ACUTE GASTROENTERITIS IN CHILDREN

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ACUTE GASTROENTERITIS

Definition

ACUTE GASTROENTERITIS

It is an infection of the gastrointestinal tract caused by bacteria, viruses and parasites.

It covers infections that cause diarrhea.

Diarrhea is loose, watery stools three or more times a day (≥3 defecations/day).

It usually takes less than a week.

It is not expected to last more than two weeks.

ACUTE GASTROENTERITIS



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Etiology

Bacteria (~15%)

***Aeromonas* spp.**
Bacillus cereus
Campylobacter jejuni
Clostridium perfringens
Clostridium difficile
Escherichia coli
Plesiomonas shigelloides
***Salmonella* spp.**
***Shigella* spp.**
Staphylococcus aureus
Vibrio cholerae
Vibrio parahaemolyticus
Yersinia enterocolitica

Viruses (~75%)

Astroviruses
Caliciviruses
Enteric adenovirüs
Herpes simplex viruses
Norovirus
Rotavirus
Cytomegalovirus

Parasites (~5%)

Balantidium coli
Blastocystis hominis
Cryptosporidium parvum
Cyclospora cayetanensis
Encaphalitozoon intestinalis
Entamoeba histolytica
Enterocytozoon bieneusi
Giardia lamblia
Isospora belli
Strongyloides stercoralis
Trichuris trichiura

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Transmission

ACUTE GASTROENTERITIS

Fecal-oral route

Contaminated water and food

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Microorganisms that can be transmitted from person to person with a small amount of inoculum.

- ***Shigella***
- ***Escherichia coli***
- ***Norovirus***
- ***Rotavirus***
- ***Giardia lamblia***
- ***Cryptosporidium parvum***
- ***Entamoeba histolytica***

ACUTE GASTROENTERITIS

Epidemiology

ACUTE GASTROENTERITIS

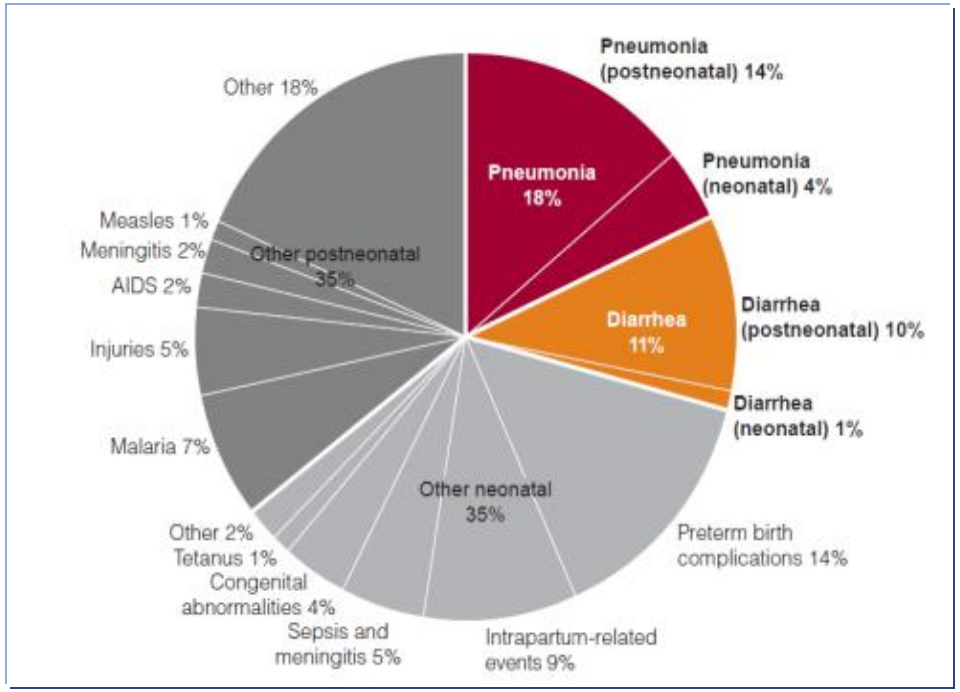
It is an important cause of morbidity and mortality under the age of 5 in underdeveloped countries.

In underdeveloped countries, 3-6 attacks occur per year.

It causes about 1.5-2 million deaths per year.

It is the second most common cause of child death.

ACUTE GASTROENTERITIS



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Signs and Symptoms

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Diarrhea **Vomiting** **Fever** **Abdominal pain** **Signs of dehydration**

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Complications

COMPLICATIONS	CAUSATIVE AGENT
Reactive arthritis	***Salmonella, Shigella, Yersinia, Campylobacter, Cryptosporidium, Clostridium difficile***
Guillain-Barré syndrome	***Campylobacter***
Glomerulonephritis	***Shigella, Campylobacter, Yersinia***
IgA nephropathy	***Campylobacter***
Erythema nodosum	***Yersinia, Campylobacter, Salmonella***
Hemolytic anemia	***Campylobacter, Yersinia***
Hemolytic uremic syndrome	***S. dysenteriae 1, E. coli***

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Laboratory Findings

ACUTE GASTROENTERITIS
Macroscopic examination of stool
Microscopic examination of stool
Stool culture
Stool PCR
Antigen detection tests

ACUTE GASTROENTERITIS
Complete blood count
Serum electrolytes (Na and K)
Kidney function tests (Urea and Cre)
Serum glucose level
Aterial blood gases

