

Epidemiology of Poliomyelitis

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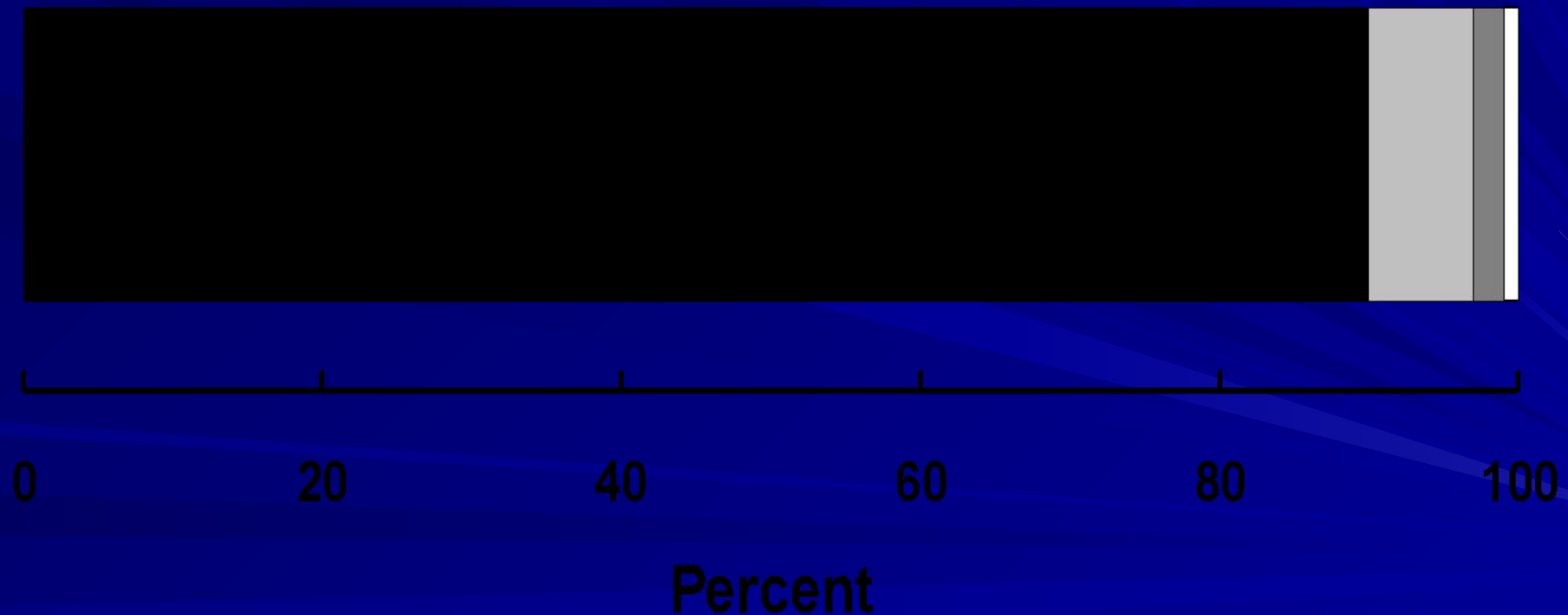
Proph.Dr. Hadi Jebur
Suhail

- A viral infection most often recognized by acute onset of flaccid paralysis.
- Infection with poliovirus results in a spectrum of clinical manifestations from inapparent infection to non-specific febrile illness, aseptic meningitis, paralytic disease, and death.
- Poliomyelitis is a highly infectious disease caused by three serotypes of poliovirus.

- Two phases of acute poliomyelitis can be distinguished: a non-specific febrile illness (minor illness) followed, in a small proportion of patients, by aseptic meningitis and/or paralytic disease (major illness).
- The ratio of cases of inapparent infection to paralytic disease ranges from 100:1 to 1000:1.

Outcomes of poliovirus infection

- Asymptomatic
- Minor non-CNS illness
- Aseptic meningitis
- Paralytic



Epidemiological pattern

- The epidemiological pattern of polio depends upon the degree of the socioeconomic development and health care services of a country.
- The pattern of the disease has been considerably modified by widespread immunization.

