



# Viral Gastroenteritis

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# Common Causes of Viral Gastroenteritis

- Rotavirus
- Calicivirus (norovirus)
- Adenovirus

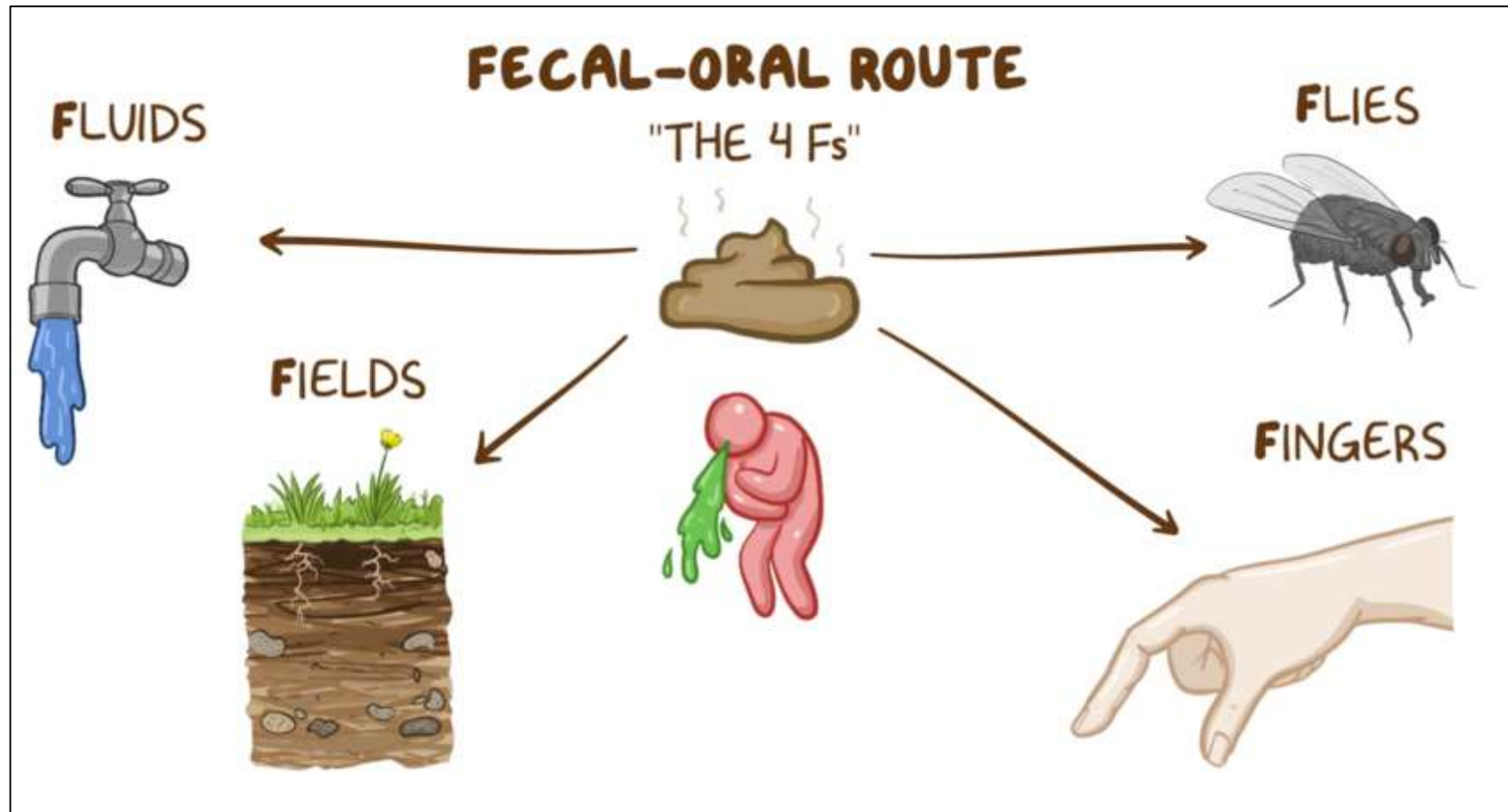


# Rotavirus - Epidemiology and Burden

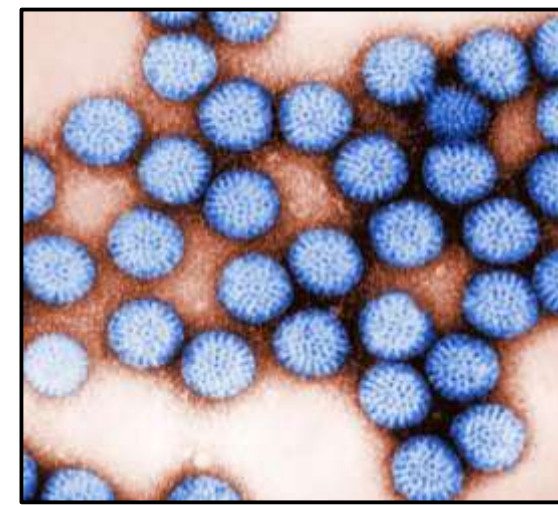
- A common cause of severe gastroenteritis **in children <5 years**
  - Historically most common in children, now declining in countries with vaccination
  - The leading cause of acute gastroenteritis in the US is norovirus infection. Rotavirus infection in the US has been on the decline since the introduction of the vaccine.
- **Peak incidence:** 6-24 months of age
  - Neonates relatively protected due to maternal antibodies
