

HUMAN ROTAVIRUS

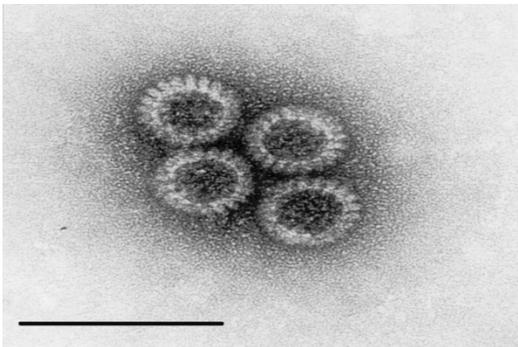
PATHOGEN SAFETY DATA SHEET / INFECTIOUS SUBSTANCES

INFECTIOUS AGENT

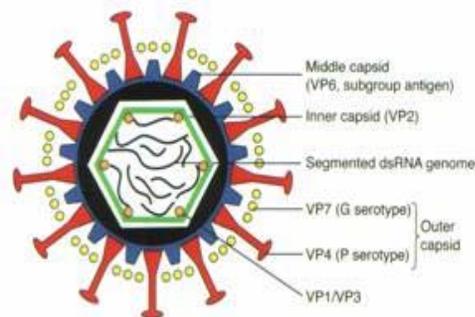
NAME: *Human rotavirus*

SYNONYM OR CROSS REFERENCE: HRV, Human reovirus-like agent, infantile gastroenteritis virus, sporadic viral gastroenteritis, severe viral gastroenteritis of infants and children, non-bacterial gastroenteritis of infancy, and rotaviral enteritis.

CHARACTERISTICS: *Human rotavirus* is classified as a member of genus *Rotavirus* within the family *Reoviridae*. Rotavirus is non-enveloped, with a diameter of about 70 nm, and has a wheel-like appearance. It has an icosahedral shaped, three-layered capsid shell. The viral genome consists of 11 segments of double-stranded RNA (dsRNA). Rotavirus can be classified into seven major serogroups (A - G). Groups A, B, and C infect both humans and animals, while the rest have only been found in animals to date. Group A has been established as the most common rotavirus responsible for causing human illness.



Electron microscope micrograph of human rotavirus¹⁾



Schematic representation of the rotavirus virion²⁾

HAZARD IDENTIFICATION

PATHOGENICITY/TOXICITY: HRV predominantly attacks enterocytes, which are mature villous epithelial cells in the small intestine. The disease caused by HRV is self-limiting in general, lasting for about 4-7 days, with symptoms similar to those caused by other gastrointestinal agents, although the symptoms of HRV infections are usually more severe. These include fever, vomiting, and non-bloody diarrhea (often watery and explosive). This usually leads to mild to severe dehydration (usually isotonic in nature); electrolyte imbalance; and in prolonged cases, to secondary disaccharidase deficiency. Subsequent gastroenteritis infections tend to be less severe compared to previous infections. A temporal association of rotavirus infection with a variety of disease conditions has been described, including upper and lower respiratory infection, intussusception, and others. An etiologic association of rotavirus infection with necrotizing enterocolitis, hemorrhagic gastroenteritis, and pneumatosis intestinalis in infancy has been suggested. Detection of rotavirus RNA in cerebrospinal fluid of patients with gastroenteritis suggests that neurological disorders such as convulsions may be associated with HRV infection, but this has not been confirmed.

EPIDEMIOLOGY: HRV is the major cause of severe diarrhea (gastroenteritis) in children throughout the world, more so in developing countries, with about 95% of children contracting the infection by 5 years of age. Death rate due to rotavirus infection is estimated at about 600,000 child deaths per year worldwide, with yearly death tolls highest in India, Nigeria, China, Pakistan, Congo, Ethiopia, and Bangladesh.

Prevalence of disease ranges from ~30% during off season to ~70% during seasonal peaks. Disease outbreaks demonstrate a seasonal pattern in temperate climates, where the disease is more pronounced during drier and cooler months. In the USA and Europe, annual epidemics begin during the months of November/December and January respectively in the Southwest and progress to Northeast by April/May and March, respectively. No specific seasonal trend is observed in tropical climates. HRV infection is generally more severe and clinically significant in children aged 3-35 months, with the first infection being the most severe. Adults tend to be asymptomatic and/or may demonstrate subclinical infection. Immunocompromised individuals are susceptible to developing more severe disease manifestations. Chances of spread of infection within families, day care centers, and hospitals are high. Nosocomial infections are also common and are a major cause of diarrhea in newborns and infants. Several outbreaks have been observed in geriatric groups within hospitals. Serogroup A rotavirus is responsible for ~95% of the rotavirus diarrhea cases worldwide; however, serogroup B rotavirus has caused several large outbreaks of gastroenteritis in adults in various parts of China, and has also been associated with severe diarrheal illness in Bangladesh and India.

HOST RANGE: Humans and experimentally infected animals.

INFECTIOUS DOSE: Unknown

MODE OF TRANSMISSION: The most common mode of transmission for HRV is through fecal-oral spread, either from person-to-person or contact with contaminated environmental surfaces. The possibility of spread through fecally contaminated food and water also exists. Transmission through respiratory droplets has also been suggested; however, more investigation is required.