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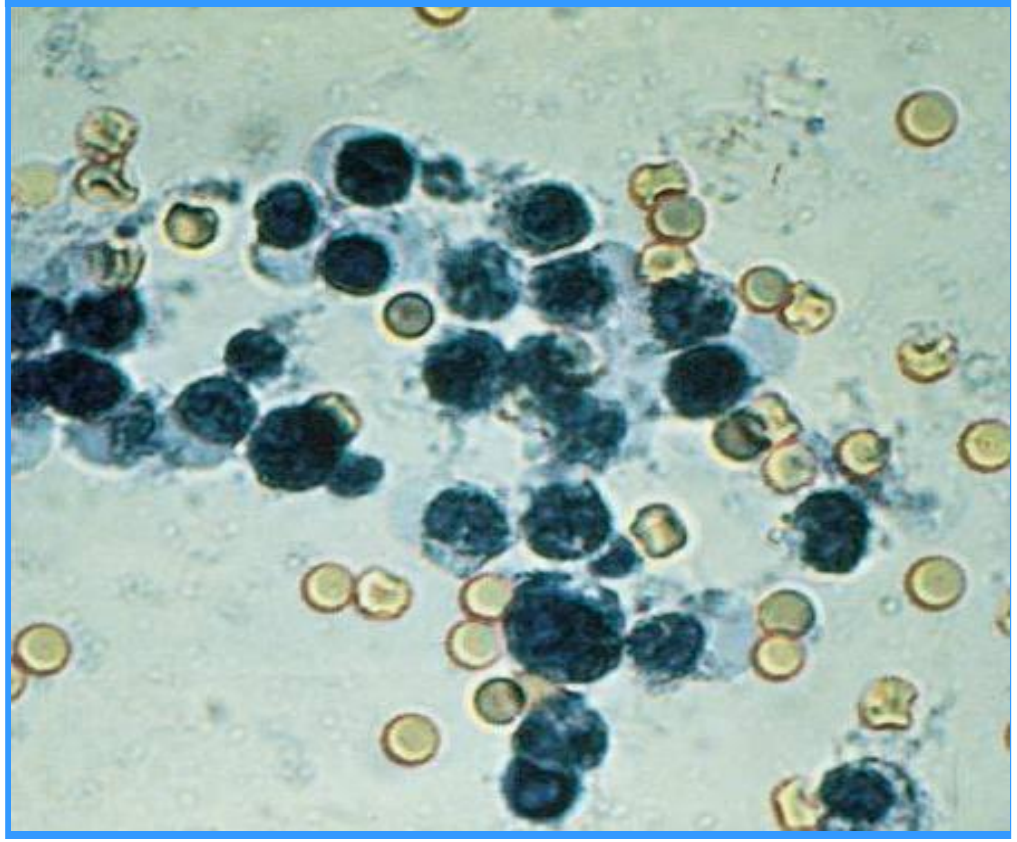
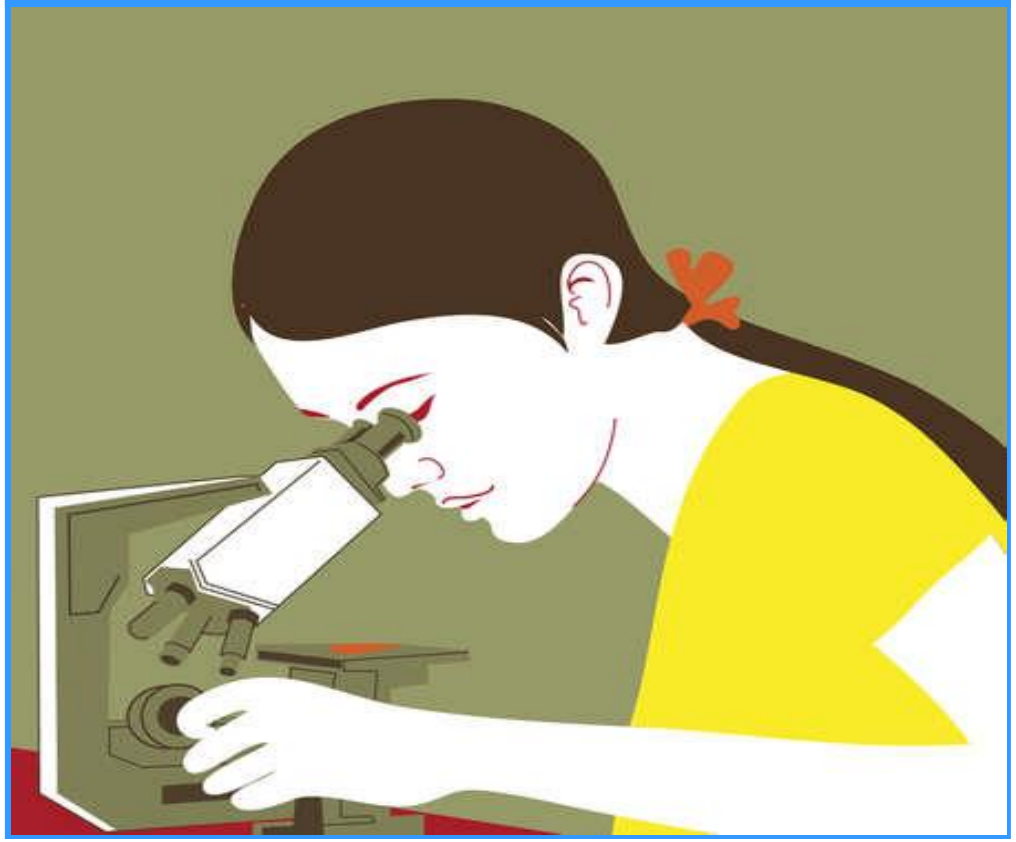
Laboratory Findings

