

ACUTE PEDIATRIC GASTROENTERITIS

*Dr. Huma Gul
SPR,
Department of Pediatrics*



Definitions and Terms

- **Acute Gastroenteritis (AGE):**

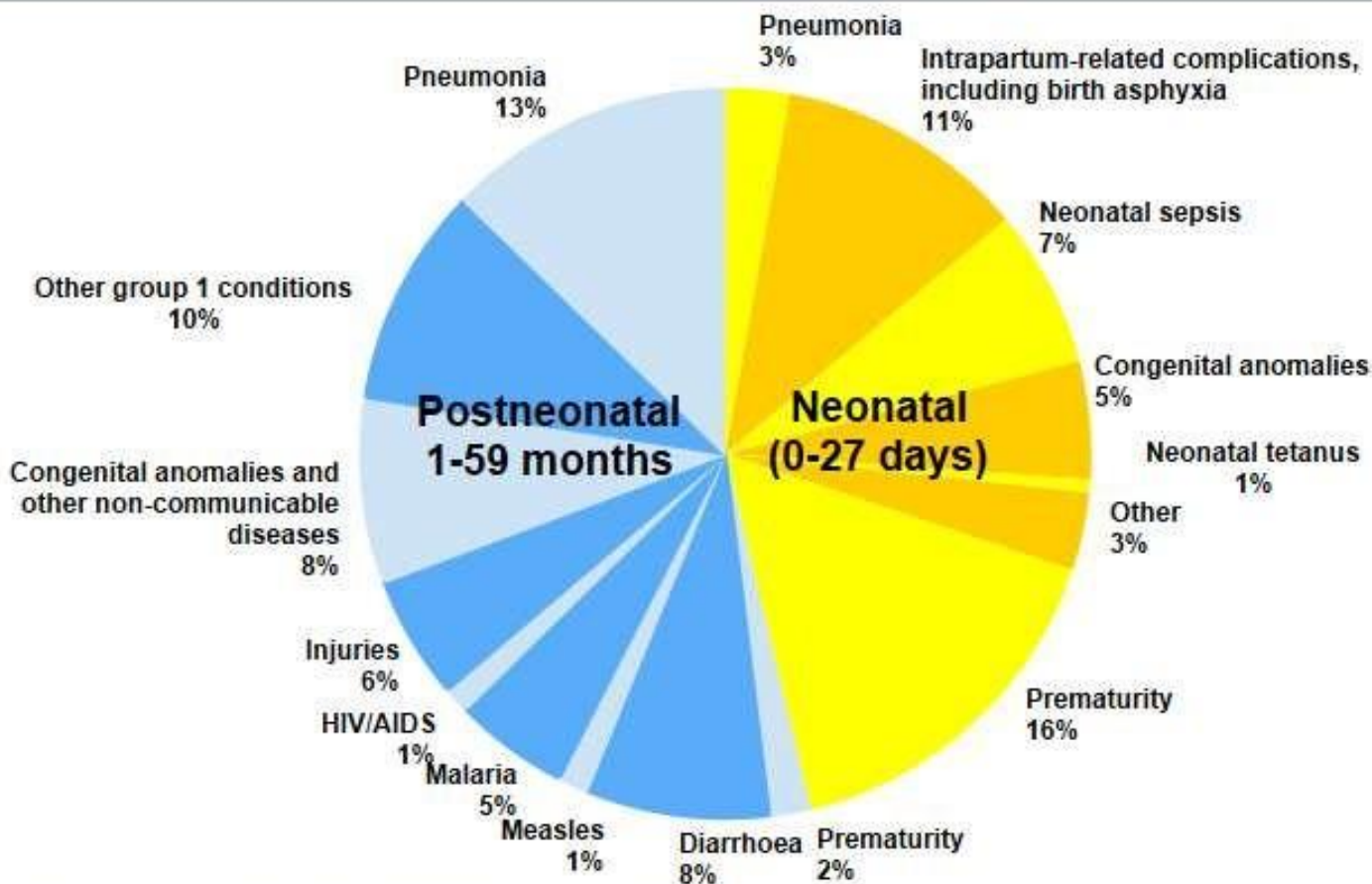
Gastroenteritis is defined as the inflammation of the mucus membranes of the Gastrointestinal tract and is characterized by diarrhea , fever and vomiting.

