

# **POLIOMYELITIS**

*Dr. Gianluca Russo, Mingha Africa Onlus*

## **1. Definition**

Polio is an acute communicable viral diseases caused by Poliovirus that is asymptomatic or poorly symptomatic in around 95% of the cases. In its most severe form, occurring in < 1% of the infections, can lead to flaccid paralysis, rarely to death by respiratory arrest.

## **2. Etiology and Transmission**

The Poliovirus is a member of human enterovirus, *Picornaviridae* family. There are 3 serotypes of human polioviruses, but since 1999 the type 2 has been eliminated. Since 2000 only type 1 and type 3 polioviruses continue to circulate in endemic areas. The poliovirus is rapidly inactivated by heat (55-60°C for 30 min), formaldehyde, chlorine and ultraviolet light.

After entering in the organism by mouth, the polioviruses start its multiplication in local lymphatic tissue of the pharynx and intestine with consequent hematological spread (viremia). During viremia the spread to the central nervous system it is possible, especially to motor neurons of the spinal cord, with different degree and extent of damage, and consequent temporary or permanent paralysis (rarely even death if respiratory paralysis occur). Immunocompetent individuals infected by poliovirus develop protective immunity through humoral (circulating antibody) response and mucosal immune response (local antibody). However, mucosal immunity decrease by the time, and circulating antibodies confers protection strictly related only to the specific type of poliovirus acquired.

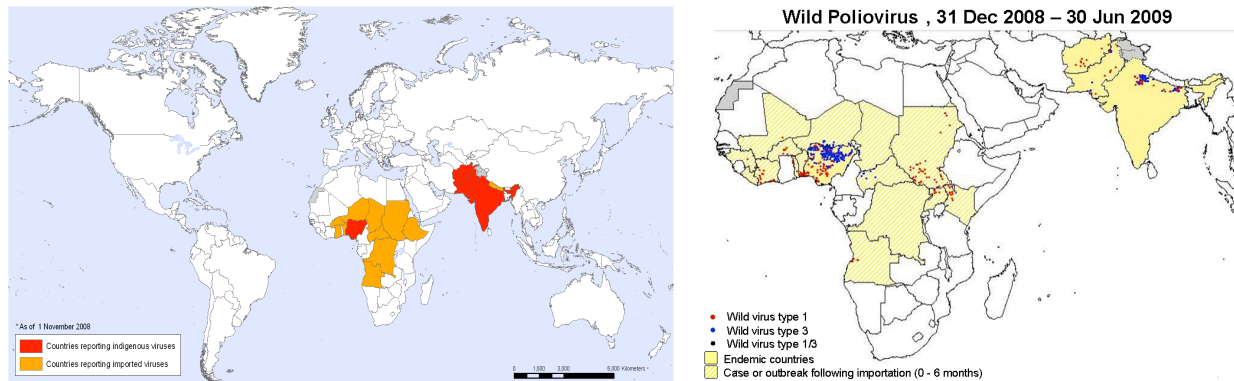
Person-to-person spread of poliovirus via the fecal-oral route (consummation of contaminated food or drinks) is the most important mode of transmission, although the oral-oral route may account for some cases. The first route of transmission is typical of areas with poor sanitation, while the second-one probably dominate in setting with a high standard of sanitation. The only reservoir is the infected human (especially children under 5 year-old) who can eliminate the virus by feces for few months after infection, or sometimes by pharyngeal secretions during the symptomatic phase. In epidemic period, the flies can play a role in the transmission as mechanical vectors by transporting infected feces on foods.

## **3. Epidemiology**

Following the widespread use of poliovirus vaccine in the mid-1950s, the global incidence of poliomyelitis declined dramatically. In 2009, a total of 23 countries reported more than 1 case of polio (total 1604 cases): of these, 4 are considered endemic (Afghanistan, India, Pakistan, and Nigeria – fig 1-2 -) since they have never eliminated indigenous circulation of poliovirus (type 1 and 3), although transmission is restricted to small geographical areas (total 1256 cases in 2009). The remaining countries (fig 1-2) were previously considered polio-free, but have reported cases imported (see maps) in 2009 (total 348 cases). As long as poliovirus transmission has not been interrupted everywhere, all polio-free countries and areas remain at risk of re-importation, particularly from the countries where polio remains endemic. The WHO account each poliovirus

