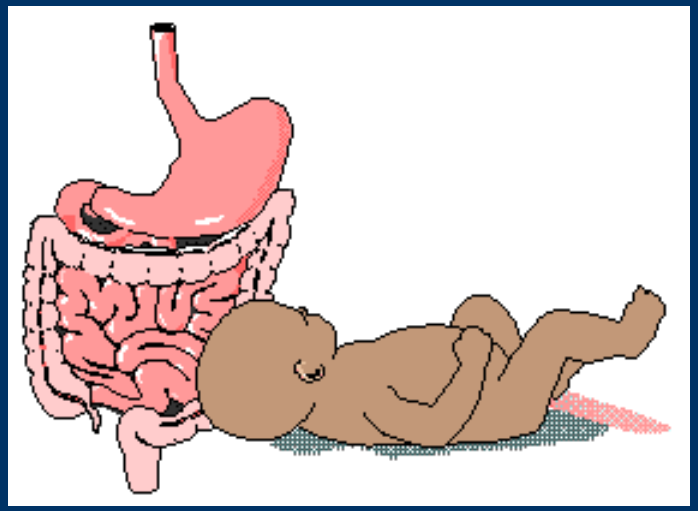
Gastrointestinal Viruses



What is viral gastroenteritis?

- Viral gastroenteritis is inflammation of the lining of the stomach, small intestine, and large intestine. Several different viruses can cause viral gastroenteritis, which is highly contagious and extremely common. Viral gastroenteritis causes millions of cases of diarrhea each year.
- Anyone can get viral gastroenteritis and most people recover without any complications, unless they become dehydrated.

Viral Gastroenteritis

- It is thought that viruses are responsible for up to 3/4 of all infective diarrhoeas.
- Viral gastroenteritis is the second most common viral illness after upper respiratory tract infection.
- In developing countries, viral gastroenteritis is a major killer of infants who are undernourished. Rotaviruses are responsible for half a million deaths a year.
- Many different types of viruses are found in the gut but only some are associated with gastroenteritis.

Associated with gastroenteritis

Major Viruses

1. **Rotavirus**
2. **Enteric adenoviruses**
3. **Noroviruses :**
    a. **Norwalk-like viruses**
    b. **Calicivirus**
    c. **Astrovirus**

Noroviruses

Norwalk-like viruses

Caliciviruses

Astroviruses

other viruses

Other viruses (minor):

- Coronaviruses
- Parvoviruses
- Pestiviruses
- Toroviruses

Found in the gut, not normally associated with gastroenteritis

- Polio
- Coxsackie A
- Coxsackie B
- Echo
- Enteroviruses 68-71
- Hepatitis A
- Hepatitis E
- Adenoviruses 1-39
- Reoviruses

Found in the gut as opportunistic infection

- CMV
- HSV
- VZV
- HIV

Gastrointestinal Viruses

Virus	Genome	Typical disease	incubation	Duration
Rotaviruses: Group A, B, C	ds-segmented RNA	Major cause of diarrhea in children	1-3 days 24-56 h	5-8 days 3-7 days
Caliciviruses Norwalk agents	ssRNA	Infects adults and children Epidemic viral gastroenteritis	1-3 days 18-24 h	1-3 days 12-48 h
EAd 40,41	Linear dsDNA	diarrhea in children	7-8 days	8-12 d
Astrovirus	+ssRNA	Infects mainly children and elderly	1-4 days	1-4 d

Gastrointestinal Viruses

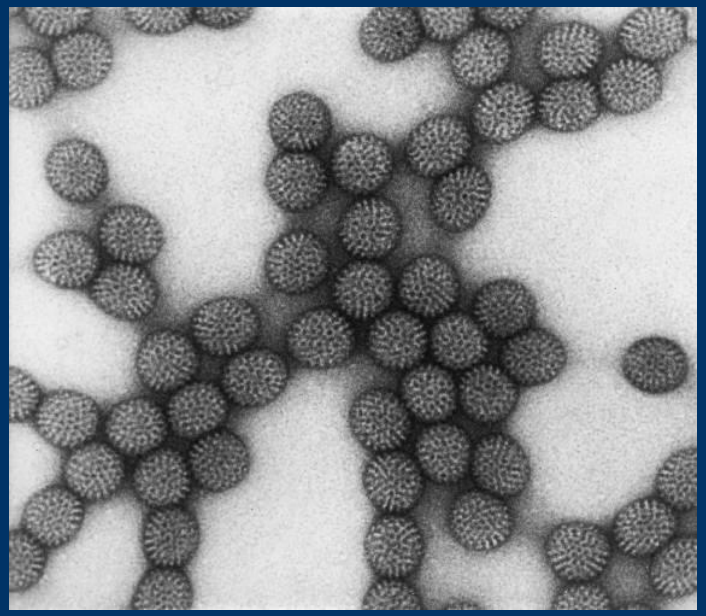
- Infants:

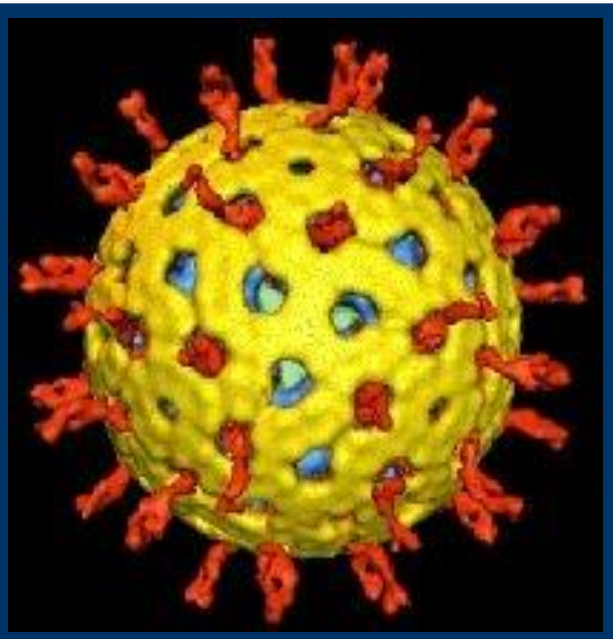
Rotavirus A; Adenovirus 40,41; Coxsackie A24 virus

- Infants, children, and adults

Norwalk virus; Calicivirus; Astrovirus; Rotavirus B; Reovirus.