- **Diarrhea:** the frequent passage of liquid stools (3 or more loose, watery stool per day)

- **Dysentery:** blood or mucus in stools



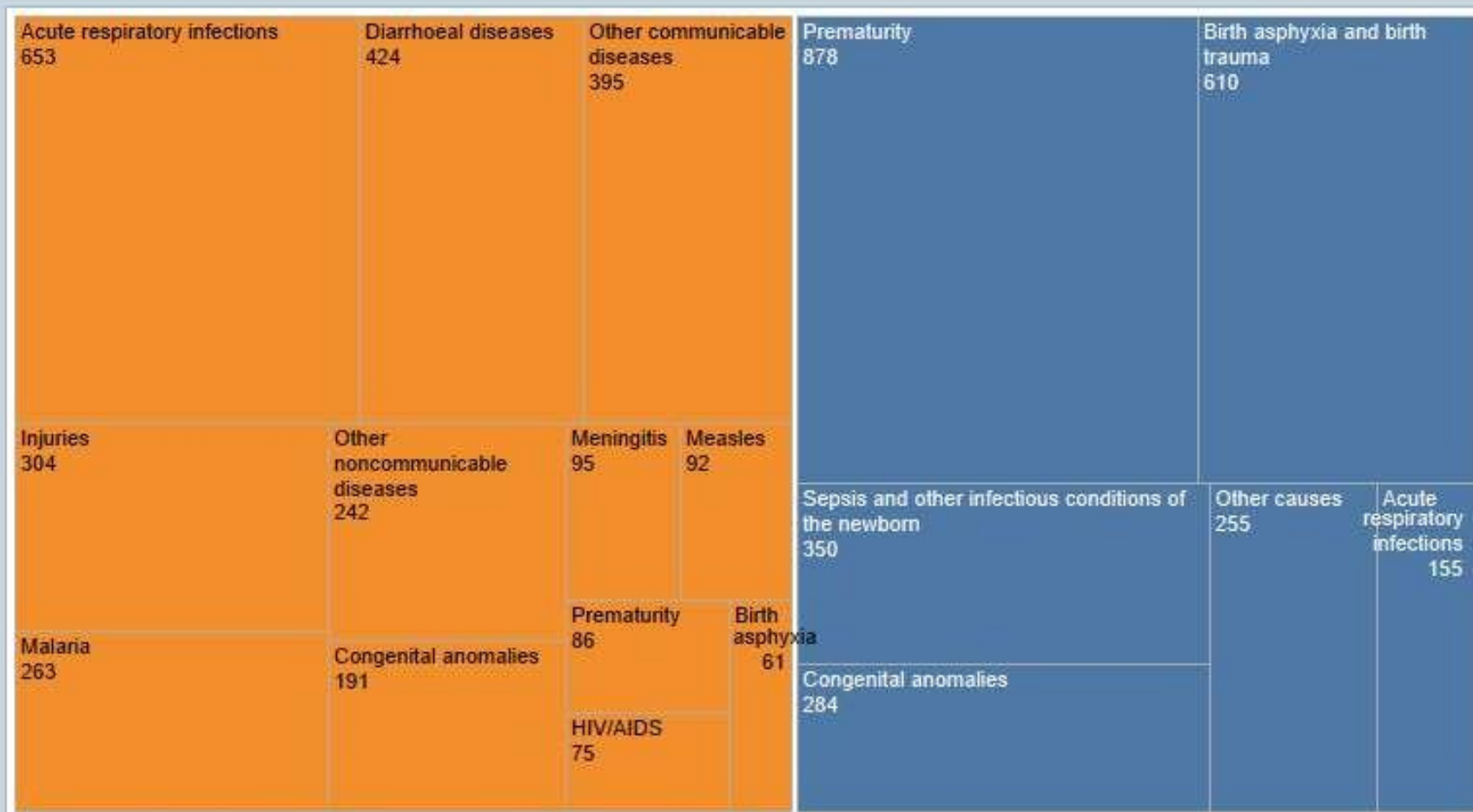
Causes of deaths among children under 5 years, 2016



Source: WHO-MCEE methods and data sources for child causes of death 2000-2016 (Global Health Estimates Technical Paper WHO/HMM/IER/GHE/2018.1)

Diarrhea accounting for 1.34 million deaths annually in children younger than 5 years.