- **Low infectious dose:** 10-100 viral particles sufficient
- Resistant to many common disinfectants
- Transmission: Highly contagious; fecal-oral route, contaminated surfaces



# Rotavirus - Epidemiology and Burden (cont.)



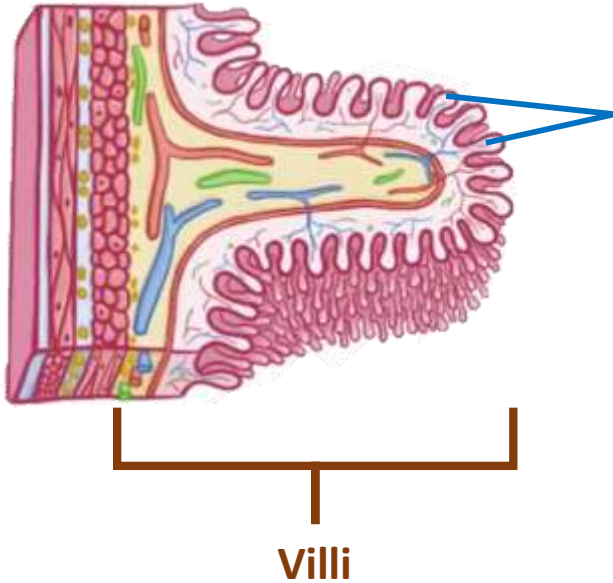
# Rotavirus - Virology



- **Family:** Reoviridae
- **Structure:** non-enveloped, 11-segmented dsRNA genome
- Unique “wheel-like” morphology on electron microscopy (“rota” = wheel).
- Resistant to stomach acid → reach the small intestine
- **Specific Pathophysiology**
  - **NSP4** protein acts as an enterotoxin → stimulates fluid secretion.
  - Infects mature enterocytes in the small intestine → villous atrophy.