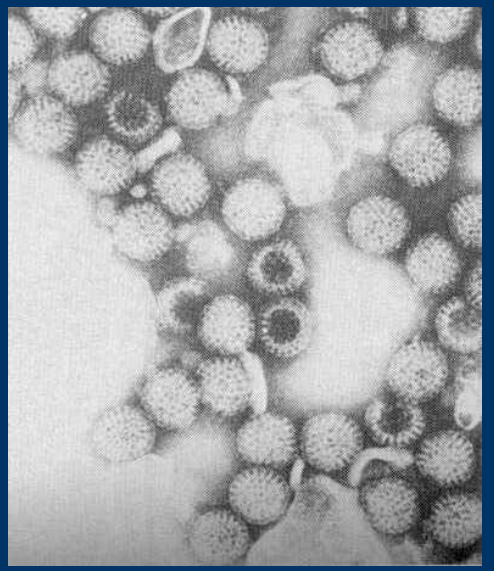
Human Rotavirus





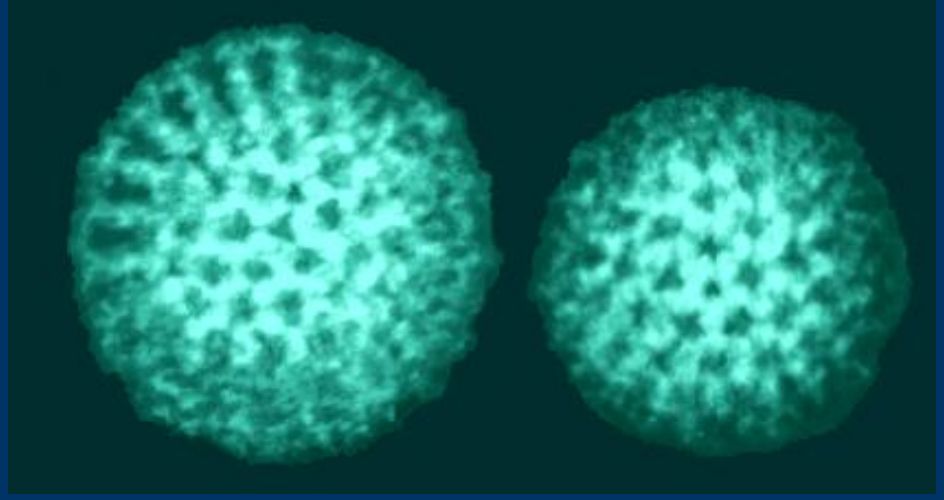
Rotavirus

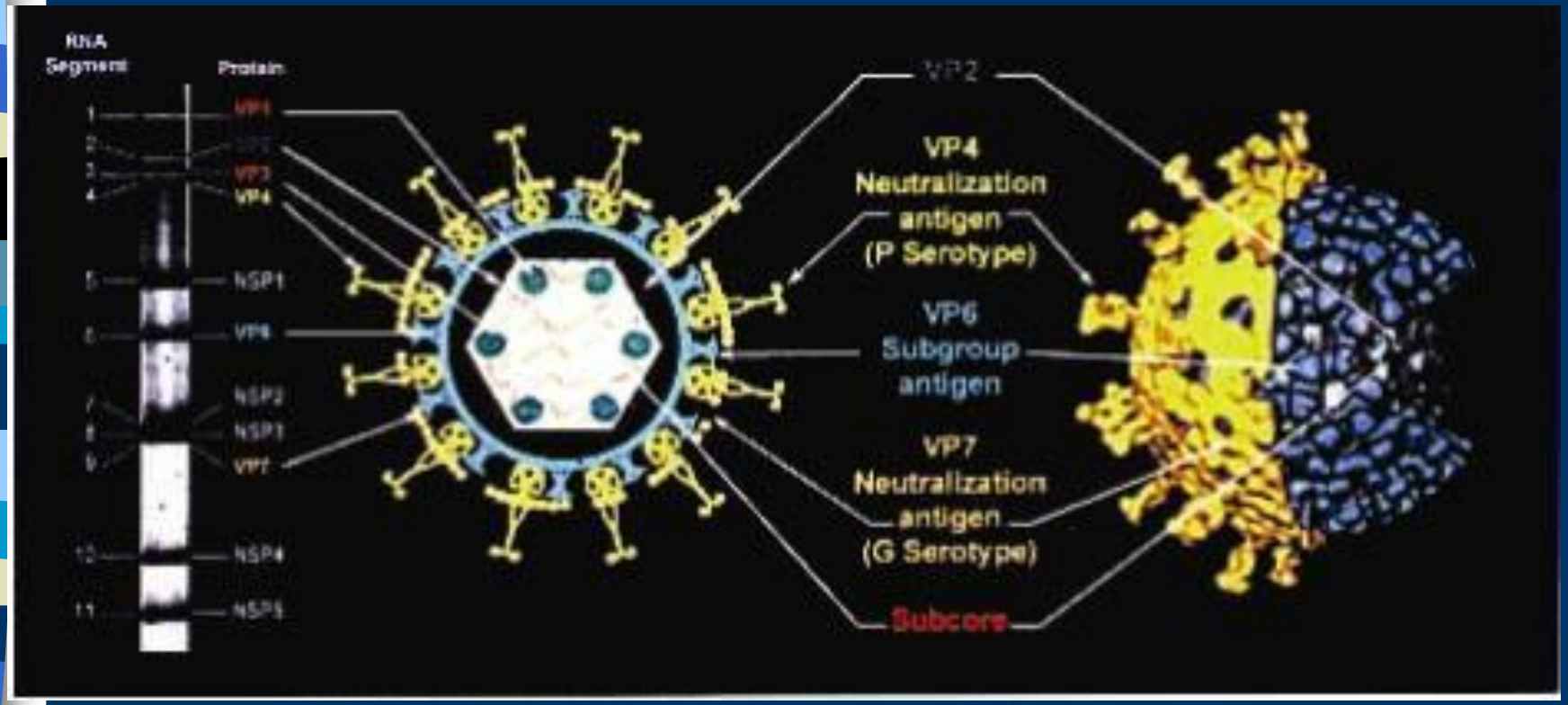
- First isolated in 1973 from children with diarrhea
- EM identification from duodenal biopsies
- Human and animal strains



Important Characteristics

1. 70 nm round, double shelled, enclosing a genome of 11 segments of double stranded RNA.
2. EM appearance of a wheel with radiating spokes
3. Icosahedral symmetry
4. Non-enveloped virus




RNA Segment
Protein
VP1
VP2
VP3
VP4
NSP1
VP6
NSP2
NSP1
VP7
NSP4
NSP5
VP2
VP4
Neutralization
antigen
(P Serotype)
VP6
Subgroup
antigen
VP7
Neutralization
antigen
(G Serotype)
Subcore

Groups of Rotaviruses

- Seven serological groups have been identified (A-G), three of which (groups A, B, and C) infect humans .