STOOL MICROSCOPY



STOOL MICROSCOPY



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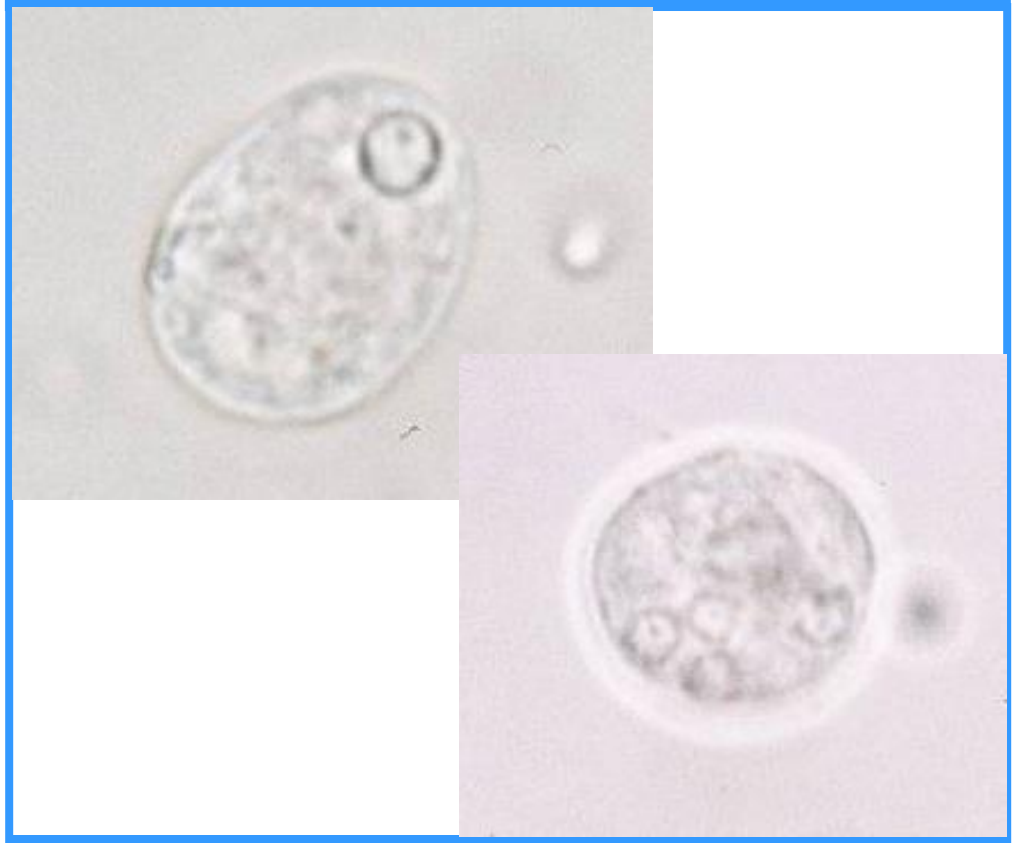
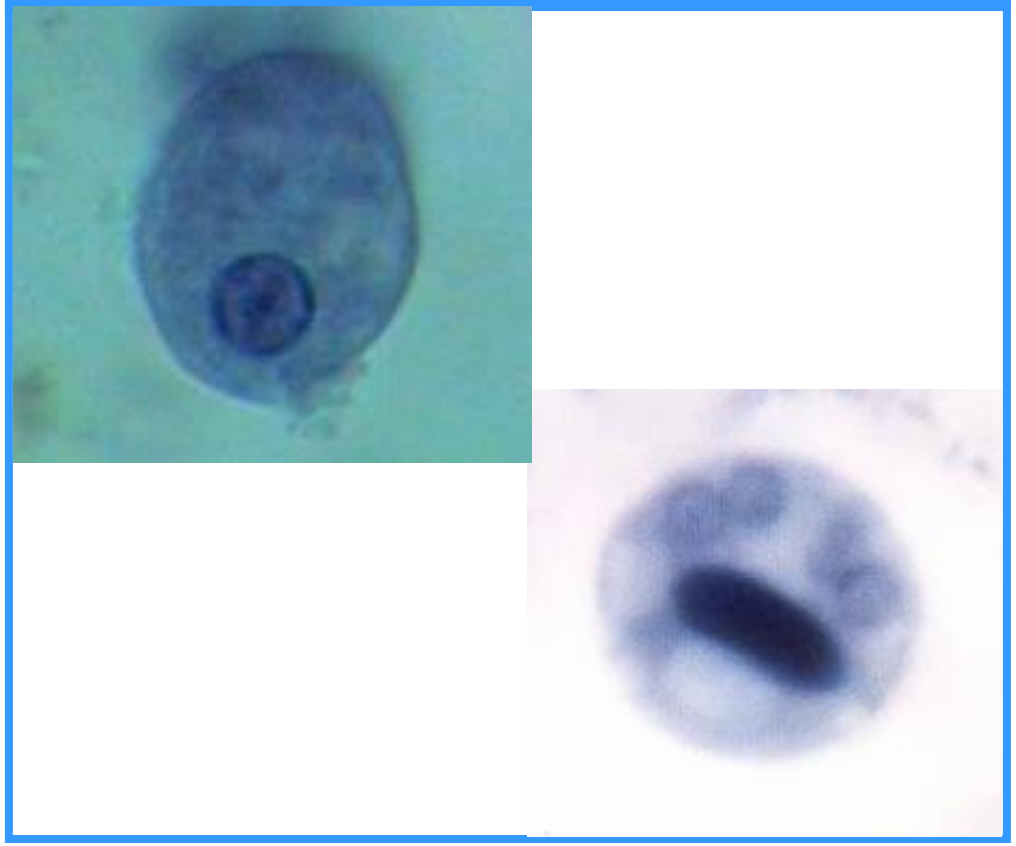
Laboratory Findings

ENTAMOEBA HISTOLYTICA



ENTAMOEBA HISTOLYTICA



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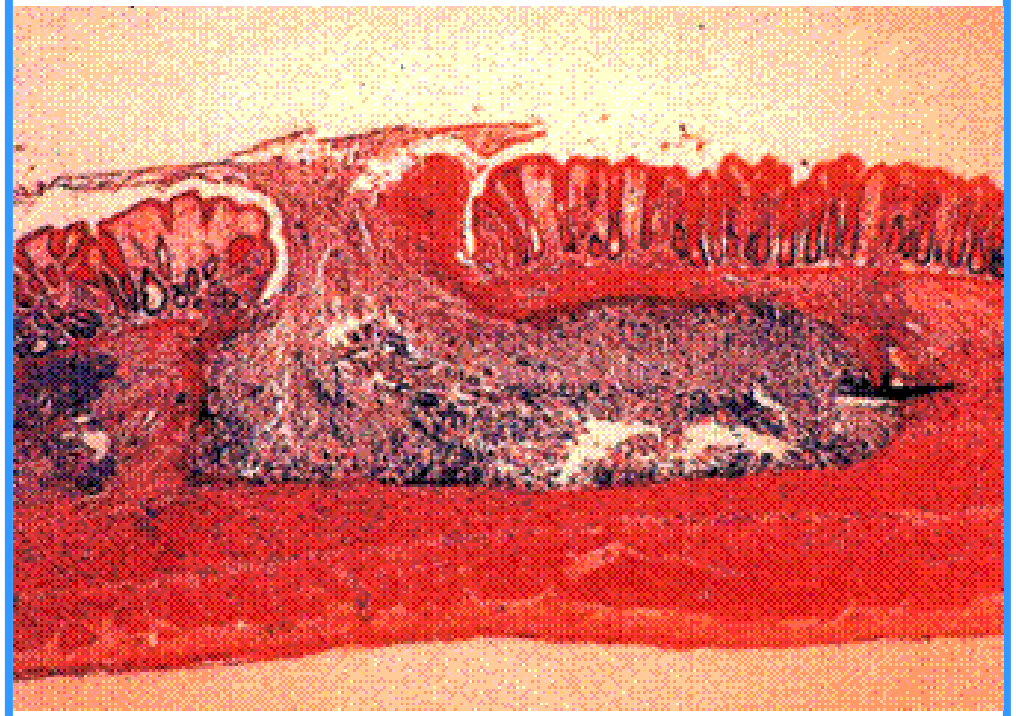
Laboratory Findings

