Enteroviruses
Which are transient inhabitants of the human alimentary tract and may be isolated from the throat or lower intestine. Four types (68-72)

1- Enterovirus 68: Isolated from respiratory tract of children with bronchiolitis or pneumonia.

2- Enterovirus 70: Acute hemorrhagic conjunctivitis's.

3- Enterovirus 71: Isolated from patients with meningitis, encephalitis and paralysis resembling poliomyelitis which cause CNS disease and diarrhea.

4- Enterovirus 72: Hepatitis A virus.

Echoviruses
Enteric Cytopathogenic Human Orphan (ECHO) viruses
- Including 33 serotypes (name orphan due to not associated with any known disease, the first isolation in 1950.
- In contrast to coxsakie viruses they are not pathogenic for mice, unlike polioviruses; they do not cause diseases in monkeys.
- Incubation period 2-9 days.
- Which cause opportunistic infection and disease like
  A- Aseptic meningitis.
  B- Rash, common in young children.
  C- Conjunctivitis.
  D- Muscle weakness and spasms.
  E- Infantile diarrhea.
  F- Congenital and neonatal disease.
  G- Cardiac disease.
**Rhinoviruses** are isolated chiefly from the nose and throat (Rhino means nose).
- Consist of more than 100 serotype.
- The virion of both groups consists of a capsid shell of 60 submits, each of four protein [VP1-VP4] arranged in icosahedral symmetry around the ssRNA positive sense genome.
- Incubation period 2-4 days.

**Rhinoviruses**
- Rhino from Greek means nose, are isolated chiefly from the nose, conjunctiva, throat, rather than the lower respiratory tract (they are acid labile, they are killed by gastric acid when swallowed, this explains why they do not infect the gastrointestinal tract, unlike the enteroviruses.
- Consist of more than 100 serotype.
- The virion consists of a capsid shell of 60 submits, each of four protein [VP1-VP4] arranged in icosahedral symmetry around the ssRNA positive sense genome.

**Mode of transmission**
- Direct, Person to person via aerosols of respiratory droplets.
- Indirect mode, in which respiratory droplets are deposited on the hand or on a surface such as table. Or by fingers to the nose or eyes.
- Spread is highest in the fall, winter early spring.

**Summary of replication cycle**
They replicate better at 33°C than 37°C. Replication is similar to that of poliovirus, but the different in the cell surface receptor, for rhinoviruses is ICAM-1(Intercellular adhesion molecule-1 an adhesion protein located on the surface of many types of cells like found on the APC which is known to interact with lymphocyte functional associated antigen-1).
**Clinical findings**
- Incubation period 2-4 days, are associated with a group of acute, a febrile upper respiratory disease usually identified as the common cold.

**Laboratory diagnosis**
Isolation the virus from nasal secretions in the cell culture, serological test is not done.

**Treatment and prevention**
- No specific antiviral therapy is available; vaccines appear impractical because of the large number of serotype.
- Paper tissues impregnated with a combination of citric acid (which inactivates rhinoviruses) and sodium lauryl sulfate (a detergent that inactivates enveloped viruses such as influenza virus and respiratory syncytial virus).
- High doses of vitamin C have little ability to prevent rhinoviruses (due to acid labile).

**Reoviruses**
Is an acronym for Respiratory Enteric Orphan, when the virus was discovered, it was isolated from the respiratory and enteric tracts and was not associated with any disease. The family of reoviridae is divided into twelve genera, rotavirus is the most important cause of infantile gastroenteritis around the world, and acute gastroenteritis is a very common disease with significant public health impact.

**Classification**
Family Reoviride includes genus Rotavirus, Reovirus and Colorado Tick Fever virus

**Rotavirus**
Rotavirus was first identified by electron microscopy in 1973 from duodenal biopsies of children with diarrhea and was later detected in stool samples of human and animal. Electron microscopic appearance of a wheel with radiating spokes (Latin, Rota =wheel).
**Important properties of Rotavirus.**

- Medium in size measuring about 60-80nm in diameter.
- Double stranded linear, segmented RNA genome (10-11 segments).
- Surrounded by double-layer icosahedral capsid (outer capsid, inner capsid) without an envelope.
- Replication occurs in cytoplasm, virions not completely uncoated.
- Virus is acid-labile but rather stable in the environment. It is susceptible to disinfection with 95% ethanol, ‘Lysol’ and formalin.

![Rotavirus structure](image)

**Proteins.** Each gene codes for one protein, except genes 9, which codes for two. There are six viral proteins (VPs) that form the virus particle (virion). These structural proteins are called VP1, VP2, VP3, VP4, VP6 and VP7. In addition to the VPs, there are six nonstructural proteins (NSPs) that are only produced in cells infected by rotavirus. These are called NSP1, NSP2, NSP3, NSP4, NSP5 and NSP6.

![Rotavirus genome structure](image)
Types of rotavirus

There are five species of rotavirus, referred to as A, B, C, D and E. Humans are primarily infected by species A, B and C, most commonly by species A. All five species cause disease in other animals. Within rotavirus A there are different strains, called serotypes. As with influenza virus, a dual classification system is used based on two proteins on the surface of the virus. The glycoprotein VP7 defines the G serotypes and the protease-sensitive protein VP4 defines P serotypes. Because the two genes that determine G-types and P-types can be passed on separately to progeny viruses, different combinations are found.

Mode of transmission

Rotavirus is transmitted by the fecal-oral route; infection occurs worldwide and by age 6 years most children have antibodies to at least one serotype.

Summary of replication cycle

Rotavirus attach to the cell surface at the site of B-adrenergic receptor, after entry of the virion the cell, the RNA-dependent RNA polymerase synthesizes mRNA from each of the segments within the cytoplasm, the mRNA are translated into the corresponding number of structural and non-structural proteins. One of these an RNA polymerase synthesizes minus strands that will become part of the genome of the progeny virus , capsid proteins form an incomplete capsid around the minus strands and then the plus strands of the progeny segments are synthesized, the virus is released from the cytoplasm by lysis of the cell.
Clinical features

Is the most common cause of severe diarrhea among infants and young children. Nearly every child in the world has been infected with rotavirus at least once by the age of five. Immunity develops with each infection, so subsequent infections are less severe; adults are rarely affected.

- Incubation period is 1-4 days, lasting 3-9 days, but longer in malnourished and immune deficient individuals
- Low-grade fever and some time can be high grade (>102°F in 30%)
- Nausea, vomiting and watery diarrhoea. Once a child is infected by the virus, there is an incubation period of about two days before symptoms appear precede diarrhea.
- Rotavirus replicates in the mucosal cells of the small intestine, resulting in the excess secretion of fluids and electrolytes into the bowel lumen, the consequent loss of salt, glucose.
- Necrotizing enterocolitis and hemorrhagic gastroenteritis is seen in neonates.
**Diagnosis**

♦ Electron microscopy-for detection of rotavirus in stool
♦ Culture- group A rotaviruses can now be cultured in monkey kidney cells.
♦ Used latex agglutination for rapid diagnosis. Several kits are commercially available.
♦ Antigen-detection in stool by ELISA (uses a monoclonal antibody) or by radioimmunoassay
♦ Molecular assay as RT-PCR.

**Treatment**

Supportive-rehydration and vaccine

**Prevention of spread**

♦ Hand washing- partly effective
♦ Alcohol hand gels
♦ Disinfection of surfaces, toilets, toys etc.