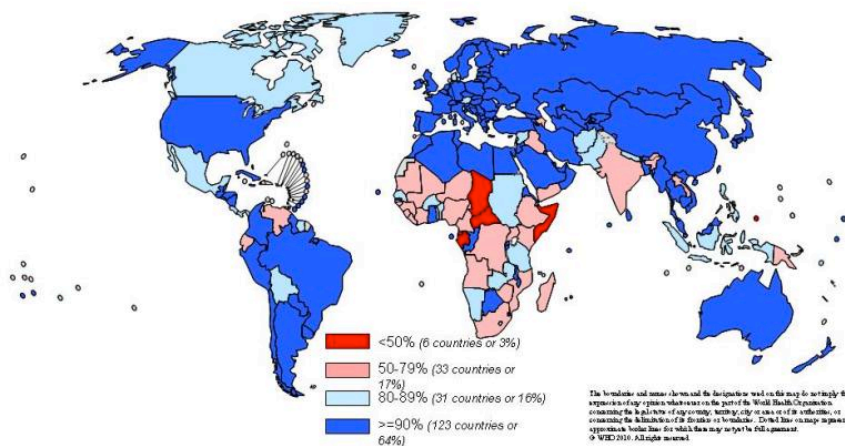
isolation as outbreak, because the majority of the infections are unapparent or poorly symptomatic, and the elimination of the virus by faeces from infected individuals can endure for few months. From January to mid-October 2010, the WHO received notification for a total of 747 polio cases, 163 in endemic countries, and the remaining 584 cases as imported cases in previously polio-free countries.

**Figure 1 and 2:** Global distribution of polio cases, WHO 2008 (fig 1); and polio serotype distribution, WHO 2009 (fig 2)



Polio is a vaccine preventable disease: figure 3 shows the polio-vaccine coverage in children. A polio-vaccine coverage of 90% (ore more) is needed for reducing significantly the circulation of the virus. Countries with high vaccine coverage bordering countries with low-vaccine coverage are at risk of importation of the virus.

**Figure 3:** Immunization with 3<sup>th</sup> dose of polio vaccine in children, 2009.



#### 4. Clinical aspects

The majority of poliovirus infection cause asymptomatic viral replication that is limited to the intestine. However, after an incubation period of 7-10 days (range 4-35 days) about 25% of infected persons develop a flu-like clinical syndrome with fever, headache, sore throat and diarrhea.

Less than 1 % of infected individuals develop the paralytic form of polio. The typical neurological manifestation of this form is acute flaccid paralysis of the limbs (predominantly lower limbs), usually asymmetric and without sensitive impairment; persistent paralysis and resulting deformities are common sequelae of polio. In rare case, nervous involvement can reach bulbar cells

resulting in respiratory paralysis and even arrest. The case-fatality rate among paralytic form of polio is 2-20%.

## 5. Prevention

### 5.1. Vaccines

The **Oral Polio Vaccine (OPV)** had been developed in 1961 by Albert Sabin. OPV is a vaccine composed of live and attenuated poliovirus strains of all three poliovirus types (trivalent OPV). In addition to tOPV, monovalent OPVs (mOPV-1; mOPV-3) have been licensed since 2005 for use in some countries; in 2009 also a bivalent OPV (bOPV) for poliovirus type 1 and 3 was licensed. The OPV induce the production of circulating and local antibodies, with consequent prevention of nervous system involvement, and limitation of intestinal viral replication stopping person-to-person transmission. The three doses immunological efficacy of tOPV is more than 90% in industrialized countries, and 70% in developing countries. The suboptimal response to OPV in developing countries are determined by a complex array of factors related to vaccine, host and environment; a dose administered at birth, or as soon as possible after birth, can significantly improve the seroconversion rates of subsequent doses. In general after vaccination the antibody concentration decline over time, but immunity against paralytic disease appears to be lifelong. The administration of OPV it is not contraindicated in patients affected by HIV/AIDS.

In most countries tOPV remain the vaccine of choice in routine and supplementary vaccination activities, also because of its capacity to stop transmission of the virus. Monovalent OPV can be recommended for use in supplementary campaigns in areas where only poliovirus type 1 or 3 alone is circulating, but it is not recommended as a substitute of tOPV in routine immunization programmes. Bivalent OPV was first used in Afghanistan (vaccination of 2.8 million children < 5 year-old) showing more efficacy than tOPV in circulating antibody production; it is recommendable to evaluate the introduction of this vaccine in supplementary immunization activities of all endemic countries.

The OPV need to be kept at 2°-8°C for a maximum of 6 months and each dose consists of 2 drops (0.1 ml). The most important adverse event registered is the development of a vaccine-associated paralytic poliomyelitis (VAPP) that occurs with an incidence of 4 cases/1000000 per year. In case of low population coverage with OPV, it is possible that Sabin virus circulate (vaccine-derived poliovirus –cVDPV) acquiring neurovirulence and transmissibility characteristics of wild-type poliovirus; this underlines, one more time, the importance of achieving and maintaining high polio immunization rates.