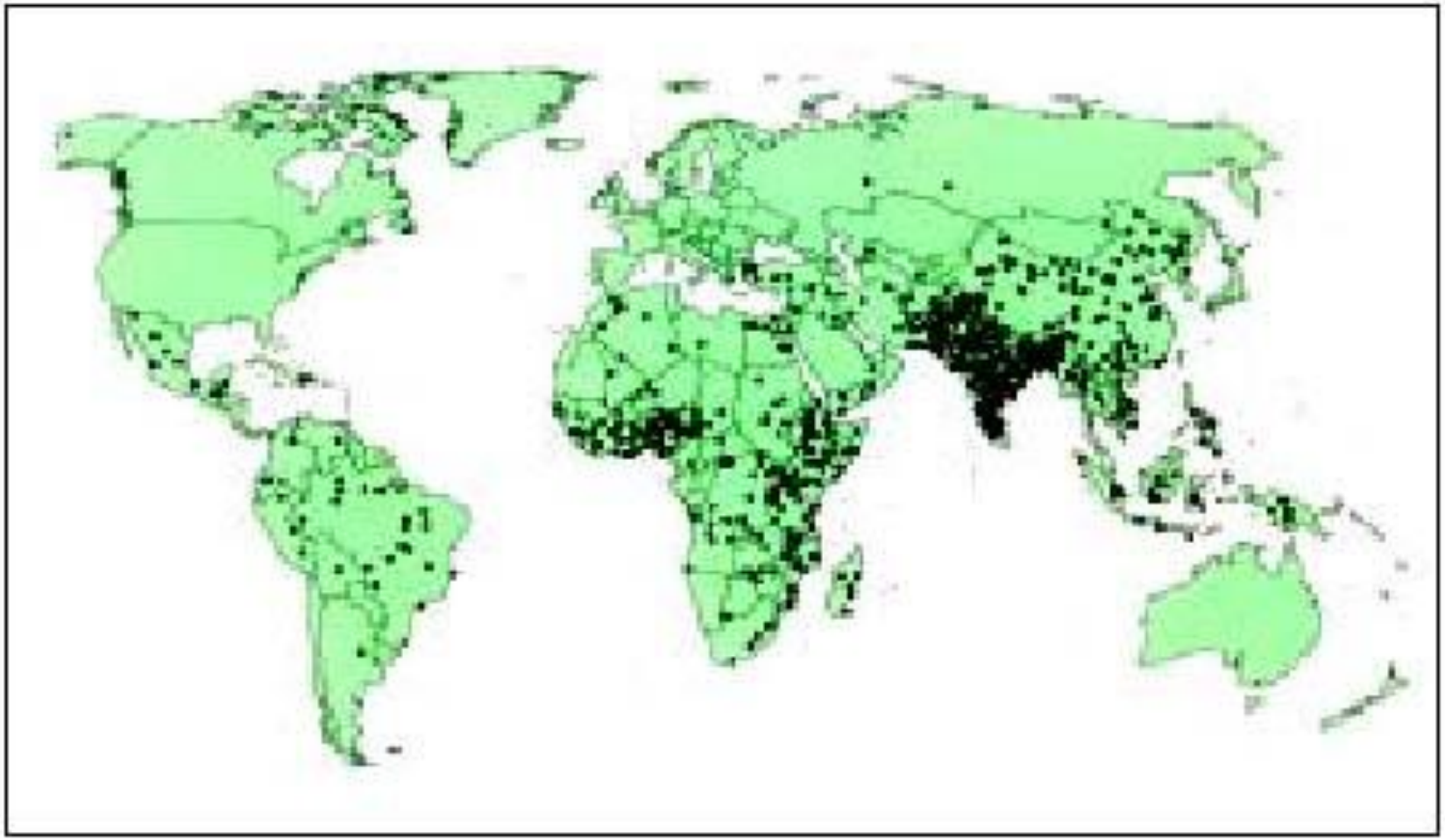
- **Group A:** subtypes 1, 2, 3, 4 (main human pathogens) (Further 7 subtypes) also infect animals (monkey, calf, mouse)

- **Group B:** Infects pigs and rats, Found to cause extensive outbreaks in China in past decade

- **Group C:** Infects Pigs (Occasionally Man)

Pathogenesis

- Essentially an ingestion disease (faecal-oral route)
- *Incubation* is short : 1 to 3 days
- *Illness:* Sudden onset watery diarrhoea, with or without vomiting. May last up to 6 days (or longer if immunocompromised). The disease is self limiting.
- *Complications:* Dehydration may result, this can be severe and life threatening in young children.



Epidemiology - Worldwide

- Millions are affected
- 600,000-850,000 deaths/year
- A major cause of diarrhea-associated hospitalizations
- Seroprevalence studies show that antibody is present in most by age 3y.