Number of deaths (thousands) among children under 5 years by cause, 2017



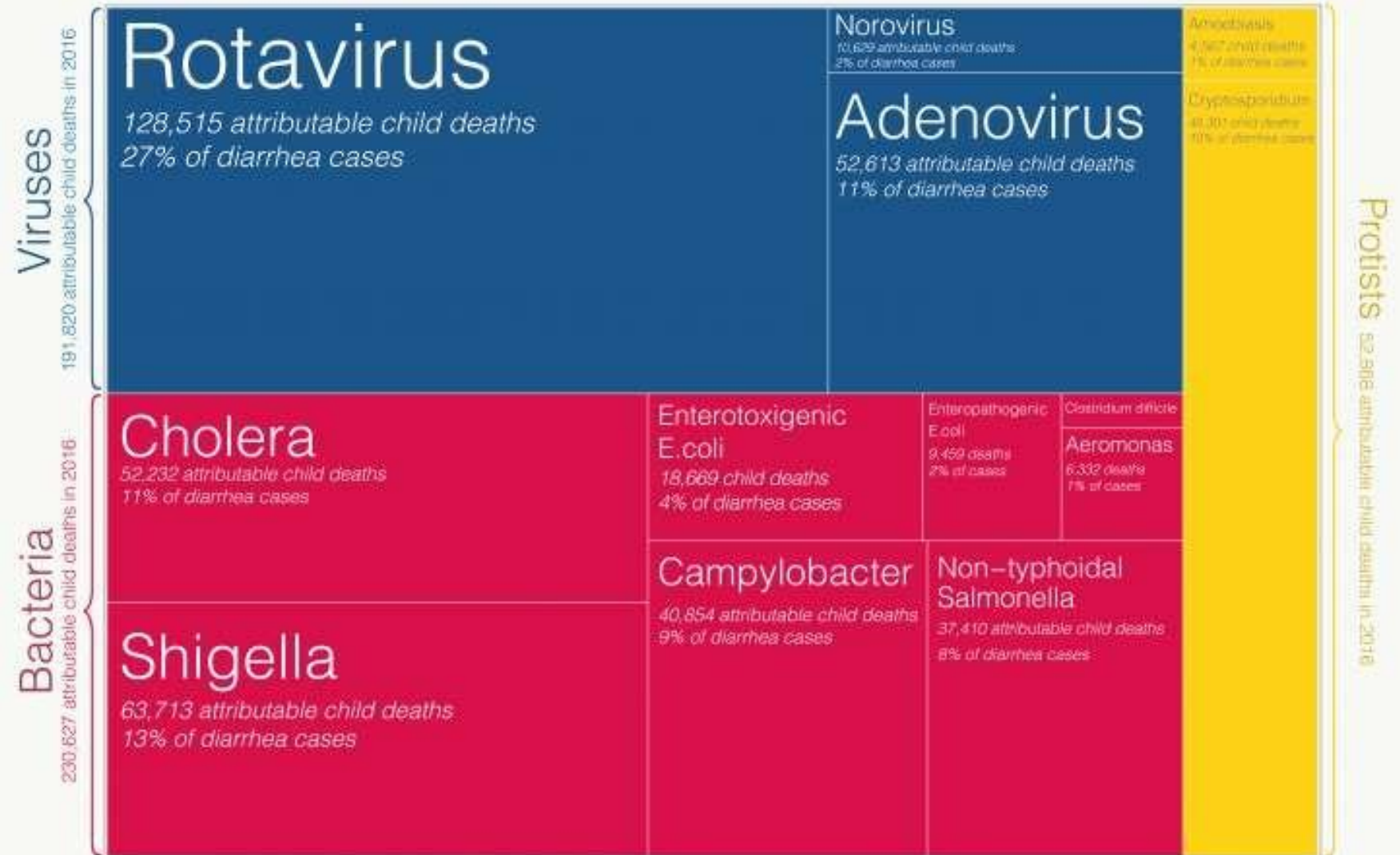
Age group ■ Neonatal (0-28 days) ■ Postneonatal (1-59 months)

Source: WHO-MCEE methods and data sources for child causes of death 2000-2017.