ENTAMOEBA HISTOLYTICA



ENTAMOEBA HISTOLYTICA



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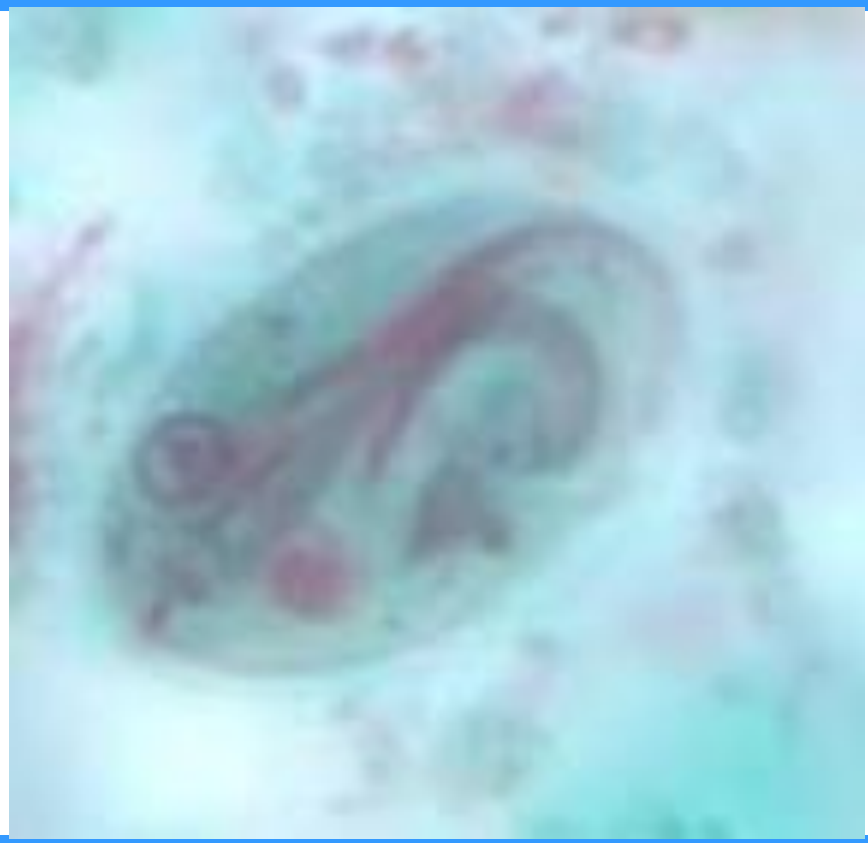
Laboratory Findings

GIARDIA INTESTINALIS



GIARDIA INTESTINALIS



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Differential Diagnosis

ANATOMICAL DEFECTS
Malrotation
Intestinal duplication
Hirschsprung's disease
Fecal impaction
Short bowel syndrome
Microvilli atrophy
Strictures

MALABSORBTION
Disaccharidase deficiency
Glucose-galactose malabsorption
Pancreatic insufficiency
Cystic fibrosis
Shwachman syndrome
Intraluminal bile salt deficiency
Cholestasis
Hartnup's disease
Abetalipoproteinemia
Celiac disease

ENDOCRINE DISEASES
Thyrotoxicosis
Addison's disease
Adrenogenital syndrome

FOOD POISONING
Heavy metal
Scombroid
Ciguatera
Mushroom

NEOPLASIS
Neuroblastoma
Ganglioneuroma
Pheochromocytoma
Carcinoid
Zollinger-Ellison syndrome
VIP syndrome

OTHERS
Non-GI infections
Milk allergy
Crohn's Disease
Ulcerative colitis
Familial dysautonomia
Immunodeficiency
Protein-losing enteropathy
Acrodermatitis enteropathica
Laxative use
Motility disorders
Pellagra

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Treatment

1. Fluid and electrolyte therapy
2. Maintaining nutrition
3. Symptomatic and supportive treatments
4. Agent-specific treatment with antimicrobial drugs

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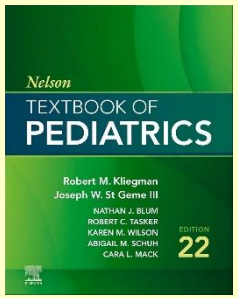
ACUTE GASTROENTERITIS

Dehydration Classification (IV)

MILD DEHYDRATION	MODERATE DEHYDRATION	SEVERE DEHYDRATION
WEIGHT LOSS **Infant: <5%** **Older child and adult: <3%**	 **5-10%** **3-6%**	 **> 10%** **> 6%**
CLINICAL FINDINGS **Normal physical findings** **Normal or increased pulse** **Decreased urine output** **Thirsty** 	 **Tachycardia** **Little or no urine output** **Irritable/lethargic** **Sunken eyes and fontanel** **Decreased tears** **Dry mucous membranes** **Mild delay in elasticity (skin turgor)** **Delayed capillary refill (>1.5 sec)** **Cool and pale**	 **Peripheral pulses either rapid and weak or absent** **Decreased blood pressure** **No urine output** **Very sunken eyes and fontanel** **No tears** **Parched mucous membranes** **Delayed elasticity (poor skin turgor)** **Very delayed capillary refill (>3 sec)** **Cold and mottled limp** **Depressed consciousness**