Epidemiology

Differences in Groups

- Group A infections are most common
- Group B has been associated with outbreaks in adults in China
- Group C is responsible for sporadic cases of diarrhea in infants around the world

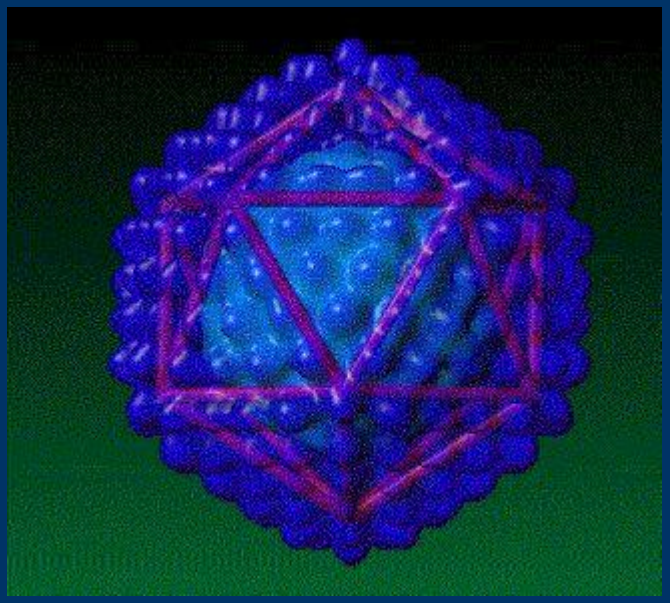
Immunity: sIgA

Lab. Diagnosis

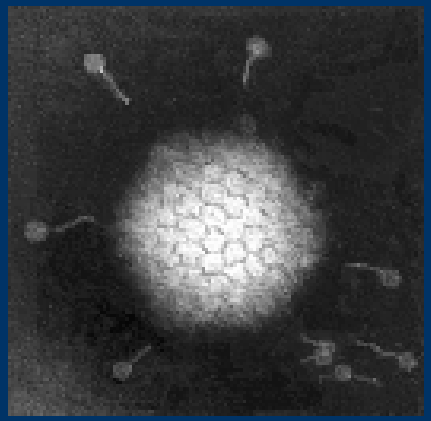
- IEM,
- Cell culture, (monkey kidney cells)
- PAGE of RNA segments,
- PCR
- Latex agglutination (for Group A rotavirus)
- ELISA
- Serology for epidemiologic studies

Gastroenteritis

Due To Enteric Adenoviruses



Enteric Adenoviruses



- Naked DNA viruses, 75 nm in diameter.
- Fastidious enteric adenovirus types 40 and 41 are associated with gastroenteritis. Some cases due to types 31, 3, 7
- Associated with cases of endemic gastroenteritis, usually in young children and neonates. Can cause occasional outbreaks.
- Possibly the second most common viral cause of gastroenteritis (7-15% of all endemic cases).
- Similar disease to rotaviruses
- Most people have antibodies against enteric adenoviruses by the age of three.

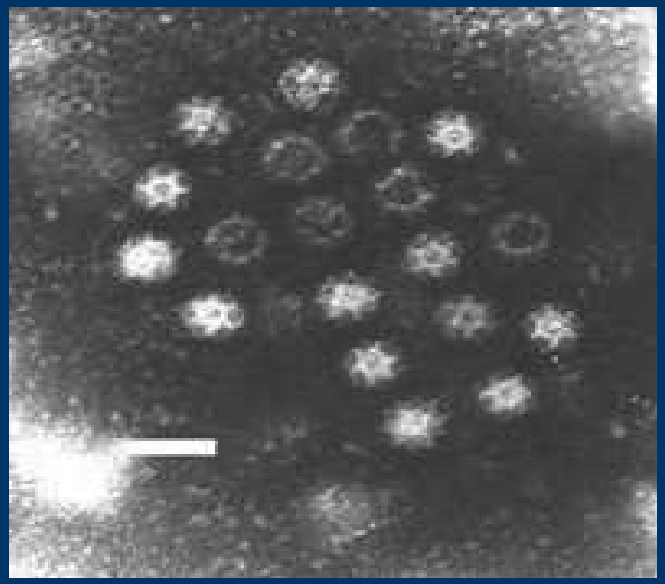
Adenovirus

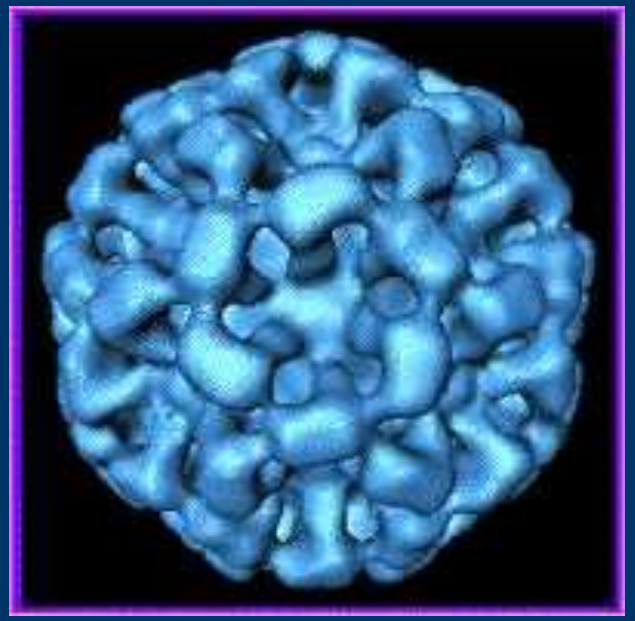
- Adenovirus mainly infects children younger than 2 years old. Symptoms typically appear 8 to 10 days after exposure and last 5 to 12 days. Adenovirus infections occur year-round.