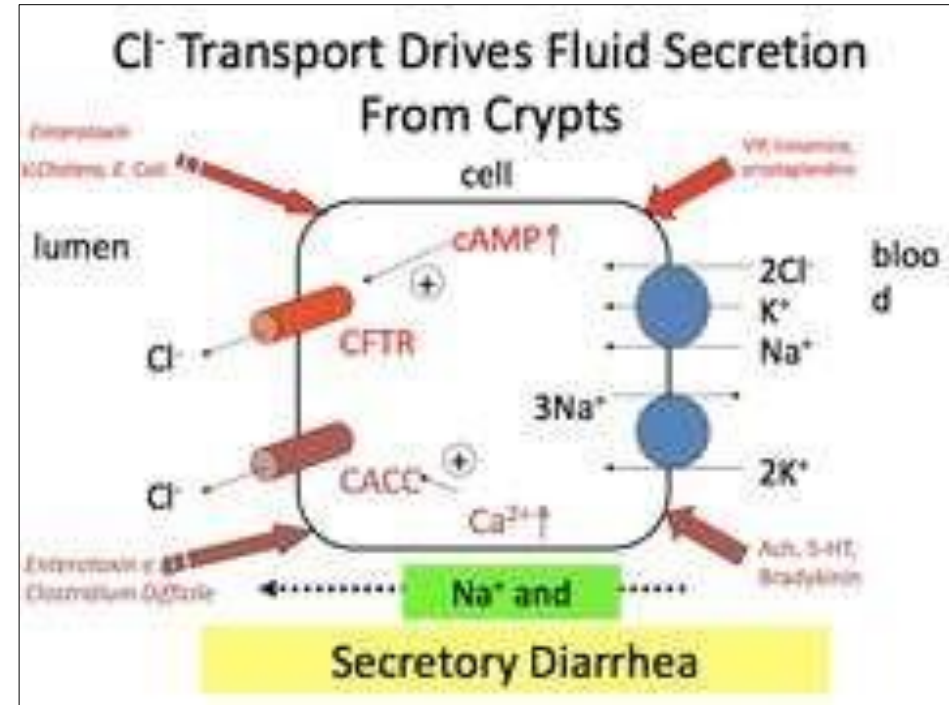
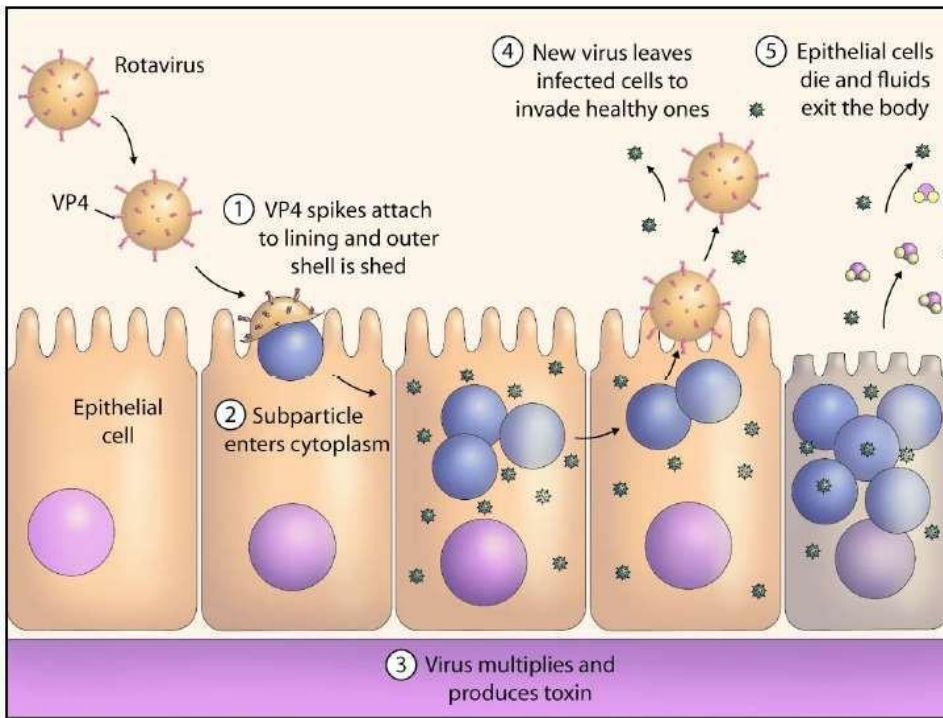
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Child deaths from diarrheal diseases by cause

Attributable number of deaths for each pathogen in children under 5 in 2016.