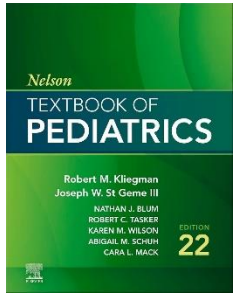
ACUTE GASTROENTERITIS

Dehydration Classification (IV)

Mild dehydration (<5% in an infant; <3% in an older child or adult): Normal or increased pulse; decreased urine output; thirsty; normal physical findings

Moderate dehydration (5–10% in an infant; 3–6% in an older child or adult): Tachycardia; little or no urine output; irritable/lethargic; sunken eyes and fontanel; decreased tears; dry mucous membranes; mild delay in elasticity (skin turgor); delayed capillary refill (>1.5 sec); cool and pale

Severe dehydration (>10% in an infant; >6% in an older child or adult): Peripheral pulses either rapid and weak or absent; decreased blood pressure; no urine output; very sunken eyes and fontanel; no tears; parched mucous membranes; delayed elasticity (poor skin turgor); very delayed capillary refill (>3 sec); cold and mottled; limp, depressed consciousness



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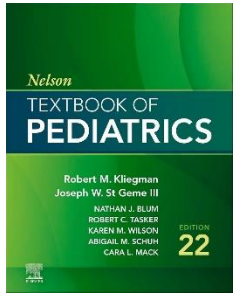
Dehydration Classification (IV)

1. Restore intravascular volume
   Isotonic fluid (NS or LR): 20 mL/kg over 20 min
   Repeat as needed
2. Calculate 24 hr fluid needs: maintenance + deficit volume
3. Subtract isotonic fluid already administered from 24 hr fluid needs
4. Administer remaining volume over 24 hr using 5% dextrose NS + 20 mEq/L KCl
5. Replace ongoing losses as they occur

LR, Ringer lactate; NS, normal saline.



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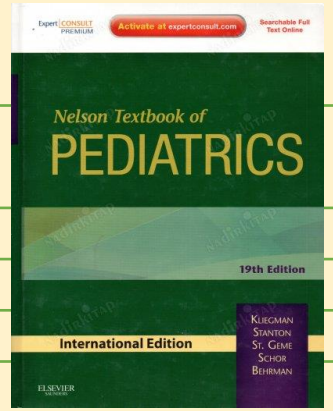
Dehydration Classification (Oral)

	MINIMAL OR NO DEHYDRATION	MILD TO MODERATE DEHYDRATION	SEVERE DEHYDRATION
Loss of Body Weight	(<%3)	(%3-9)	(>%9)
Mental status	Well; alert	Normal, fatigued or restless, irritable	Apathetic, lethargic, unconscious
Thirst	Drinks normally; might refuse liquids	Thirsty; eager to drink	Drinks poorly; unable to drink
Heart rate	Normal	Normal to increased	Tachycardia, with bradycardia in most severe cases
Quality of pulses	Normal	Normal to decreased	Weak, thready, or impalpable
Breathing	Normal	Normal; fast	Deep
Eyes	Normal	Slightly sunken	Deeply sunken
Tears	Present	Decreased	Absent
Mouth and tongue	Moist	Dry	Parched
Skinfold	Instant recoil	Recoil in <2 sec	Recoil in >2 sec
Capillary refill	Normal	Prolonged	Prolonged; minimal
Extremities	Warm	Cool	Cold; mottled; cyanotic
Urine output	Normal to decreased	Decreased	More decreased



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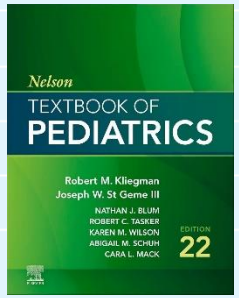
Dehydration Classification (Oral)

SYMPTOM	MINIMAL OR NO DEHYDRATION	SOME DEHYDRATION	SEVERE DEHYDRATION
Mental status[C,G4,W]	Well; alert	Normal, fatigued or restless, irritable	Apathetic, lethargic, limp, unconscious/comatose
Thirst[W]	Drinks normally; might refuse liquids	Thirsty; eager to drink	Drinks poorly; unable to drink
Heart rate[G10]	Normal	Normal to increased	Tachycardia, with bradycardia in most severe cases
Quality of pulses[G10]	Normal	Normal to decreased	Weak, thready, or impalpable
Breathing [G10]	Normal	Normal; fast	Deep, fast
Eyes[C,G10,W]	Normal	Slightly sunken	Deeply sunken
Tears[C,G4]	Present	Decreased	Absent
Mouth and tongue/mucous membranes[C,G4]	Moist	Dry, "sticky" or "tacky"	Parched
Skinfold[G10,W]	Instant recoil	Recoil in <2 sec (slow)	Recoil in >2 sec (very slow)
Capillary refill[G4]	Normal	Prolonged	Prolonged; minimal
Extremities	Warm	Cool	Cold; mottled; cyanotic
Urine output[G10]	Normal to decreased	Decreased	Minimal

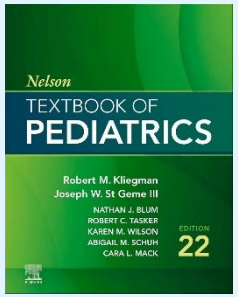


[C]Denotes inclusion in Clinical Dehydration Scale (CDS); CDS scores each category from 0 to 2 with an overall score of 0 = no dehydration (<3%), 1-4 = some dehydration (<6%).
[G4]Denotes inclusion in 4-point and 10-point Gorelick scales: ≥2 Clinical Signs ≥5% ΔBW; ≥3 Clinical Signs ≥10% ΔBW.
[G10]Denotes items included in 10-point Gorelick scale but not in the 4-point Gorelick scale: ≥3 Clinical Signs ≥5% ΔBW; ≥7 Clinical Signs ≥10% ΔBW. Gorelick Scale uses "no or minimal dehydration" and "moderate to severe dehydration."
[W]Denotes inclusion in the World Health Organization (WHO) scale.
BW, Body weight.