Diagnosis- Enteric adenoviruses

- Isolation requires special media-Graham 2
- Antigens detection of adenovirus in faeces by ELISA for rapid detection is available
- EM

Human Caliciviruses

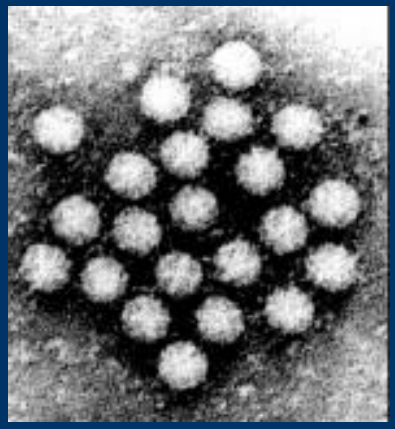




Human Caliciviruses (HuCV)

- Belong to Family *Caliciviridae*
- Non-enveloped RNA viruses with ss RNA
- 27-35 nm in size
- Contain a single capsid protein
- Genomic analysis divides it into 4 groups
- Human Caliciviruses belong to 2 genera

Caliciviruses



- Associated mainly with epidemic outbreaks of gastroenteritis, although occasionally responsible for endemic cases.
- Like Norwalk type viruses, vomiting is the prominent feature of disease.
- Majority of children have antibodies against caliciviruses by the age of three.
- Diagnosed by electron microscopy only, often difficult to diagnose because of small size.

Classification Of HuCV

NLV (Norovirus)

- Norwalk virus
- Hawaii virus
- Snow Mountain virus
- Montgomery county virus
- Taunton (England)

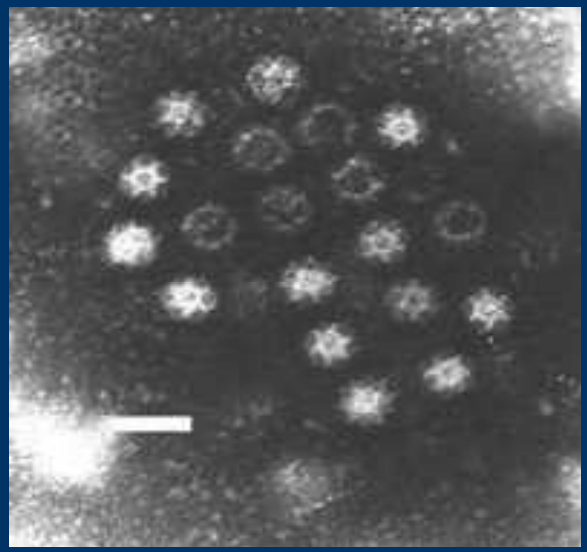
SLV (Sapovirus)

- Sapporo virus
- Manchester virus
- Houston/86
- London/92

Morphology of HuCV- typical

- Typical morphology
- 32 cup-like depressions
- EM appearance of “Star of David”

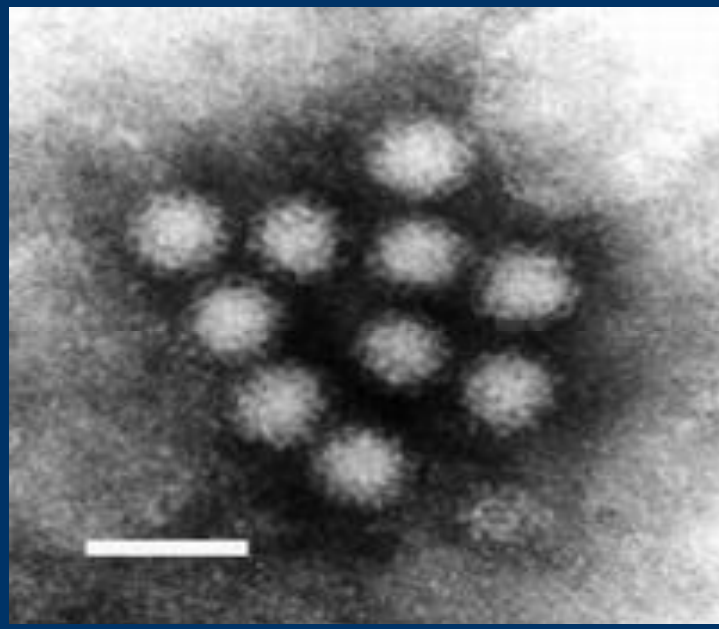
E.g.- Sapporo-like viruses



Morphology of HuCV- atypical

- Atypical morphology
- Smooth surface
- Small Round Structured viruses

E.g.- Norwalk-like viruses



Epidemiology-Noroviruses

- Worldwide distribution
- >23 million cases/year in the U.S.
- Major cause of foodborne outbreaks of GE
- Most people have had infections by age 4 years (by seroprevalence studies)