The **Inactivated poliovirus vaccine (IPV)** was developed in 1955 by Jonas Salk, is administered by intramuscular injection, and consist of inactivated (killed) poliovirus strains of all three poliovirus types. The vaccine is stable at ambient temperature, but should be refrigerated to ensure efficacy; freezing must be avoided because of possible reduction of potency.

There is no consistent experience in using IPV in routine vaccination schedule in developing countries. IPV is not recommended for routine use in polio-endemic countries or in developing countries at risk of poliovirus importation. The rationale for the recent introduction of IPV in several countries (polio-free not at risk of poliovirus importation) has been the need to prevent VAPP, but also for optimizing the administration of others vaccines through combination products.

IPV induces production of circulating antibodies that can persist for decades (possibly for life), but their titres decrease over time. In case of poliovirus infection these antibodies prevent the spread

of the virus to the nervous system, protecting against paralysis, but not stop the production of the virus in the intestine with consequent possible person-to-person transmission. The IPV is safe and the adverse events registered are only localized in the site of injection: erythema (< 1%), induration (3-11%), and tenderness (14-29%).

The **choice of vaccine** depends from local epidemiological profile in term of existent polio transmission and potential risk of polio importation. OPV alone is the vaccine recommended in all polio-endemic countries and in countries at risk of polio importation and subsequent spread. In this context it is indicate for children a 4 doses administration of OPV: the 1<sup>st</sup> dose at birth, the 2<sup>nd</sup> dose after 6-8 weeks, the third dose at 3-4 months, and 4<sup>th</sup> dose at 6 months. IPV alone may be considered as alternative to OPV alone only in countries that have the lowest risk for poliovirus importation and transmission: the schedule of IPV administration for children in these contexts consists of 4 doses (2, 4, 6-18 months, and 4-6 years of age). A sequential IPV/OPV is used in some countries, where the children's vaccination start at 2 months of age with an IPV dose, followed by two OPV doses separated by an interval of 4-8 weeks.

**Travelers** to polio-endemic countries or areas who have previously received  $\geq 3$  doses of OPV or IPV should be offered another dose of polio vaccine as a once-only dose before departure. Non immunized individuals intending to travel to polio-endemic destinations should complete a primary schedule of polio vaccine, using either IPV or OPV. For people who travel frequently to polio-endemic areas but who stay only for brief periods, a one-time only additional dose of a polio vaccine (IPV or OPV) after the primary series should be sufficient to prevent disease. Before travelling abroad, persons living in a polio-endemic country should have completed a full course of vaccination against polio, preferably with OPV, to boost mucosal immunity and reduce the risk of poliovirus fecal shedding. Such travelers should receive an additional dose of OPV 1–12 months prior to each international travel. In case of urgent travel, a minimum of 1 dose of OPV should be given, ideally 4 weeks before departure. Some polio-free countries (for example, Saudi Arabia) may require travelers from polio-endemic countries to be immunized against polio in order to obtain an entry visa, or they may require that travelers receive an additional dose on arrival, or both.

## 5.2. Hygienic rules

Although vaccination provides high level of protection, still the GOLDEN RULE is adoption of Hygienic practices that will avoid other illnesses. Food and water precaution:

- Tap water and ice may not be safe and consequently it is advisable to drink only bottled or filtered or boiled and carbonated water.
- Look for bubbles from carbonated beverages: bubbles are evidence that the product have been processed (bottles may be refilled with tap water and resold).
- It is better to avoid ice from unknown source.
- Do not purchase unsealed drinks or ice cream made by street vendors.
- Do not rinse your mouth or toothbrush with tap water and do not open your mouth in the shower.
- Food served in large hotels and well-known restaurant should be safe, but it is advisable prefer food that has been thoroughly cooked and served hot.
- Ensure that milk and other diary products have been pasteurised.
- Eat only cooked vegetables, avoid salads and peeled fruit.
- Cook all meat thoroughly and eat it hot whenever possible. Avoid leftovers and reheated food.

- Shellfish, even well cooked, is a high-risk food. If in doubt leave it.
- Avoid food from roadside stalls and informal eating houses.
- Maintain strict personal hygiene: wash or sanitize your hands frequently and immediately prior to eating.
- Do not drink water without first boiling it for an extended period, or filtering it in a specially-designed water purifier, unless you are absolutely certain of its source.
- If in doubt, use bottled water from a trusted source in sealed bottles—use this water also to make ice and for cleaning your teeth.
- Boil unpasteurized milk prior to use—avoid ice cream and yogurt-based foods.

## **6. Diagnosis and Therapy**

The clinical diagnosis is really difficult in the majority of the cases, except the paralytic form of the diseases. The viral isolation from the feces or cerebrospinal fluid can confirm the diagnosis. Unfortunately only symptomatic treatment is available, ranging from pain and fever relief to intubation and mechanical ventilation for those rare cases with respiratory insufficiency.