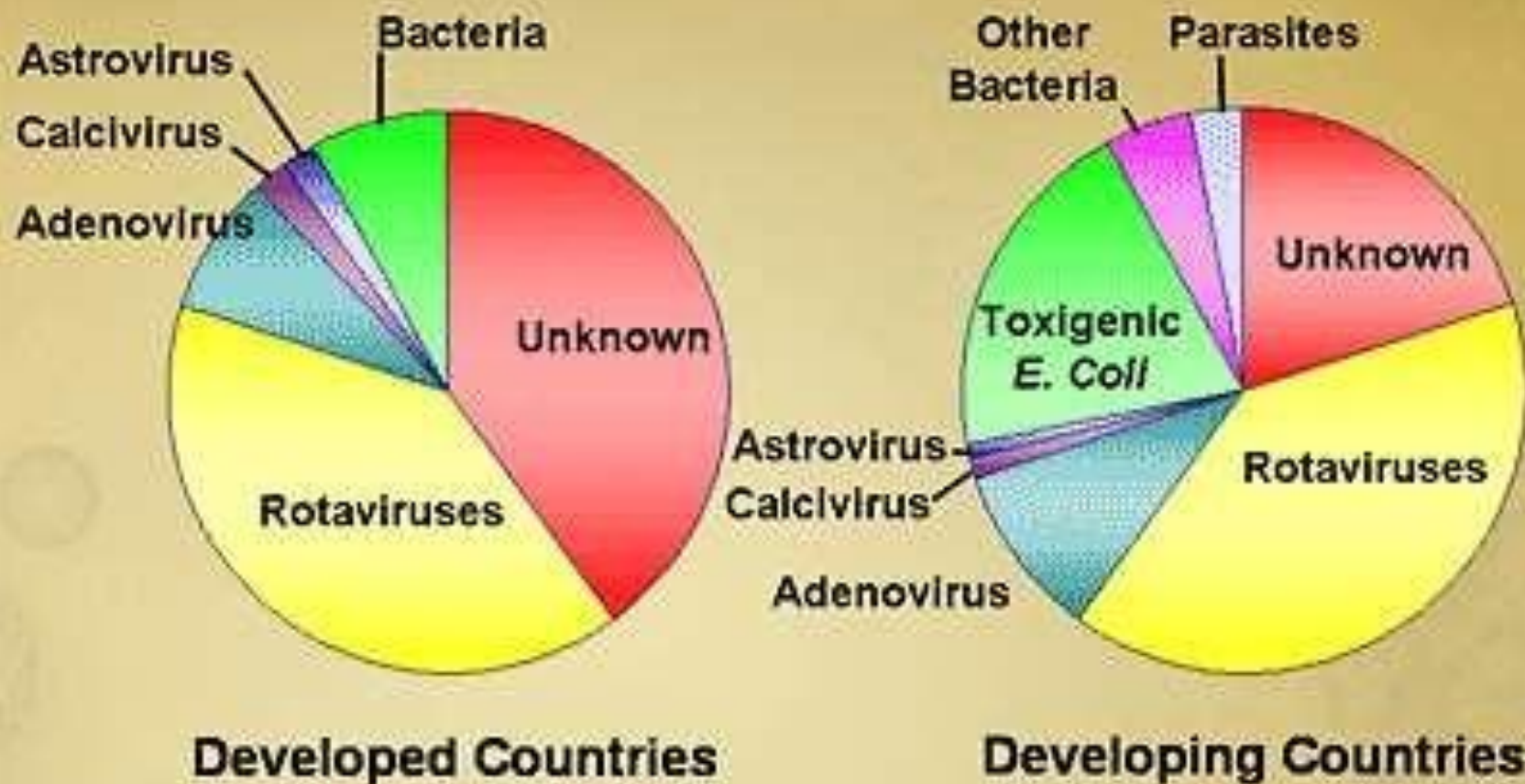
Pathophysiology



The 2 primary mechanisms

- (1) Damage to the villous brush border of the intestine → malabsorption of intestinal contents → **an osmotic diarrhea**
- (2) Release of toxins that bind to specific enterocyte receptors → release of chloride ions into the intestinal lumen → **secretory diarrhea**

Etiologic Agents of Severe Diarrheal Illness Requiring Hospitalization in Infants and Young Children



Causes of acute gastroenteritis in children

Viruses (~70%)

- Rotaviruses
- Norwalk (noroviruses)
- Adenoviruses
- Caliciviruses
- Astroviruses
- Enteroviruses

Protozoa

Giardia lamblia
Entamoeba histolytica
Cryptosporidium


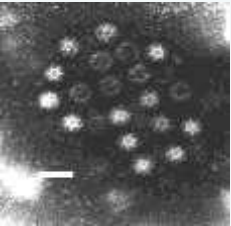
Bacteria (~15%)

Enterotoxigenic *E. coli*
Campylobacter jejuni
Salmonella spp
Enteropathogenic *E. coli*
Shigella spp
Yersinia enterocolitica
Cholera
C. difficile

Helminths

Strongyloides stercoralis

Viral infections

Virus	Character	incubation period	duration
Rota virus 	commonest dehydrating diarrhea	1-3 d	5-7 d
Norwalk virus (noroviruses) 	outbreaks of GE in both children and adults	1-3 d	1-2 d
Adeno virus	2 ND common after rota	8-10 d	5-12 d

Bacterial infections

- **E. coli** infection, **typhoid** and **shigellosis** are more in developing communities.
- ***Clostridium difficile*** : pseudomembranous colitis, observed in patients who develop severe diarrhea during or following a course of antibiotics.
- In patients with ***sickle cell disease***, ***Salmonella*** species are the most frequent cause of gastroenteritis

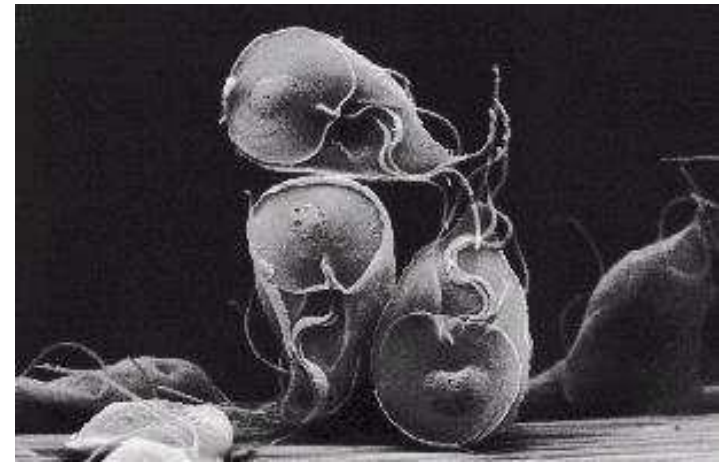


Protozoal agents

1. Cryptosporidium species
2. G lamblia
3. Entamoeba histolytica



Cryptosporidium



G lamblia

Sign & Symptoms

- Nausea & Vomiting
- Diarrhea
- Loss of appetite
- Fever
- Headaches
- Abdominal pain
- Bloody stools
- Fainting and Weakness
- Heartburn
- Dehydration
- Lethargic



Diarrhea

- **Watery** stools are more consistent with viral gastroenteritis
- Stools with **blood** or **mucous** are indicative of a bacterial pathogen.
- a long duration of diarrhea (>14 days)
 1. parasitic
 2. noninfectious cause of diarrhea.



