social and nutritional history
- Nature of the vomitus (projectile/non-projectile), color, contents,

painful/painless

**The color and content of vomitus** are often of crucial significance. A rough estimate of the level of obstruction can be discerned based on these findings:

Nature of vomitus	Approximate level of obstruction
Non-bilious acidic vomitus	Distal to <u>stomach</u> , proximal to duodenum
Bilious vomiting	Distal to 2nd part of <u>duodenum</u>
Feculent vomitus	Obstruction in the <u>large bowel</u>
Non-digested food content	Proximal obstruction

It is of paramount importance to assess hydration status in every pediatric patient with vomiting. The **red-flag signs of dehydration** should usher emergent, rapid, aggressive fluid management. These are documented as follows:

- Reduced skin turgor
- Sunken eyes, often tearless
- Dry mucous membranes
- Sunken fontanelle
- Tachycardia, tachypnea
- Prolonged capillary refill time

## Investigations

The list of differentials, formed at the end of the clinical assessment, helps guide the investigation. Some frequent investigations and their relevance are:

Investigation	Relevance
Complete blood count	To look for leucocytosis in case of infections
Serum creatinine and electrolytes	Assess hydration, potential electrolyte imbalance after vomiting, renal function
Blood glucose level	In DKA
Blood gases	In inborn errors of metabolism,
Imaging	Abdominal imaging: X-ray, ultrasonography, CT abdomen with pelvis, endoscopy as per the etiology Brain imaging: if intracranial etiology is suspected.

## Treatment of Pediatric Vomiting

Once the cause is identified, there are two phases of management of vomiting - namely to resuscitate and stabilize the patient in an emergent manner with subsequent treatment of the underlying cause.

Strategy	Explanation
Assess hydration status	Hydration is the most important step in the resuscitation of a pediatric patient. Well-established protocols are available based on age, the weight of the patient and customized therapy can be initiated. Regular monitoring is a must. While oral intake is desirable, one should use intravenous resuscitation when deemed necessary.
Check for electrolyte imbalance	Vomiting is associated with an electrolyte imbalance which can occasionally turn symptomatic. A careful assessment of a patient's hydration and electrolytes with the simultaneous management of the same is the key.
Treat underlying etiology	Definitive treatment of the underlying condition is the ultimate treatment.

# Pediatric Diarrhea

The normal frequency of bowel movement varies depending on the child's age, weight, and diet. For example, breastfed infants may have three soft bowel movements daily, while a toddler may have one or two formed movements daily. A **daily stool volume greater than 10 ml/kg/body weight per day** is an objective definition of diarrhea.

The working definition involves liquid consistency, increased frequency, and increased volume of stools. Twice the normal frequency of motions for an infant and more than three liquid stools per day in older children is considered abnormal.

The presence of certain substances in stools is never normal:

- Mucus
- Fresh blood - red
- Altered blood - black
- Foul smell
- Runny, watery stools

Any of these symptoms require an appropriate workup and subsequent management.

Certain subsets of the pediatric population are more prone to develop diarrhea. The relevant significant ones are:

- Lack of [breastfeeding](#)
- Malnutrition
- Measles
- Regular attendance at childcare centers
- Exposure to unhygienic circumstances
- Poor maternal education
- Immunodeficient individuals

## Classification

Pediatric diarrhea can be classified as variously as follows:

### Based on temporal relation:

- Acute: for less than 14 days
- Chronic/persistent: for more than 14 days

### Based on mechanism:

- Osmotic: stool volume depends on diet and decreases with fasting
- Secretory: stool volume is increased and does not vary with diet
- Motility disturbance: often diagnosed in older children
- Mucosal inflammation: secondary to invasive bacteria and [inflammatory bowel disease](#)
- Mixed secretory-osmotic: seen in infections like Rotavirus

### Based on clinical features:

- Acute watery diarrhea:
  - Most common, usually self-limiting. The most crucial concern is the maintenance of hydration status.
  - Rotavirus, Vibrio cholerae

- Acute bloody diarrhea:
  - Also known as dysentery; the culmination of intestinal mucosal erosion by invasive species. The most significant complications are sepsis, HUS (Hemolytic Uremic Syndrome), malnutrition, and [dehydration](#).
  - Entamoeba histolytica, Shigella species.

**Based on etiology:**

- Infectious: secondary to infection
- Mal-absorptive: increased stool output with an excess of fluid and electrolytes

## Infectious Diarrhea

Viral infectious diarrhea is the most prevalent pediatric diarrhea, followed by pyogenic. The key to diagnosis is recovering the infectious organism from stools. **Enzyme immunoassay** is helpful in some cases.

A short summary of infectious diarrhea is presented below:

Infectious agent	Diarrhea-key points	Treatment
<b>Viral etiology</b>		
Rotavirus	Most common viral diarrhea; prevalent during winter. The most common cause of watery diarrhea; lasts for 7-10 days. It may be associated with vomiting.	Symptomatic management; maintain hydration
Norwalk virus	Prevalent in cruise ships	Symptomatic management; maintain hydration
<b>Bacterial etiology</b>		
E. coli	Enteropathogenic E.coli is responsible for breakouts in nurseries and daycare.	
Salmonella	Salmonella reaches the pediatric population through eggs, milk, poultry, and reptiles.	Antibiotics indicated only for age < 3 months, toxic state, and disseminated disease. Trimethoprim/sulfamethoxazole is typically used, but it prolongs carrier state.
Shigella	Transmitted through contaminated food; Shigella can cause seizures.	Trimethoprim/sulfamethoxazole is the first choice.
Campylobacter	Transmitted by contaminated food.	Antibiotics for severe disease, erythromycin is the drug of choice.
Yersinia	Transmitted by pets, contaminated food, may be associated with arthritis and rash (often confused with Inflammatory Bowel Disease, pseudo-appendicitis)	Antibiotics for < 3 months of age and septicemia. Aminoglycosides or third-generation cephalosporins are recommended.
S. aureus	Onset within 12 hours of ingestion, toxin-mediated.	Penicillin and third-generation Cephalosporin work; for resistant species; Vancomycin is advocated.