ACUTE GASTROENTERITIS

Dehydration Classification (Oral)

DEGREE OF DEHYDRATION	REHYDRATION THERAPY	REPLACEMENT OF LOSSES
Some dehydration	Infants and children: ORS, 75 mL/kg over 3-4 hr. Continue breastfeeding. After 4 hr, give food every 3-4 hr for children who normally receive solid foods.	*Infants and children:* <2 yr old: 50-100 mL ORS for each diarrheal stool or vomiting episode, up to ~500 mL/day ≥2 yr old: 100-200 mL ORS for each diarrheal stool or vomiting episode, up to ~1 L/day Replace losses as above as long as diarrhea or vomiting continues
Severe dehydration	Malnourished infants may benefit from smaller-volume, frequent boluses of 5-10 mL/kg body weight due to reduced capacity to increase cardiac output with larger volume resuscitation. Infants (<12 mo) and children (12 mo to 5 yr) without malnutrition: Give 20-30 mL/kg boluses of IV isotonic crystalloid solution (e.g., Ringer lactate or normal saline solution) over 30-60 min. Repeat boluses as necessary to restore adequate perfusion. Then give 70 mL/kg over 2.5-5 hr. (Note the slower infusion times are for infants.) If IV hydration is not possible, administer ORS 20 mL/kg/hr × 6 hours via nasogastric tube. Reassess the infant or child frequently and adjust infusion rate if needed. Give ORS as soon as the child can drink. Allow to feed (breast milk or solid food) as described for some dehydration. Adjust electrolytes and administer dextrose based on chemistry values.	*Infants and children:* <10 kg body weight (children <2 yr): 50-100 mL ORS for each diarrheal stool or vomiting episode >10 kg body weight (children ≥2 yr): 100-200 mL ORS for each diarrheal stool or vomiting episode *Adolescents and adults:* Ad libitum Replace losses as above as long as diarrhea or vomiting continue If unable to drink, either administer ORS through a nasogastric tube or give dextrose-containing IV fluids as appropriate based on chemistry values



Note: Low-osmolarity ORS can be given to all age-groups, with any cause of diarrhea. It is safe in the presence of hypernatremia, as well as hyponatremia (except when edema is present). Some commercially available formulations that can be used as ORS include Pedialyte Liters (Abbott Nutrition), CeraLyte (Cera Products), and Enfalac Lytren (Mead Johnson). Popular beverages that should not be used for rehydration include apple juice, Gatorade, and commercial soft drinks.

ORS, Oral rehydration solution; IV, intravenous.

ACUTE GASTROENTERITIS

Treatment

1. Fluid and electrolyte therapy
2. Maintaining nutrition
3. Symptomatic and supportive treatments
4. Agent-specific treatment with antimicrobial drugs

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Treatment: Nutrition

Breastfed babies	**During rehydration and maintenance continue breastfeeding.**
Formula feeding	**Resume normal formula after rehydration.**
Non-Breastfed Non-Formula feeding	**After the rehydration, give the liquid and solid foods that the child normally takes. Avoid foods rich in fatty and simple sugars.**

ACUTE GASTROENTERITIS

Treatment: Nutrition

APPROPRIATE	INAPPROPRIATE
Water	Cola and similar drinks
Rice	Soft drinks
Potatoes	Beverages
Soups (potato, carrot, rice)	
Yogurt	
Ayran	
Fruits and vegetables	
Bread	
Cracker	
Milk	
Lean meat (Chicken)	

ACUTE GASTROENTERITIS

Treatment

1. Fluid and electrolyte therapy
2. Maintaining nutrition
3. **Symptomatic and supportive treatments**
4. Agent-specific treatment with antimicrobial drugs

ACUTE GASTROENTERITIS

Treatment: Anti-diarrheal Drugs

- **Drugs that shorten the severity and duration of diarrhea**
  - **Anti-motility drugs:** **Loperamide, Diphenoxylate+atropine**
  - **Anti-secretory drugs:** **Bismuth subsalicylate, Racecadotril**
  - **Adsorbent drugs:** **Kaolin-pectin, Attapulgite, Smectite**

Shigellosis	**Prolongation of disease duration**
***C. difficile* colitis**	**Development of toxic megacolon**
Shiga toxin producing *E. coli*	**HUS development**
Drug side effects	**Development of encephalopathy**
Drug interaction	**Impairment of the absorption of other drugs**
Cost	

These drugs are not routinely recommended in children.

ACUTE GASTROENTERITIS

Treatment: Anti-emetic Drugs

- **Drugs that prevent or reduce vomiting**
  - **Serotonin receptor antagonists**
    - **Ondansetron**
  - **Phenothiazines**
    - **Promethazine, metoclopramide, prochlorperazine**
  - **Antihistamines**
    - **Dimenhydrinate**
  - **Dopamine receptor antagonists**
    - **Domperidone**
  - **Glucocorticoids**
    - **Dexamethasone**

These drugs are not routinely recommended in children.

ACUTE GASTROENTERITIS

Treatment: Probiotics and Prebiotics

- **Probiotics: Live microorganisms that have the potential to benefit the host by altering the host's intestinal flora.**

  Saccharomyces boulardii
  Lactobacillus rhamnosus GG
  Lactobacillus acidophilus
  Streptococcus thermophilus

- **Prebiotics are substrates used selectively by beneficial host microorganisms.**

  Fructooligosaccharides
  Inulin

- **The mechanism of action is controversial**

  Binding sites from intestinal epithelial cells, competition for nutrients
  Secretion of bacteriocins
  Stimulation of the immune system…

Viral gastroenteritis	**Shortens the duration of illness**
Antibiotics related diarrhea	**Generally useful**
Tourist diarrhea	**Conflicting results have been reported**
Dysenteriae	**No benefits**

These drugs are not routinely recommended in children.

ACUTE GASTROENTERITIS

Treatment: Zinc

Zinc deficiency is associated with T cell dysfunction, amd lymphoid atrophy.

Zinc deficiency; Intestinal disaccharidase activity is reduced

Zinc deficiency; Intestinal secretory activity increases

Zinc deficiency; Longer and more severe diarrhea

Zinc deficiency; Higher chance of chronic diarrhea

With its treatment, the duration of diarrhea is reduced by 25%, and the number of defecations by 33%.

In malnourished children and in regions where zinc deficiency is common, 5 mg/day (10-14 days) should be given.

Not routinely recommended in children whose zinc deficiency is not considered.