# Rotavirus - Pathophysiology



Microvilli

Villi

## ROTAVIRUS

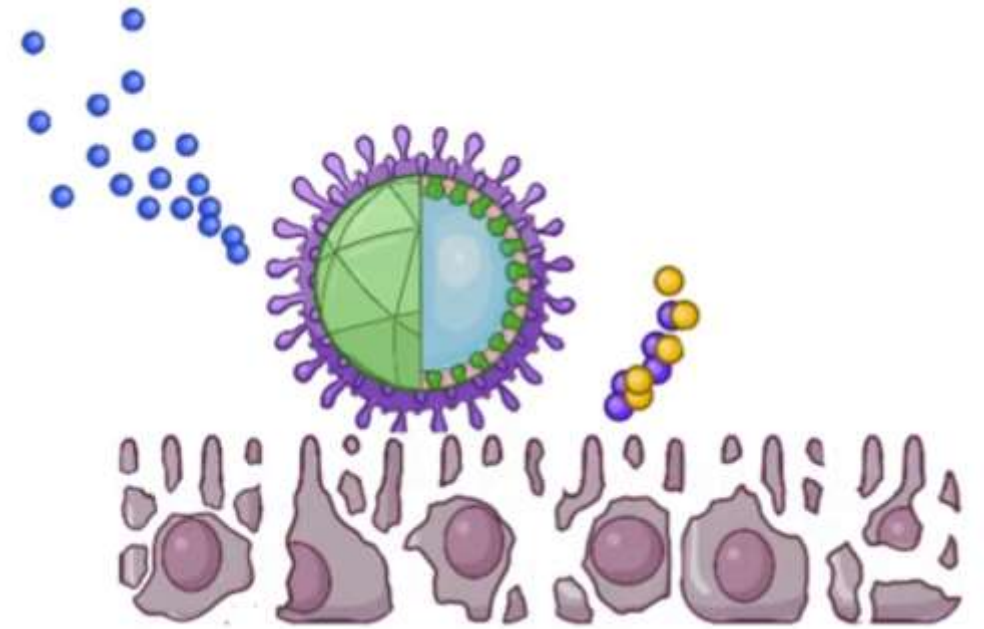
- \* ↓ Activity of digestive enzymes (e.g. **maltase** & **lactase** )
- \* Produces **Non-structural protein 4**  
- Damages cells (apoptosis)

## Brush Border

- ~ surface area → absorb nutrients
- ~ Digestive enzymes produced by enterocytes

## Watery Diarrhea

- \* Malabsorption of nutrients
- \* ↓ brush border enzyme activity
- \* ↑ intestinal secretion



- NSP4: Viral enterotoxin (critical for pathogenesis)
  - Disrupts calcium homeostasis
  - Alters cell permeability
  - Induces chloride secretion
  - Disrupts tight junctions
  - Induces apoptosis of enterocytes



# Rotavirus - Clinical Features

- Incubation period: 1–3 days
- Fever, malaise
- Abdominal pain
- Vomiting and watery diarrhea (First infection typically most severe)
  - Can be severe: > 10 loose, watery stools within 24 hours
  - Usually lasts 3–7 days
- Mild to severe dehydration
- Repeat infections are often less severe than initial infection due to the generation of protective secretory IgA against rotaviral antigens



# Rotavirus - Complications

- Severe dehydration
- Temporary lactose intolerance
  - Secondary to lactase deficiency
- Intussusception (due to vaccine)



# Rotavirus - Diagnosis

- **Diagnosis is usually clinical.**
- **Laboratory diagnosis:**
  - Antigen detection (ELISA, latex agglutination)
  - PCR techniques (Mostly used for epidemiological or research purposes)
  - Electron microscopy (historical)
- **Differential diagnoses**
  - Norovirus infection
  - Bacterial gastroenteritis
  - Food poisoning



# Rotavirus - Treatment

- **Treatment is supportive**
  - Fluid replacement (Oral Rehydration Therapy (ORT))
  - Electrolyte repletion
  - Antiemetics
- Patients with severe gastroenteritis or signs of significant dehydration may require inpatient treatment, including IV fluid resuscitation.