<b>Clostridium</b>	History of preceding heavy antibiotic use usually prevails.	Oral Metronidazole or Vancomycin is used.
<b>Parasitic etiology</b>		
Entamoeba histolytica, Giardiasis, Cryptosporidium		Metronidazole is typically recommended as the drug of choice.

## Diagnosis of Pediatric Diarrhea

Diarrhea is deceptive and not always innocuous and benign in nature. Constant vigilance and prevention of dehydration is a must. Correct, timely diagnosis is the key.

The diagnostic strategy begins with expert **history taking** and performing a relevant clinical examination.

The relevant key points to be focused upon in history are as follows:

- Demographics of the child
- Onset, duration, and the progress of diarrhea
- Nature, content, color, smell, consistency, frequency of stools
- Presence of blood, worms, mucus, foreign body in the stools
- Associated complaints: fever, abdominal pain, earache, history of measles, vaccination, convulsions
- Treatment history

The relevant physical examination can then be carried out in the right perspective as suggested by a focused history is very helpful. The **assessment of hydration status** forms the heart of a physical examination in pediatric diarrhea.

In children, the signs and symptoms of dehydration are not always loud and clear. A simplified grading of dehydration status based on clinical acumen is as follows:

	<b>Degree of dehydration</b>		
<b>Clinical feature</b>	<b>Less than 3% loss of body weight (NO DEHYDRATION)</b>	<b>3-9% loss of body weight (SOME DEHYDRATION)</b>	<b>More than 9% loss of body weight (SEVERE DEHYDRATION)</b>
Eyes	Normal	Mildly sunken	Deeply sunken
Tears	Adequate	Decreased	Absent
Tongue	Moist	Dry	Parch dry
Skinfold	Supple with instant recoil when pinched	Recoils in less than 2 seconds	Recoils in more than 2 seconds
Mental status	Normal	Normal or fatigued; may be restless and irritable	Lethargic, apathetic, drowsy or sometimes frankly unconscious
Thirst	Normal	Thirsty and looks forward to fluids	Unable to drink
Heart rate	Normal	Normal to increased	Increased; bradycardia may be encountered in severe cases
Extremities	Warm	Cold	Cold, cyanotic and mottled
Urine output	Adequate; or slightly decreased.	Decreased	Grossly decreased

Capillary refill	Normal	Prolonged	Prolonged with little refill
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Assessment and subsequent desired treatment of dehydration is the most significant life-saving act that medical personnel is expected to perform in the management of pediatric diarrhea.

## Investigations

**Ancillary tests** are often helpful in reaching the correct diagnosis, but they do not bring about a drastic change in the acute management of pediatric diarrhea. They are definitely relevant in the long run to know the exact etiology and rule out predisposing factors if any.

These tests can be summarized as follows:

<b>Routine blood investigations</b>	The complete blood count is adjunct to confirming infectious etiology. Renal function tests and electrolytes are helpful in the assessment of hydration status.
<b>Stool microscopy and culture</b>	The following points are noted: Presence of blood, ova, cysts or trophozoites Leucocyte count (more than 10 per HPF) is indicative of invasive diarrhea. For chronic diarrhea, stool cultures are obtained.
<b>Imaging</b>	Ultrasonography and endoscopy are reserved mostly for patients with chronic diarrhea.
<b>Serum enzyme assays</b>	Increasing the number of specific biochemical enzyme assays is available to accurately pinpoint the cause of diarrhea.

## Treatment of Pediatric Diarrhea

It is worth reiterating that the acute management of diarrhea revolves around the emergent maintenance of **hydration** status. The long-term management consists of the determination of the cause, inciting factors, and correction of the same to prevent a relapse.

The treatment strategy is summarized as follows:

<b>Acute fluid management</b>	Rapid recognition of dehydration and treatment of the same is very important. Oral rehydration therapy is typically used. In infants and neonates, breastfeeding is strongly recommended.
<b>Zinc</b>	Zinc is advocated by WHO, especially for children in developing countries as its deficiency is associated with impaired cellular and humoral immunity and dysregulated electrolyte balance. Zinc supplements reduce the morbidity associated with pediatric diarrhea.
<b>Probiotics</b>	Probiotics strengthen the mucosal immune response and consolidate the tight junctions between the enterocytes. Competitive inhibition of the binding of pathogens to the bowel mucosa is often instrumental.
<b>Prevention</b>	Hand washing post defecation and prior to the consumption of food can decrease the burden of infectious diarrhea by about 50%.
<b>Drug therapy</b>	Antibiotics are to be used only in very small children and in patients with systemic infection. The use of drugs like anti-motility and anti-secretory agents is not recommended for pediatric patients.

## Summary

- Vomiting by itself is more of a symptom than a diagnosis. Meticulous history taking and a relevant physical exam with pertinent ancillary tests performed help in making the right diagnosis. Treatment follows accordingly.
- Pediatric diarrhea can be variously classified based on etiology, mechanism, and temporal relation.
- The key factor in the treatment of both pediatric vomiting and diarrhea is the maintenance of the hydration status.
- Long-term management consists of evaluating the underlying cause, treating the condition, and taking corrective steps to avoid relapses.

## References

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