ACUTE GASTROENTERITIS

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ACUTE GASTROENTERITIS

Treatment: Antibiotics

- Empirical antibiotic therapy is not usually required.
- Administration of antibiotics in EHEC gastroenteritis may increase the risk of HUS.
- Infants with severe malnutrition and diarrhea should be given antibiotics.
- Toxic patients with suspected bacteremia should be given antibiotics.
- Empirical antibiotic therapy should be started according to regional resistance patterns.

ACUTE GASTROENTERITIS

Treatment: Antibiotics

ORGANISM	DRUGS OF CHOİCE	DOSAGE AND DURATION OF TREATMENT
Shigella	Ciprofloxacin, Ampicillin, Ceftriaxone, or TMP-SMX	Ceftriaxone IV, IM 50–100 mg/kg/day qd, bid × 7 day
	Most species have become resistant to antibiotics	Ciprofloxacin PO 20–30 mg/kg/day bid × 7–10 day
		TMP 10 mg/kg/day and SMX 50 mg/kg/day bid × 5 day
		Ampicilin PO, IV 50–100 mg/kg/day qid × 7 day
EPEC, ETEC, EIEC	TMP-SMX or Ciprofloxacin	10 mg/kg/day TMP ve 50 mg/kg/day SMX bid × 5 day
		Ciprofloxacin PO 20–30 mg/kg/day qid for 5–10 day
Salmonella	Infections in the normal host with non-typhoidal species do not require treatment	*See Shigella* therapy
	Indication for treatment: infants <3 months, malignancy, chronic GI disease, severe colitis, hemoglobinopathies, HIV infection and other immunodeficiencies	
	Most species have become resistant to antibiotics	
Aeromonas/Plesiomonas	TMP-SMX	10 mg/kg/day TMP ve 50 mg/kg/day SMX bid 5 day
	Ciprofloxacin	Ciprofloxacin PO 20–30 mg/kg/day bid 7–10 day
Yersinia spp.	Antibiotics are not usually needed for diarrhea	
	Deferoxamine therapy should be discontinued during severe infection or bacteremia.In sepsis, doxycycline, aminoglycoside, TMP-SMX, or fluoroquinolone are used in combination.	
Campylobacter jejuni	Erythromycin or Azithromycin	Erythromycin PO, 50 mg/kg/day tid 5 day
		Azithromycin PO, 5–10 mg/kg/day qid 5 day
Clostridium difficile	Metronidazole (first choice)	PO 30 mg/kg/day tid 5 day
	Vancomycin (second choice)	PO 40 mg/kg/day qid 7 day