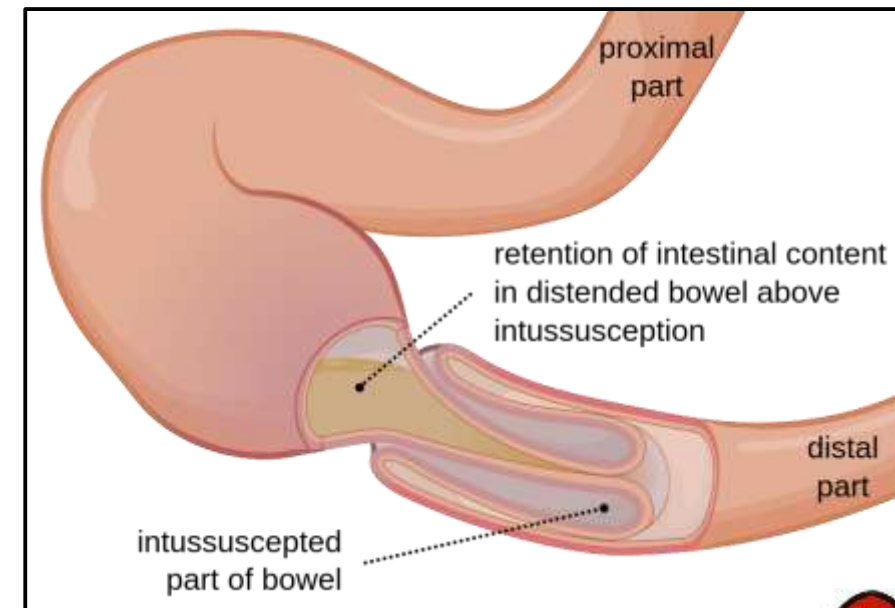
# Rotavirus - Treatment

- For outpatients, educate patients and/or caregivers on:
  - The expected duration of illness (Usually lasts 3–7 days)
  - Return precautions (E.g., signs of significant dehydration, altered mental status, prolonged or atypical symptoms)
  - Prevention of rotavirus transmission
- **Important:** Antidiarrheal medications are **not recommended**
  - Will delay viral clearance from intestines



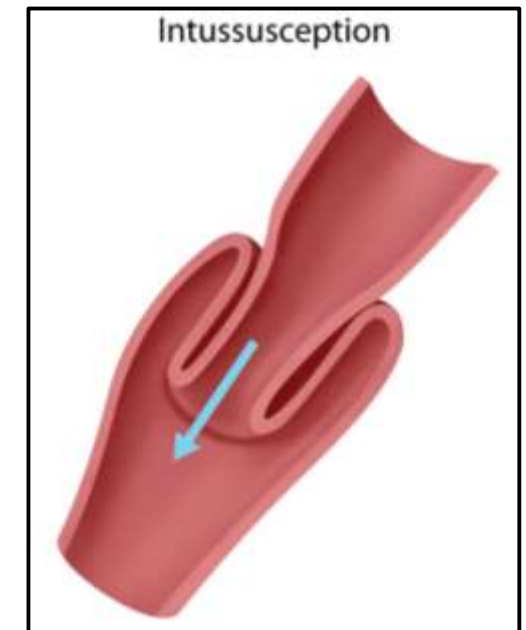
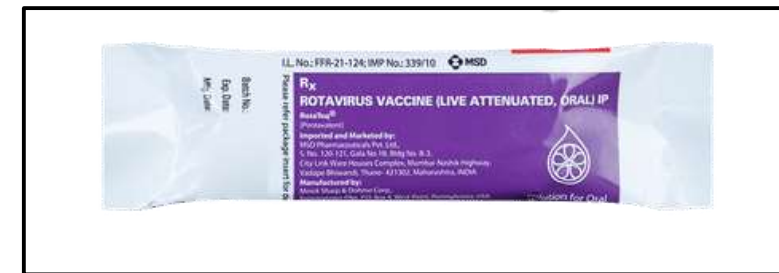
# Rotavirus – Vaccination – first trials ☹️

- **1998:** First rotavirus vaccine (RotaShield) approved by FDA
- **Effectiveness:** 80-100% against severe rotavirus diarrhea
- **Safety Signal:** Increased risk of intussusception detected (~1 case per 5,000 - 10,000 vaccinated infants)
- **1999:** withdrawn from market within 1 year of introduction
- **Impact:** Led to enhanced safety monitoring for subsequent rotavirus vaccines

