Enteroviruses (EV) 1: Polioviruses **Dr S Navqi, infectious diseases registrar, Sep 2020**

EV are members of the *Picornaviridae* family. Identification of EV into species is based on patterns of replication in cell cultures, phylogenetic analysis and clinical syndromes. **Structure**: EVs are small (30-nm diameter in the hydrated state), non- enveloped viruses that possess a single-stranded positive-sense RNA genome. **Poliovirus (PV),** the causative agent of poliomyelitis, is a serotype of the species Enterovirus C. The three serotypes of poliovirus, PV-1, PV-2, and PV-3, each have a slightly different capsid protein. Capsid proteins define cellular receptor specificity and virus antigenicity. PV-1 is the most common form encountered in nature, but all three forms are extremely infectious.

As of September 2020, wild PV-1 is highly localized to regions in Pakistan and Afghanistan. Wild PV-2 was declared eradicated in September 2015 and wild PV-3 was declared eradicated in 2019. There is minimal heterotypic immunity between the serotypes.

Enterovirus species	Serotypes (3, 5)
EV A (24 serotypes, 20 infecting humans)	
Coxsackieviruses (CV)	CV-A2-A8, A10, A12, A14, A16
Enteroviruses (EV)	EV-A71, A76, A89, A92, A114, A119, A120
EV B (61 serotypes, 59 infecting humans)	
Coxsackieviruses (CV)	CV-A9, B1-6
Echoviruses (E)	E1-7, 9, 11-21, 24-27, 29-33
Enteroviruses (EV)	EV-B69, B73-B75, B77-B88, B93, B97, B98, B100, B101, B106, B107
EV C (23 serotypes)	
Coxsackievirus (CV)	CV-A1, A11, A13, A17, A19-A22, A24
Poliovirus (PV)	PV1-3
Enterovirus (EV)	EV-C95, C96, C99, C102, C104, C105, C109, C113, C116, C117, C118
EV D (5 serotypes, 4 infecting humans)	
Enterovirus (EV)	EV-D68, D70, D94, D111
Rhinovirus (RV) A (77 serotypes)	RV-A1, A2, A7-A13, A15, A16, A18-A25, A28-A34, A36, A38-A41, A43-A47, A49-A51, A53-A68, A71, A73-A78, A80-A82, A88-A90, A94-A96, A98, A100-A106
Rhinovirus (RV) B (30 serotypes)	RV-B3-6, B14, B17, B26, B27, B35, B37, B42, B48, B52, B69-70, B72, B79, B83-84, B86, B91-93, B97, B99-104
Rhinovirus (RV) C (51 serotypes)	RV-C1-51
Human parechovirus (HPeV)	Serotypes (3)
HPeV (16 serotypes)	HPeV1–16

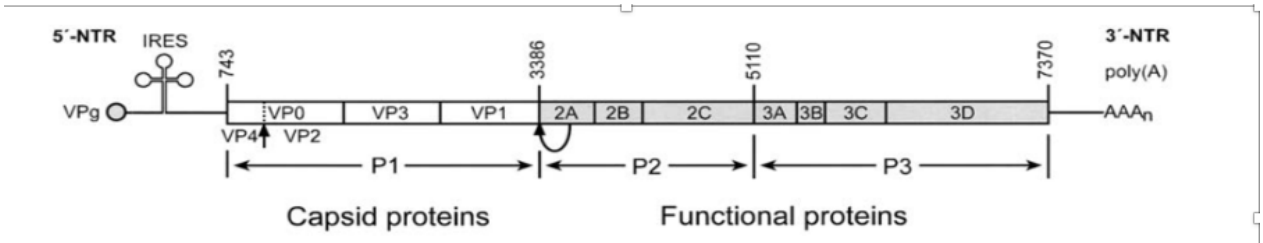


FIGURE 1 Genome organization of PV type 1. The PV genome is a single-stranded positive-

PV are inactivated by heat (>56°C), UV light, chlorination, and formaldehyde. The PVs are stable in liquid environments and can survive for many weeks in water, body fluids, and sewage due to thermostability in the presence of divalent cations, acid stability, and the absence of a lipid envelope. **Cell cycle**: Poliovirus infects human cells by binding to an immunoglobulin-like receptor, CD155 on the cell surface > an irreversible conformational change of the viral particle necessary for viral entry > entry of the viral nucleic acid via the formation of a pore in the cell membrane through which the RNA is then "injected" into the host cell cytoplasm, or via virus uptake by receptor mediated endocytosis. On entry, the virus hijacks the cell's translation machinery, causing inhibition of protein synthesis. Humans are the only natural host and reservoir of polioviruses.