INCUBATION PERIOD: The incubation period for HRV infection is about 1-3 days.

COMMUNICABILITY: Person-to-person transmission appears to be fairly common through the fecal-oral route. Rotavirus shedding rate is the highest during the diarrheal stage of the disease, which occurs during the first 2-5 days of illness.

DISSEMINATION

RESERVOIR: Humans are the only reservoir for HRV; however, infection by group A rotaviruses (GARVs) has been reported in calves, pigs, foals, cats, dogs, and some birds. The GARVs found in animals appear to be very closely related to HRV. Evidence for some interspecies infection by GARVs does exist. More importantly, it has been suggested that reassortment and interspecies transmission may generate novel human GARVs; and hence it is important to consider these animals as relevant reservoirs for HRV.

ZOONOSIS: None

VECTORS: None

STABILITY AND VIABILITY

DRUG SUSCEPTIBILITY: Unknown

SUSCEPTIBILITY TO DISINFECTANTS: HRV, either in suspension or on inanimate surfaces, is susceptible to glutaraldehyde (2%); chlorinated disinfectants (>20,000 ppm chlorine); iodinated disinfectants (>10,000 ppm iodine); combinations of quaternary ammonium compounds with alcohols (>40%), some acids (HCl), some bases (sodium metasilicate); and combinations of phenolic compounds with strong anionic surfactants. Longer exposure times are required for disinfecting contaminated surfaces as compared to contaminated suspensions/solutions. HRV has also been shown to be very susceptible to Lysol brand disinfectants (79% ethyl alcohol, 0.1% *o*-phenylphenol). Other disinfectants include formalin (2%) and sodium hypochlorite (2%).

PHYSICAL INACTIVATION: HRV is susceptible to strong acidic pH (<3.0). It is also susceptible to heating above 50 °C (for 30 minutes), but is stabilized in 2M magnesium sulphate.

SURVIVAL OUTSIDE HOST: HRV can survive ambient temperatures (30-35 °C) and can remain infectious on inanimate objects for up to 60 days. HRV tends to be more stable at medium or low humidity levels.

FIRST AID / MEDICAL

SURVEILLANCE: Monitor for symptoms of disease. Electron microscopy is still the gold standard diagnostic technique for HRV; however, it is slightly less sensitive and more expensive than some new diagnostic techniques, like enzyme-linked immunosorbent assays (ELISAs) and latex agglutination assays used for the detection of HRV (group A) antigen in stool samples.

FIRST AID/TREATMENT: Supportive therapy is needed to prevent dehydration by replacement of fluid and electrolyte losses. This can be done using the World Health Organization (WHO) formulation or other commercial formulations, or through intravenous fluids in cases of severe diarrhea, intractable vomiting, acidosis, and/or shock accompany the illness. Resumption of normal diet should be promoted after rehydration.

IMMUNISATION: In the past, the rhesus-human rotavirus reassortment-tetravalent vaccine (Rotashield) had been recommended for use by the US Advisory Committee on Immunization Practices (ACIP), but its use was suspended in 1999. RotaTeq is a live, oral, human-bovine, reassortment rotavirus vaccine developed from a strain of bovine rotavirus, approved by the US Food and Drug Administration (FDA). Rotarix is a live, oral human rotavirus vaccine developed from the most common strain of human rotavirus, also approved by FDA.

PROPHYLAXIS: None

LABORATORY HAZARDS

LABORATORY-ACQUIRED INFECTIONS: No cases of laboratory-acquired infection have been reported to date.

SOURCES/SPECIMENS: The main sources of HRV are intestinal mucosa and stool extracts of infected humans. It has also been detected in rectal swabs of infected humans.

PRIMARY HAZARDS: Ingestion of feces or stool samples and other contaminated materials. Exposure of mucous membranes to contaminated droplets. Importance of aerosol exposure may also present a primary hazard.

SPECIAL HAZARDS: None

EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk Group 2.

CONTAINMENT REQUIREMENTS: Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, or cultures.

PROTECTIVE CLOTHING: Lab coat. Gloves when direct skin contact with infected materials or animals is unavoidable. Eye protection must be used where there is a known or potential risk of exposure to splashes.

OTHER PRECAUTIONS: All procedures that may produce aerosols, or involve high concentrations or large volumes should be conducted in a biological safety cabinet (BSC). The use of needles, syringes, and other sharp objects should be strictly limited. Additional precautions should be considered with work involving animals or large scale activities.

HANDLING AND STORAGE

SPILLS: Allow aerosols to settle. While wearing protective clothing, gently cover the spill with absorbent paper towel and apply appropriate disinfectant, starting at perimeter and working towards the centre. Allow sufficient contact time before clean up.

DISPOSAL: Decontaminate, either by steam sterilization, incineration, or chemical disinfection, before disposal.

STORAGE: The infectious agent should be stored in sealed containers that are appropriately labeled.

REFERENCE

Pathogen Safety Data Sheet (PSDS) for human rotavirus has been modified from the ones produced by the Public Health Agency of Canada as educational and informational resources for laboratory personnel working with infectious substances.

- 1) Picture: Micrograph prepared by Dr. Cornelia Büchen-Osmond
- 2) Picture from www.chsjournal.org