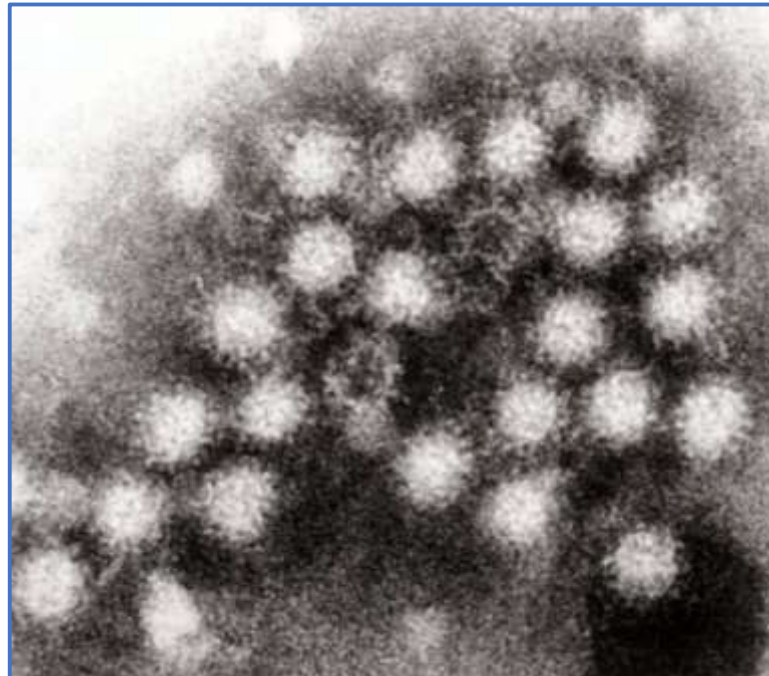


# Rotavirus – Vaccination 😊

- **Available vaccines (oral live attenuated):**
  - Rotarix (monovalent)
  - RotaTeq (pentavalent)
- **Indications:** recommended for all infants unless there is a contraindication
- **Contraindications to rotavirus vaccination**
  - Severe combined immunodeficiency (SCID)
  - History of **intussusception**: Rotavirus vaccine is associated with intussusception.
    - Both Rotarix and RotaTeq can still cause intussusception, but at a much lower rate than RotaShield.



# Norovirus



Transmission electron micrograph of Norovirus virions



# Norovirus

- Previously known as "Norwalk virus" after 1968 outbreak in Norwalk, Ohio
- Named "Norovirus" in 2002 by the International Committee on Taxonomy of Viruses
- **Significance in Clinical Medicine**
  - Leading cause of acute gastroenteritis worldwide
  - High contagiousness
  - Environmental stability



# Norovirus - Virology and Classification

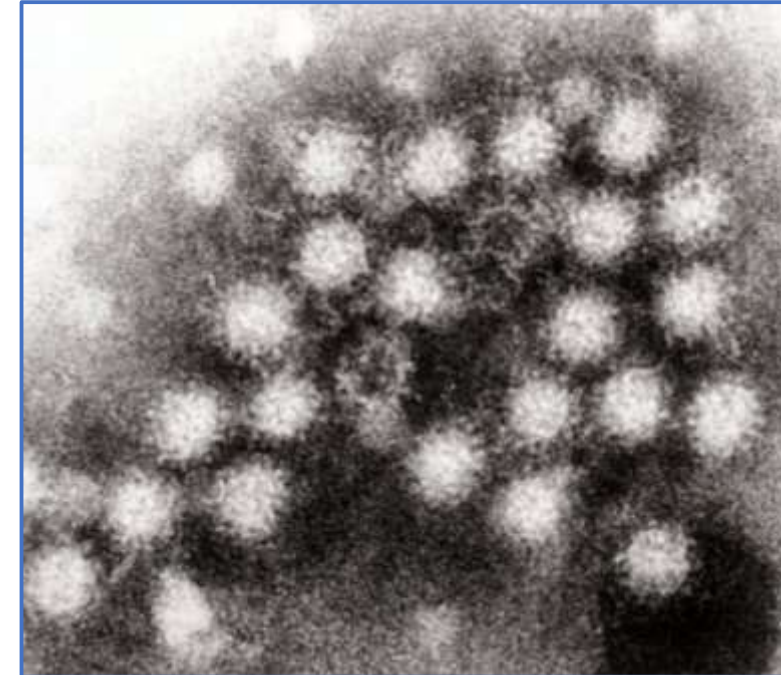
- **Basic Characteristics**

- **Family:** Caliciviridae

- **Structure:**

- Nonenveloped, icosahedral symmetry
    - Single-stranded, positive-sense RNA virus
    - Size: 27-32 nm in diameter
    - Cup-shaped depressions on surface (calyx = cup in Latin)