Differential Diagnoses

1. Infections outside the gastrointestinal tract (eg, AOM , URI)
2. Chronic nonspecific diarrhea of childhood (toddler diarrhea)
3. Malabsorption syndromes
4. Inflammatory Bowel Disease
5. Pediatric Lactose Intolerance

Lab Studies

- Are **not** required if the etiology is apparent and some dehydration is present. With severe dehydration, the following are suggested

Serum electrolytes →

Because hyponatremia and hypernatremia require specific treatment

Bicarbonate concentration →

Useful in ruling out dehydration
Poor tissue perfusion in dehydration results in production of lactic acid
Loss of bicarbonate in diarrheal stools.

Glucose

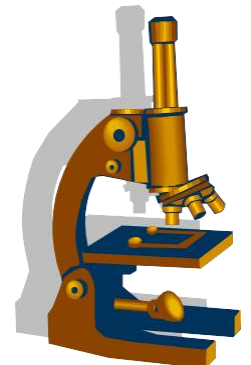
May be dangerously low because of poor intake

Blood urea and creatinine

Elevated in renal hypoperfusion.

Urine specific gravity

Stool examination / culture



Stool examination

Presence of pus,
RBC, or gross blood.

No pus or RBC

Stool cultures
or rectal swab

Virus detection

Evidence of systemic infection-complete workup:

CBC and blood cultures. If indicated, urine cultures, chest radiography, and/or LP



Complications

1. Dehydration → acidosis, shock and death

2. Electrolyte imbalance

3. Seizures

4. Secondary carbohydrate malabsorption

5. Hemolytic uremic syndrome



Symptoms of dehydration

- **Irritability** →
- No tears when crying
- Sunken eye
- Thirst
- Lethargy
- Dry mouth and skin





Skin turgor is assessed by pinching the skin of the abdomen or thigh between the thumb and the bent forefinger in a longitudinal manner. The sign is unreliable in obese or severely malnourished children.

Severe dehydration

- Abnormally sleepy
- lethargic
- Sunken eyes



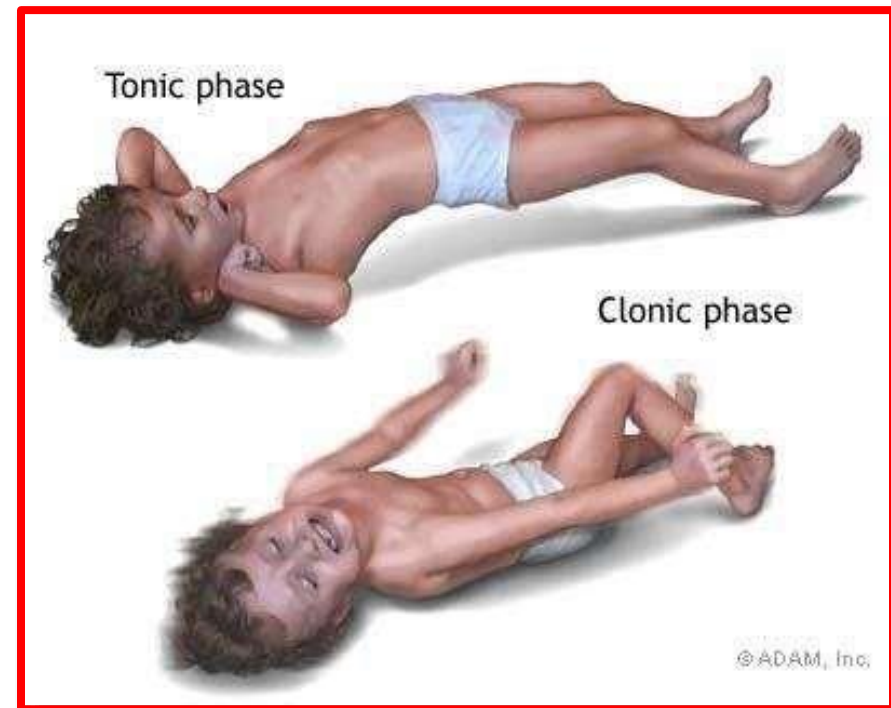
Clinical Findings of Dehydration:

Symptom	Minimal or no Dehydration (<3%)	Mild to Moderate (3%-9%)	Severe (>10%)
Mental Status	Alert	Normal, restless, irritable	Lethargic, unconscious
Thirst	Normal PO or refuses	Thirsty	Drinks poorly or unable
Heart Rate	Normal	Normal to increased	Tachycardia
Quality of pulses	Normal	Normal to decreased	Weak or impalpable
Breathing	Normal	Normal to fast	Deep
Eyes	Normal	Slightly sunken	Deeply sunken
Tears	Present	Decreased	Absent
Oral mucosa	Moist	Dry	Parched
Skin fold	Instant recoil	Recoil in < 2 sec	Recoil > 2sec
Capillary refill	Normal	Prolonged	Prolonged; minimal
Extremities	Warm	Cool	Cool, mottled, cyanotic
Urine output	Normal to decrease	Decreased	Minimal

Seizures in a patient with diarrhea

Causes :

1. Shigella species
2. Enterohemorrhagic Escherichia coli
3. Electrolyte imbalance , $\uparrow\text{Na}$



Management

Basic guidelines for the management of dehydration

- ORS should be use for rehydration
- Oral rehydration should be performed within 3-4 hr
- Rapid realimentation, an age-appropriate unrestricted diet is recommended as soon as dehydration is corrected. Gut rest is not indicated
- In breastfeed infants, nursing should continue
- Diluted formula or special formulas are not indicated
- Additional ORS can be administer for ongoing losses
- No unnecessary labs or medications (i.e. antidiarrheals)



Minimal or no dehydration

- If the child is **breastfed**, give breastfeeding more frequently than usual and for longer at each feed.
- If not breastfed, then **oral** fluids (including clean water, soup, rice water, yogurt drink)
- For ongoing fluid losses give 10 mL/kg ORS for each loose stool and 2 mL/kg for each episode of emesis



Composition of Oral Rehydration Solutions

Solution	Carbs (gm/L)	Sodium (mmol/L)	Potassium (mmol/L)	Chloride (mmol/L)	Base (mmol/L)	Osmolarity (mOsm/L)
WHO-ORS (2002)	13.5	75	30	65	30	245
WHO-ORS (1975)	20	90	20	80	30	311
Pedialyte	25	45	20	35	30	250
Enfalyte	30	50	25	45	34	200
Rehydralyte	25	75	20	65	30	305
CeraLyte	40	50-90	20	N/A	30	220
Gatorade	14	110	30			290-303
Apple Juice	120	0.4	44	45	N/A	730
Coca-Cola	112	1.6	N/A	N/A	13.4	650

In the human body, the plasma osmolality is about 285 mOsm/l

Mild-to-moderate dehydration

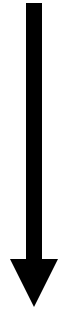
- Give 50-100 mL/kg of ORS over a **2- to 4-hour period**.
- After the initial rehydration phase, manage as before
- ORS should be given slowly at rate of 5 mL every 1-2 min
- For patients who do not tolerate ORS by mouth, nasogastric (NG) feeding



Hypernatremic dehydration

- An exception to this, is the management of hypernatremic dehydration (≥ 150 mmol/L of sodium). Hypernatremic dehydration should be corrected with the same volumes of ORS described above, but over **12 hours** instead of 4 hours.
- This reduces the risk of seizures associated with rapid correction of hypernatremia in **mild-to-moderate dehydration**.

**Rapid correction of
Hypernatremic
dehydration**



Brain edema



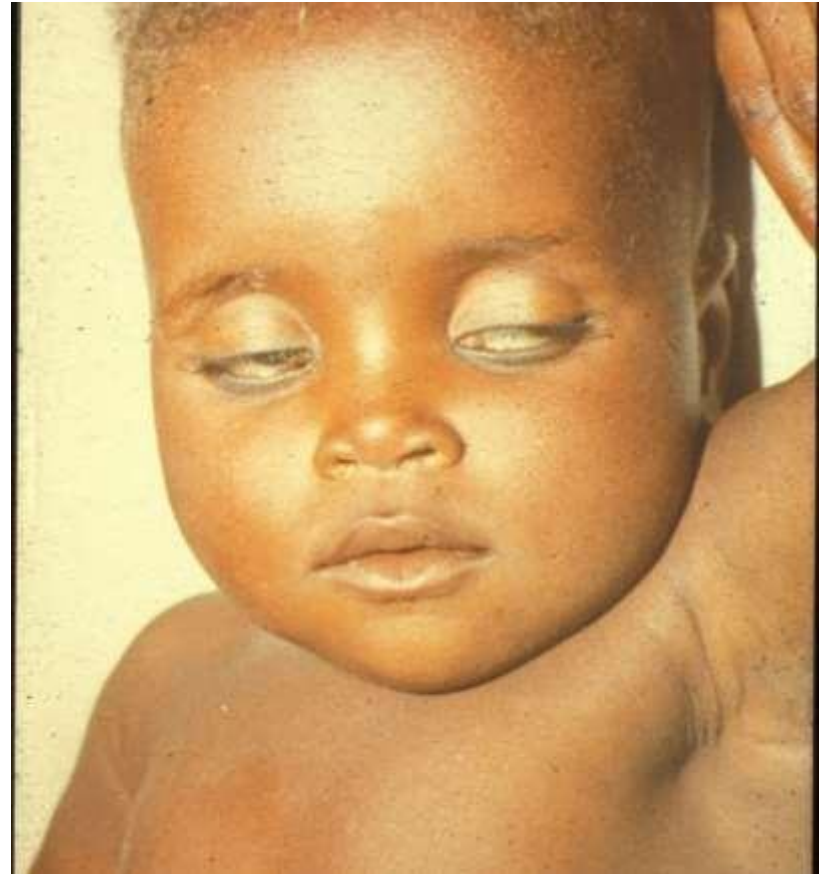
The falx appears to be prominent. This white enhancement represents hemorrhage in the interhemispheric space. It is most prominent posteriorly. This represents a posterior interhemispheric subdural hematoma. There is evidence of cerebral edema and a slight midline shift