- According to the WHO; Three epidemiological patterns have now been delineated:
 - Countries with no immunization: the virus infects all children, and by age 5 years almost all children develop antibodies to at least one of the 3 types of polio virus. In that pattern paralytic polio cases are frequent in infants.
 - Countries with partial immunization: In these countries, wild polio virus is largely replaced by vaccine virus in the environment.
 - Countries with almost total immunization coverage: in these countries polio is becoming rare, however, sporadic cases do occur rarely.

Causative organism

- Poliovirus: belongs to “Picorna” viruses which are small RNA-containing viruses.
- Polioviruses have three antigenically distinct types, giving no cross immunity:
 - Type I: “Leon”; the commonest in epidemics
 - Type II: “Berlinhide”; the prevailing type in endemic areas.
 - Type III: “Lansing”; occasionally causes epidemics.
- Polioviruses are relatively resistant and survive for a long time under suitable environmental conditions, but are readily destroyed by heat (e.g. pasteurization of milk, and chlorination of water).

Reservoir of infection

- Man is the only reservoir of infection of poliomyelitis.
- Man: cases and carriers
- Cases: all clinical forms of disease
- Carriers: all types of carriers (e.g. incubatory, convalescent, contact and healthy) except chronic type. In endemic areas, healthy carriers are the most frequent type encountered.

Foci of infection

- Pharynx: the virus is found in the oropharyngeal secretions.
- Small intestine: the virus finds exit in stools.

Modes of transmission

Since foci of infection are the throat and small intestines, poliomyelitis spreads by two routes:

- Oral-oral infection: direct droplet infection
- Faeco-oral infection:
 - Food-borne (ingestion) infection through the ingestion of contaminated foods. Vehicles include milk, water, or any others that may be contaminated by handling, flies, dust....
 - Hand to mouth infection.

(polio virus has the ability to survive in cold environments. Overcrowding and poor sanitation provide opportunities for exposure to infection.)