- Highly stable in environment and Resistant to many common disinfectants
  - Acid-resistant (survives gastric acid)



Transmission electron micrograph of Norovirus virions

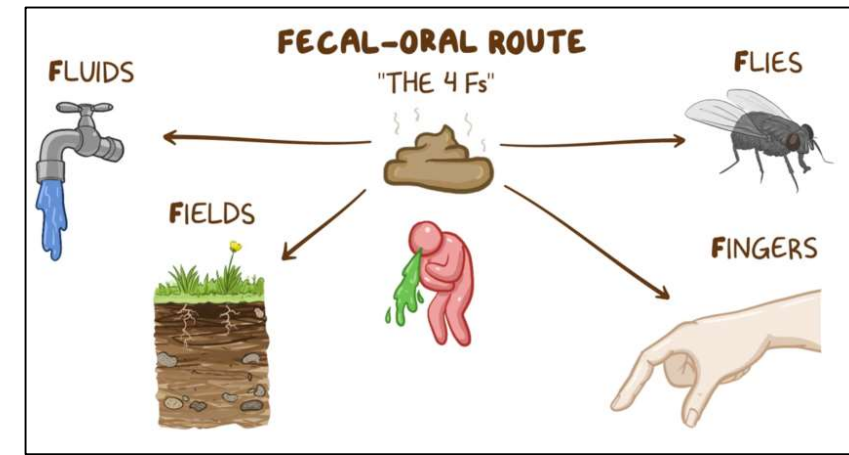


# Norovirus - Epidemiology

- **Peak incidence:** November–March (winter months) → Norovirus infection is also known as "winter vomiting disease."
- Community outbreaks (in nursing homes, hospitals, preschools, cruise ships, etc.) are common → Due to the close proximity of individuals
- Most common cause of:
  - Adult gastroenteritis (Over 50% of cases are attributed to norovirus)
  - Severe acute gastroenteritis in children younger than 5 years of age



# Norovirus - Transmission



- **Fecal-oral route** through contaminated food or water, person-to-person contact, via airborne droplets, and contact with contaminated surfaces
- **The virus is highly virulent** → Less than 18 viral particles are needed to cause infection.
- Individuals are highly infectious during the acute phase and 24–72 hours following onset of symptoms



# Norovirus – Clinical features

- Incubation period: 12–48 hours
- Nausea and acute-onset vomiting
- Watery, non-bloody diarrhea
- Abdominal cramps
- Fever
- Symptoms resolve after 48–72 hours.

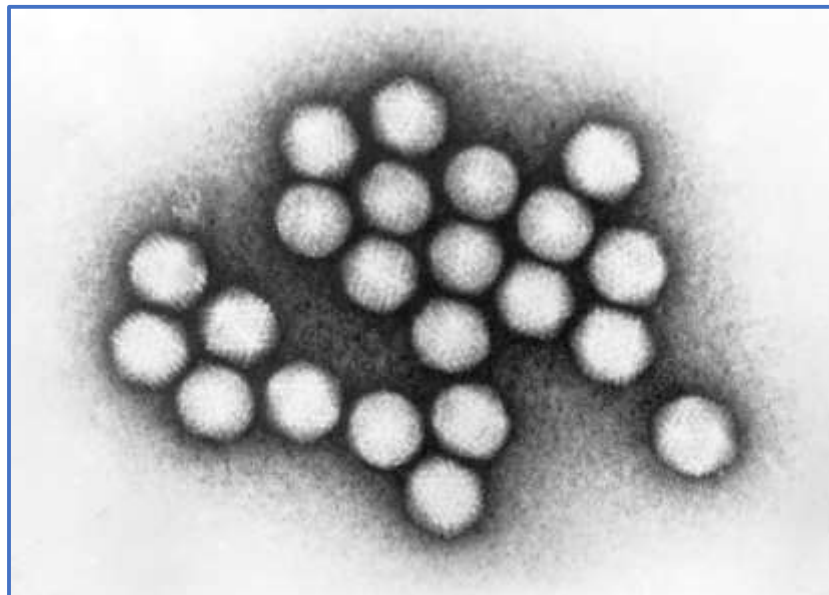


# Norovirus – Diagnosis & Treatment

- Diagnosis is usually clinical
- Laboratory studies
  - Reverse transcription-quantitative PCR (RT-qPCR): preferred
  - Multiplex assays: allow for detection of multiple pathogens
  - Others (not routinely used in clinical practice): e.g., enzyme immunoassays
- Treatment:
  - Same approach as for rotavirus infection
  - No vaccine (in 2025, there is one under clinical trials)