ACUTE GASTROENTERITIS

Treatment: Antibiotics

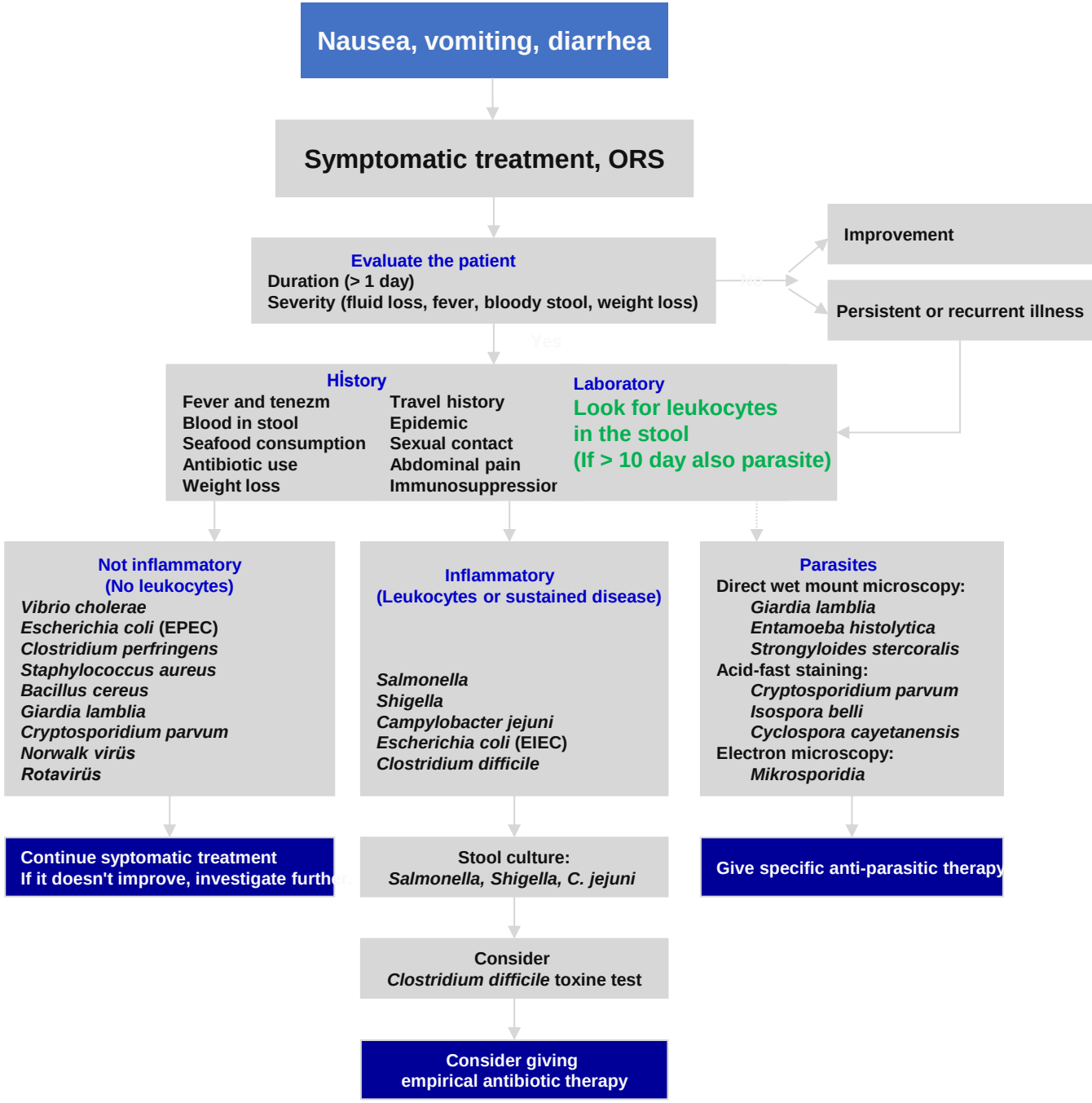
RISK FACTORS FOR SALMONELLA BACTEREMIA

- ❑ Newborns
- ❑ Infants <3 months
- ❑ Infants <12 months with temperatures >39°C
- ❑ Immunodeficiency
- ❑ Malignancy; especially leukemia and lymphoma
- ❑ Immunosuppressive and corticosteroid therapy
- ❑ Hemolytic anemia; sickle cell anemia, malaria, bartonellosis
- ❑ Collagen vascular disease
- ❑ Inflammatory bowel disease
- ❑ Gastrectomy or gastroenterostomy
- ❑ Achlorhydria or antacid drug therapy
- ❑ Bowel motility disorder
- ❑ Shistosomiasis
- ❑ Malnutrition

ACUTE GASTROENTERITIS

Treatment: Antiparasitic Drugs

PARASITE	*ANTIMICROBIAL DRUG*
Balantidium coli	*Tetrasiklin, metronidazol veya iyodokinol*
Blastocystis hominis	*Metronidazol veya iyodokinol*
Cryptosporidium parvum	*Paramomisin veya azitromisin*
Cyclospora cayetanensis	*TMP-SMZ*
Encaphalitozoon intestinalis	*Albendazol*
Entamoeba histolytica	*Metronidazol ve/veya iyodokinol*
Enterocytozoon bieneusi	*Albendazol*
Giardia lamblia	*Metronidazol, albendazol, furazolidon veya paramomisin*
Isospora belli	*TMP-SMZ*
Strongyloides stercoralis	*İvermektin veya tiabendazol*
Trichuris trichiura	*Mebendazol veya albendazol*


Nausea, vomiting, diarrhea
Symptomatic treatment, ORS
Evaluate the patient
Duration (> 1 day)
Severity (fluid loss, fever, bloody stool, weight loss)
No
Improvement
Persistent or recurrent illness
Yes
History
Fever and tenezm
Blood in stool
Seafood consumption
Antibiotic use
Weight loss
Travel history
Epidemic
Sexual contact
Abdominal pain
Immunosuppressior
Laboratory
Look for leukocytes in the stool
(If > 10 day also parasite)
Not inflammatory
(No leukocytes)
Vibrio cholerae
Escherichia coli (EPEC)
Clostridium perfringens
Staphylococcus aureus
Bacillus cereus
Giardia lamblia
Cryptosporidium parvum
Norwalk virüs
Rotavirüs
Inflammatory
(Leukocytes or sustained disease)
Salmonella
Shigella
Campylobacter jejuni
Escherichia coli (EIEC)
Clostridium difficile
Parasites
Direct wet mount microscopy:
Giardia lamblia
Entamoeba histolytica
Strongyloides stercoralis
Acid-fast staining:
Cryptosporidium parvum
Isospora belli
Cyclospora cayetanensis
Electron microscopy:
Mikrosporidia
Continue syptomatic treatment
If it doesn't improve, investigate furth
Stool culture:
Salmonella, Shigella, C. jejuni
Give specific anti-parasitic therapy
Consider
Clostridium difficile toxine test
Consider giving
empirical antibiotic therapy

ACUTE GASTROENTERITIS

Prevention

HYGIENE RULES



HYGIENE RULES



ACUTE GASTROENTERITIS

Prevention

BREASTFEEDING



BREASTFEEDING



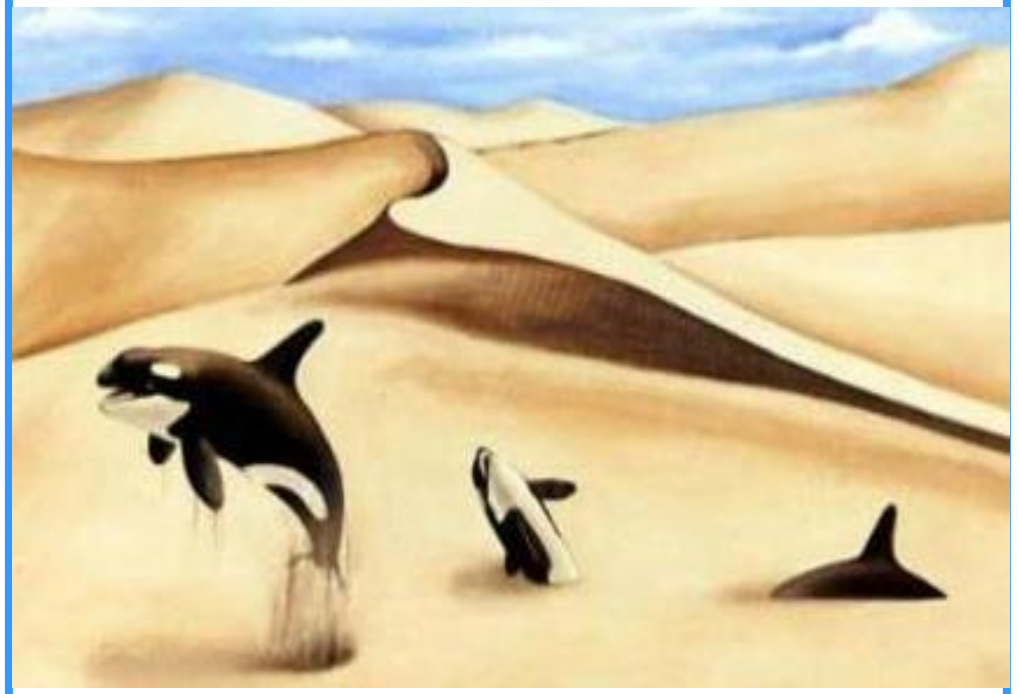
ACUTE GASTROENTERITIS

Prevention

USING CLEAN WATER AND FOOD



USING CLEAN WATER AND FOOD



ACUTE GASTROENTERITIS

Prevention

VACCINATION



VACCINATION





ACUTE GASTROENTERITIS

Clean Water, Vaccines, Antibiotics...

THE GREATEST MEDICAL ADVANCES IN HUMAN HISTORY