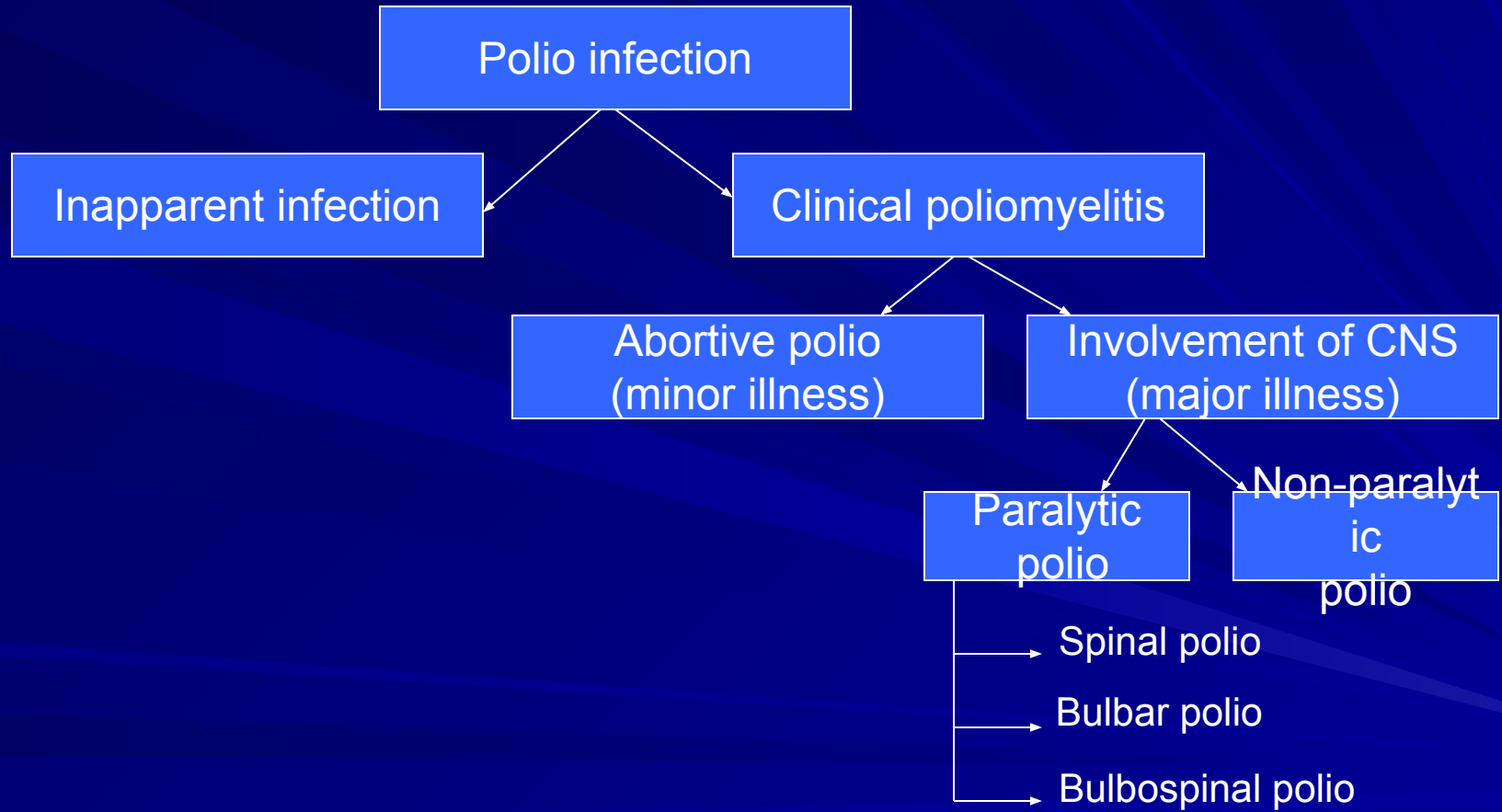
Period of infectivity

- Contact and healthy carriers: about 2 weeks
- Cases: the cases are most infectious 7 to 10 days before and after the onset of symptoms. In the feaces, the virus is excreted commonly for 2 to 3 weeks, sometimes as long as 3 to 4 months.
- In polio cases, infectivity in the pharyngeal foci is around one week, and in the intestinal foci 6-8 weeks.
- Incubation Period: 7-14 days

Susceptibility

- Age: more than 95% reported in infancy and childhood with over 50% of them in infancy.
- Sex: no sex ratio differences, but in some countries, males are infected more frequently than females in a ratio 3:1.
- Risk factors: (provocative factors of paralytic polio in individuals infected with polio virus): fatigue, trauma, intramuscular injections, operative procedures, pregnancy, excessive muscular exercise...
- Immunity: The maternal antibodies gradually disappear during the first 6 months of life. Immunity following infection is fairly solid, although infection with other types of polio virus can still occur.

Sequelae of polio infection



Inapparent infection

- Incidence is more than 100 to 1000 times the clinical cases.
- No clinical manifestations, but infection is associated with acquired immunity, and carrier state.

Clinical poliomyelitis

I. Abortive polio (minor illness):

- The majority of clinical cases are abortive, with mild systemic manifestations for one or two days only, then clears up giving immunity. Some abortive cases may be so mild to pass unnoticed.
- Manifestations:
 - Moderate fever
 - Upper respiratory manifestations: pharyngitis and sore throat
 - Gastrointestinal manifestations: vomiting, abdominal pain, and diarrhea.

Clinical poliomyelitis (cont.)

II. Involvement of the CNS (major illness):

- Affects a small proportion of the clinical cases, and appears few days after subsidence of the abortive stage. It takes two forms: nonparalytic and paralytic polio.
- Nonparalytic polio is manifested by fever, headache, nausea, vomiting, and abdominal pain. Signs of meningeal irritation (meningism), and aseptic meningitis (pain and stiffness in the neck back and limbs) may also occur.
- The case either recovers or passes to the paralytic stage, and here the nonparalytic form is considered as a “preparalytic stage”.

Clinical poliomyelitis (cont.)