# Adenovirus

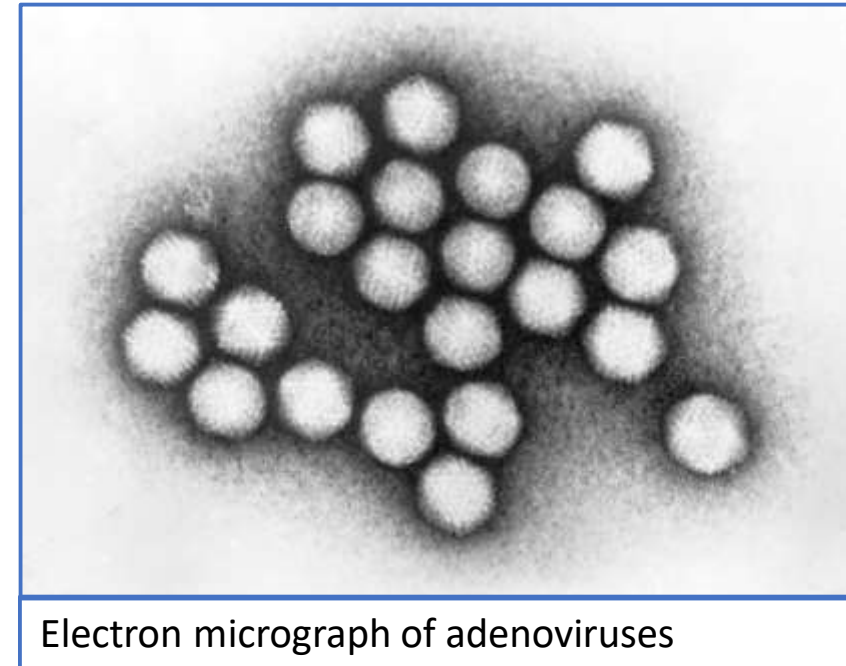


Electron micrograph of adenoviruses



# Adenovirus – Historical Context

- First isolated in 1953 from adenoid tissue (hence the name)
- Initially recognized as respiratory pathogens
- Enteric adenovirus types identified in the 1970s
- Now recognized as important causes of gastroenteritis, especially in children



# Adenovirus – Structure & characteristics

- Non-enveloped ds DNA virus.
- Infects mucoepithelial cells of respiratory, GI and GU tracts
- Enter via epithelium, replicate and spread to lymphoid tissue.
- Stable in the environment and in GI tract.
- Relatively resistant to disinfection (nonenveloped)



# Adenovirus – Structure & characteristics (cont.)

- Viral shedding in faeces may persist for years.
- Sub-grouped into 7 groups A-G (according to DNA sequence), with 60 serotypes in all the groups.
- Certain serotypes are associated with certain infections e.g. types 1-4, 7, 14 and 21 are associated with respiratory infections, **types 40 & 41 associated with Gut infection**, types 8, 19 and 37 associated with epidemic keratoconjunctivitis