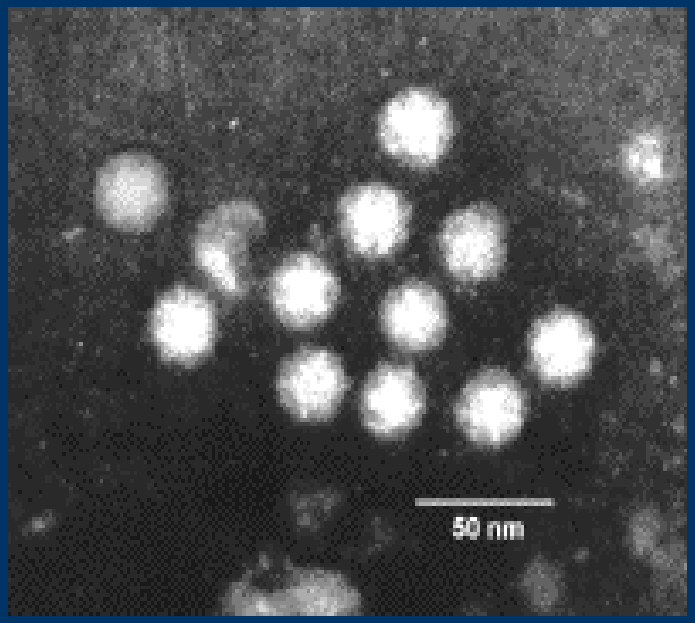
Norwalk-like Viruses

- Small RNA viruses, with ragged surface, 35 nm in diameter, now classified as caliciviruses.
- Always associated with epidemic outbreaks of gastroenteritis, adults more commonly affected than children.
- Associated with consumption of shellfish and other contaminated foods. Aerosol spread possible as well as faecal-oral spread.
- Also named "winter vomiting disease", with vomiting being the prominent symptom, diarrhoea usually mild.
- Antibodies acquired later in life, in the US, only 50% of adults are seropositive by the age of 50.

Diagnosis- Human Caliciviruses

- Specimen- stool , vomitus, environmental swabs, [not yet on foods]
- Immune EM
- RT-PCR in state public health labs.
- Serology for epidemiologic purposes

Human Astrovirus



Astrovirus

- Described in relation to an outbreak of gastroenteritis in 1975
- Detected by EM
- Immunologically distinct from Human Caliciviruses
- Belong to family *Astroviridae*
- 8 human serotypes are known

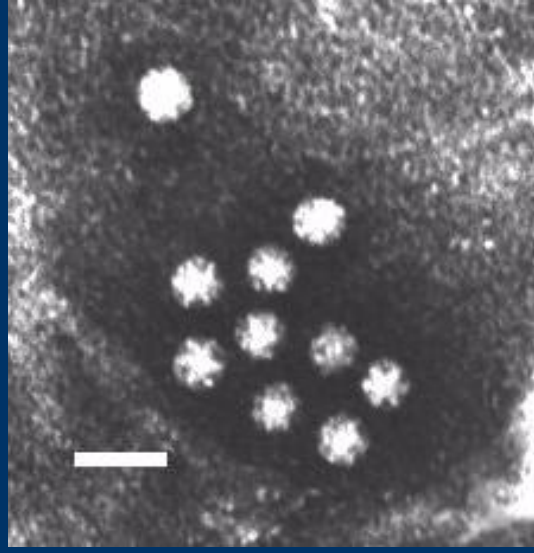
Astrovirus- structure

- Small ss RNA virus
- Non-enveloped
- 27-32nm in size
- Round with an unbroken, smooth surface
- EM appearance of a 5 or 6 pointed star *within* smooth edge
- Contain 3 structural proteins

Astrovirus - Epidemiology

- Worldwide
- Mainly in children <7 years of age.
- Transmission person-to-person via fecal-oral route
- Outbreaks due to fecal contamination of sea-food or water

Astroviruses



- Small RNA viruses, named because of star-shaped surface morphology, 28 nm in diameter.
- Associated with cases of endemic gastroenteritis, usually in young children and neonates. Can cause occasional outbreaks.
- Responsible for up to 10% of cases of gastroenteritis.
- Similar disease to rota and adenoviruses.
- Most people have antibodies by the age of three.