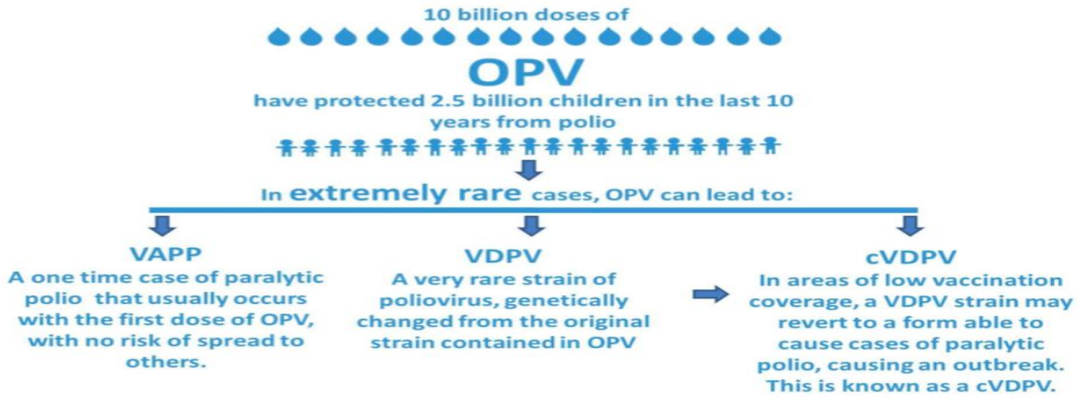
Clinical manifestations: faecal–oral route, viral replication occurs in the alimentary tract. Virus is shed in the faeces of infected individuals. In 95% of cases only a primary, transient viremia occurs, and the infection is asymptomatic. In about 5% of cases, the virus spreads and replicates in other sites such as brown fat, reticuloendothelial tissue, and muscle > secondary viremia and leads to the development of minor symptoms such as fever, headache, and sore throat. Paralytic poliomyelitis occurs in less than 1% of poliovirus infections, occurs when the virus enters the

CNS and replicates in motor neurons within the spinal cord, brain stem, or motor cortex, resulting in the selective destruction of motor neurons leading to temporary or permanent paralysis. In rare cases, paralytic poliomyelitis leads to respiratory arrest and death. The mechanisms by which poliovirus enters the CNS are poorly understood. All theories require primary viremia.

Incubation period 9 to 12 days (range, 5 to 35 days) measured from presumed contact until the onset of the prodrome.

Vaccinations: Inactivated Polio vaccine (IPV): prepared by the inactivation of poliovirus strains with formalin treatment. In developed countries, four doses of IPV are recommended at 2 months, 4 months, 6 to 18 months, and 4 to 6 years of age. Detectable antibody persists at protective levels for at least 5 years. The protective efficacy is lower than for an equivalent number of OPV doses.

Live-Attenuated Oral Poliovirus Vaccine (OPV) : developed by multiple passages of polioviruses in monkey kidney cell cultures which introduces mutations in the viral IRES and hinders the ability of the virus to infect nervous tissue. Superior immunogenicity compared with the original IPV formulation, lower cost, ease of administration, spread of vaccine virus to unimmunized, susceptible persons, and induction of gastrointestinal immunity. Intestinal immunity induced by OPV is similar to intestinal immunity after natural poliovirus infection. Monovalent (more immunogenic) and bivalent forms (OPV1 and 3). The WHO Expanded Program on Immunization recommends for a dose at birth and for three additional OPV doses at 6, 10, and 14 weeks of age. Supplemental immunisations for all children younger than 5 years, regardless of immunization history, receive two doses of OPV given 1 month apart, and have been particularly successful in many areas in rapidly controlling poliomyelitis.



Polio surveillance: NERL in Melbourne. AFP surveillance: Pediatricians reviewing a patient less than 15 years of age presenting with AFP, or clinicians reviewing a patient of any age with suspected poliomyelitis, are requested to notify the NERL . VIDRL forwards a clinical questionnaire for the clinician to complete.

Specimens: According to the WHO surveillance criterion, 2 faecal specimens must be collected more than 24 hours apart due to intermittent virus shedding, and within 14 days of the onset of paralysis, while the virus titer remains high.

Diagnosis: Enterovirus ID using a semi-nested RT-PCR directed to highly conserved sequence in the 5' non-translated region (NTR). Two WHO RT-PCR tests targeting VP1 genpmic region are used to determine a poliovirus strain. The NERL sequences the complete poliovirus viral protein 1 (VP1) genomic region, which contains a major neutralising antibody binding site. **Cultures** are processed by the NERL according to the two-phase separation procedure by using L20B and RD-A cell lines and observed microscopically for cytopathic effect. All enterovirus isolates from cell culture are typed by nucleic acid sequencing .

References

- National ERL report, 2018
- Pakistan and Afghanistan (2020 continuing sporadic cases across multiple provinces in each country) polio situations