# Adenovirus –Clinical Significance

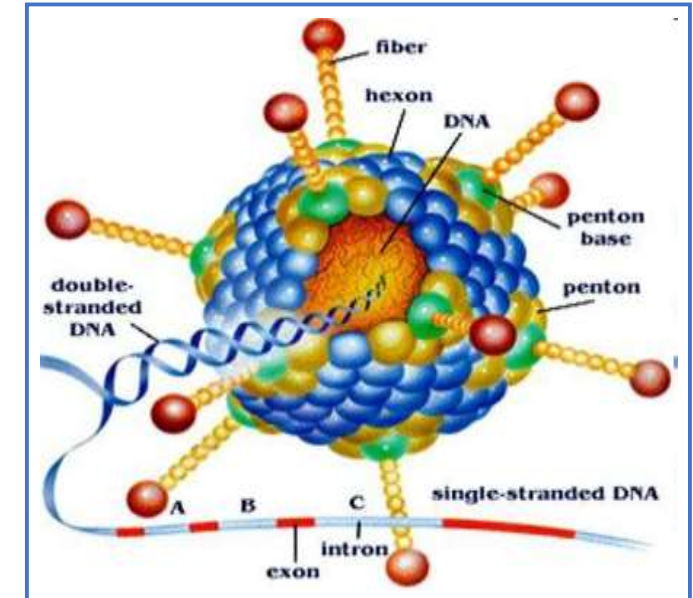
- Diverse clinical manifestations:
  - Respiratory infections
  - Conjunctivitis
  - Gastroenteritis
  - Hemorrhagic cystitis
  - Meningoencephalitis
- Third most common viral cause of gastroenteritis in children (after rotavirus and norovirus)



# Adenovirus – Virology and Classification

- **Basic Characteristics**

- Family: Adenoviridae
- Structure:
  - Nonenveloped, icosahedral capsid
  - Double-stranded DNA genome
  - Size: 70-90 nm in diameter
  - Fiber projections from each vertex



# Adenovirus – Epidemiology

- **Global Impact**

- Enteric adenoviruses account for 5-15% of viral gastroenteritis
- Second most common viral cause of diarrhea in children <2 years in many regions
- Estimated 5-15% of diarrheal hospitalizations worldwide

- **Population Distribution**

- Peak incidence: 6-24 months of age. Most cases in children <5 years

- **Outbreaks reported in:**

- Daycare centers, Pediatric hospitals, Swimming pools, Military facilities

- **Transmission**

- Fecal-oral route, Respiratory route (less common for enteric types)



# Adenovirus – Clinical Presentation

- **Incubation Period:** 3-10 days (longer than other viral gastroenteritis)
- **Cardinal Symptoms of Enteric Adenovirus Infection**
  - Diarrhea: Watery, non-bloody, Prolonged duration (5-12 days)
  - Vomiting
  - Fever (Low to moderate): Present in 50-60% of cases
- **Associated Symptoms**
  - Abdominal pain/cramps, Anorexia, Malaise, Weight loss
  - **Respiratory symptoms in 30-50% of cases:**
    - Rhinorrhea, Pharyngitis, Cough, Conjunctivitis
- **Bowel intussusception**



# Adenovirus – Diagnosis & Treatment

- Clinical Diagnosis
- Lab methods
  - Enzyme immunoassay (EIA)
  - Electron microscopy
  - PCR (preferred method)
- Treatment & prevention:
  - Same approach as for rotavirus infection
  - There is no vaccine for adenovirus 40/41.
  - **Note:** For respiratory infections, a vaccine is available for military people and not the civilians.
    - The vaccine is given orally and it contains 3 serotypes, 4, 7 and 21 (but not for 40 & 41)



Feature	Rotavirus	Norovirus	Adenovirus
<b>Incubation Period</b>	1-3 days	12-48 hours	3-10 days
<b>Duration of Illness</b>	3-8 days	24-72 hours	5-12 days
<b>Vomiting</b>	+++ (prominent, often precedes diarrhea)	+++ (prominent feature)	+ (mild to moderate)
<b>Diarrhea</b>	+++ (watery, may have mucus)	++ (watery)	+++ (watery, prolonged)
<b>Abdominal Pain</b>	++ (moderate)	++ (moderate)	++ (moderate)
<b>Respiratory Symptoms</b>	Rare	Rare	<b>Common (30-50% of cases)</b>
<b>Dehydration Risk</b>	High	Moderate	Moderate





Thank you





- USMLE Questions

- Step 1 – ID: 1498
- Step 1 – ID: 1497
- Step 1 – ID: 15215
- Step 2 – ID: 17748
- Step 2 – ID: 105673
- Step 2 – ID: 8951