Children with severe dehydration should be admitted for IV fluids.



Severe dehydration

- Is a medical emergency
- IV bolus of 20-30 mL/kg (LR) or (NS) solution over 60 minutes.
- Repeat till pulse, perfusion, and/or mental status improve
- After this, the patient should be given an infusion of 70 mL/kg LR or NS over 5 hours (children < 12 months) or 2.5 hours (older children).
- Once resuscitation is complete , rehydration should continue with ORS as described above



Dehydration



After rehydration



When to admit children with AGE

1. Inability to tolerate oral rehydration therapy
2. Severely dehydrated or in shock
3. At high risk of dehydration
 - < 6 months old
 - High frequency of watery stools or vomits
 - Minimal oral intake
 - Worsening symptoms
 - If the parent or carer is unable to manage the child at home.
4. At high risk of complications
 - Children with significant underlying disease (eg, diabetes, renal failure, SCD..)
 - High fever
 - Poor nutrition
 - Hypernatremic
 - Hyponatremic states



Malnutrition

Antimicrobials

Generally not indicated

- **C difficile-** *stop antibiotic & start metronidazole*
- **Cholera-**tetracycline and doxycycline
- **Giardia-**metronidazole
- **Cryptosporidium-**metronidazole or Nitazoxanide



Antidiarrheals are not recommended

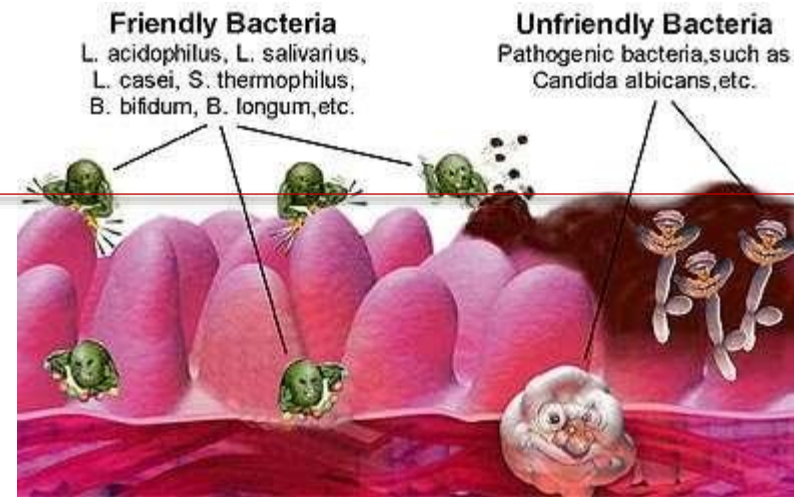
- Loperamide has been linked to cases of severe abdominal distention and even death



• **Ondasetron**

- a serotonin antagonist antiemetic
- Effective in decreasing vomiting and facilitates ORT
- Proven efficacious and safe in children \geq 6 months
- Shown to shorten the ED stay

Probiotics



- Probiotics are live microbial feeding supplements
- Possible mechanisms of action include synthesis of antimicrobial substances, competition with pathogens for nutrients, modification of toxins, and stimulation of nonspecific immune responses to pathogens.
- Two large systematic reviews have found probiotics (especially *Lactobacillus* GG) to be effective in reducing the duration of diarrhea
- A recent meta-analysis found probiotics may be especially effective for the prevention of *C difficile* –associated diarrhea in patients receiving antibiotics.

zinc

- zinc supplementation may be effective in reducing the **duration** of diarrhea in children older than 6 months in areas where zinc deficiency is prevalent.
- WHO recommends zinc supplementation (**10-20 mg/day** for 10-14 days) for all children younger than 5 years with acute gastroenteritis
- little data support this recommendation for children in developed countries



Prevention

- Vaccination-RotaTeq & Rotarix
- Probiotics
- Washing hands.
- Clean food preparation & preservation.



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Thank you