Diagnosis

- EM (virus shed in stool in great numbers)
- EIA
- RT-PCR

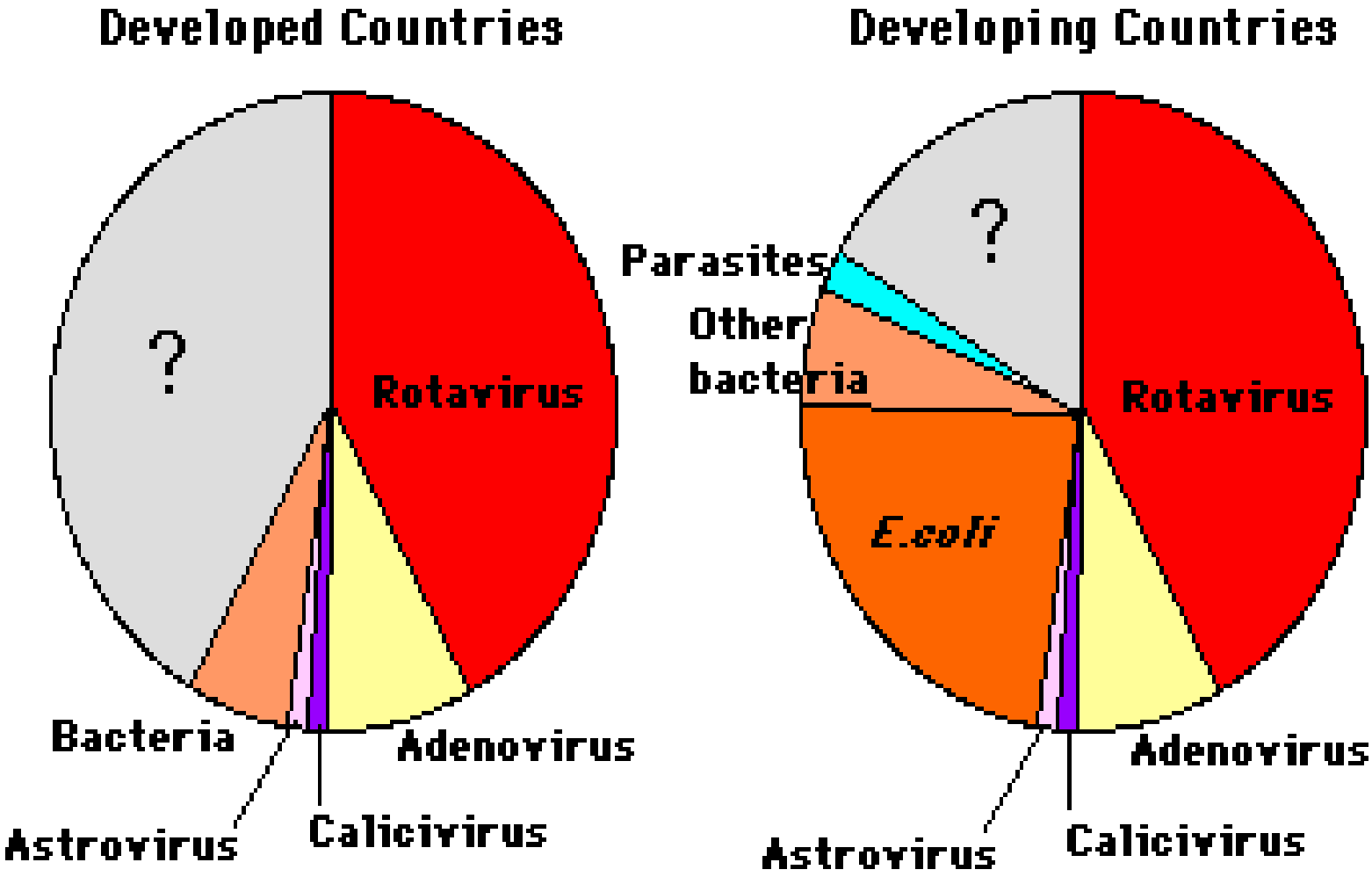
Other Possible Diarrhoeal Viruses

Coronaviruses

- RNA viruses with a crown-like appearance
- Not convincing associated with gastroenteritis at present

Small Round Viruses

- Small virus-like particles with a smooth surface, 22-28nm in diameter
- May possibly be parvoviruses, enteroviruses, or cubic bacteriophages
- Occasionally seen in the faeces of endemic or epidemic cases of gastroenteritis


Developed Countries
?
Rotavirus
Bacteria
Adenovirus
Astrovirus
Calicivirus
Developing Countries
?
Parasites
Other bacteria
E.coli
Rotavirus
Adenovirus
Astrovirus
Calicivirus

Thank you for your attention