Paralytic poliomyelitis:

- Paralysis usually appears within 4 days after the preparalytic stage (around 7-10 days from onset of disease).
- The case shows fever, headache, irritability, and different paralytic manifestations according to the part of the CNS involved, with destruction of the motor nerve cells, but not the sensory nerve cells.
- Forms: spinal, bulbar, and bulbospinal.

Spinal polio

- Different spinal nerves are involved, due to injury of the anterior horn cells of the spinal cord, causing tenderness, weakness, and flaccid paralysis of the corresponding striated muscles.
- The lower limbs are the most commonly affected.

Bulbar polio

- Nuclei of the cranial nerves are involved, causing weakness of the supplied muscles, and maybe encephalitis.
- Bulbar manifestations include dysphagia, nasal voice, fluid regurgitation from the nose, difficult chewing, facial weakness and diplopia
- Paralysis of the muscles of respiration is the most serious life-threatening manifestation.

Bulbospinal polio

- Combination of both spinal and bulbar forms

Complications and case fatality

- Respiratory complications: pneumonia, pulmonary edema
- Cardiovascular complications: myocarditis, cor pulmonale.
- Late complications: soft tissue and bone deformities, osteoporosis, and chronic distension of the colon.
- Case fatality: varies from 1% to 10% according to the form of disease (higher in bulbar), complications and age (fatality increases with age).

Case definition

The following case definition for paralytic poliomyelitis has been approved by CDC (1997)

- ***Clinical case definition***

Acute onset of a flaccid paralysis of one or more limbs with decreased or absent tendon reflexes in the affected limbs, without other apparent cause, and without sensory or cognitive loss.

Case classification

- **Probable:** A case that meets the clinical case definition.
- **Confirmed:** A case that meets the clinical case definition and in which the patient has a neurologic deficit 60 days after onset of initial symptoms, has died, or has unknown follow-up status. Confirmed cases are then further classified based on epidemiologic and laboratory criteria. Only confirmed cases are included in the *Morbidity and Mortality Weekly Report (MMWR)*.
- **Indigenous case:** Any case which cannot be proved to be imported.
- **Imported case:** A case which has its source outside the country. A person with poliomyelitis who has entered the country and had onset of illness within 30 days before or after entry

Diagnosis and laboratory testing

- Laboratory studies, especially attempted poliovirus isolation, are critical to rule out or confirm the diagnosis of paralytic poliomyelitis.
- ***Virus isolation***
 - The likelihood of poliovirus isolation is highest from stool specimens, intermediate from pharyngeal swabs, and very low from blood or spinal fluid.

Diagnosis and laboratory testing (cont.)

- ***Serologic testing***

A four-fold titer rise between the acute and convalescent specimens suggests poliovirus infection.

- ***Cerebrospinal fluid (CSF) analysis***

The cerebrospinal fluid usually contains an increased number of leukocytes—from 10 to 200 cells/mm³ (primarily lymphocytes) and a mildly elevated protein, from 40 to 50 mg/100 ml.

Prevention

General prevention:

- Health promotion through environmental sanitation.
- Health education (modes of spread, protective value of vaccination).

Prevention

- Seroprophylaxis by immunoglobulins:
Not a practical way of giving protection because it must be given either before or very shortly after exposure to infection.
(0.3 ml/kg of body weight).

prevention

- Active immunization:
 - Salk vaccine (intramuscular polio trivalent killed vaccine).
 - Sabin vaccine (oral polio trivalent live attenuated vaccine).

Inactivated Polio Vaccine

- Highly effective in producing immunity to poliovirus
- >90% immune after 2 doses
- >99% immune after 3 doses
- Duration of immunity not known with certainty

Oral Polio Vaccine

- Highly effective in producing immunity to poliovirus
- 50% immune after 1 dose
- >95% immune after 3 doses
- Immunity probably lifelong

Salk versus Sabin vaccine

IPV (Salk)	OPV (Sabin)
<ul style="list-style-type: none">• killed formolised virus• Given SC or IM• Induces circulating antibodies, but not local (intestinal immunity)• Prevents paralysis but does not prevent reinfection• Not useful in controlling epidemics• More difficult to manufacture and is relatively costly• Does not require stringent conditions during storage and transportation. Has a longer shelf life.	<ul style="list-style-type: none">• live attenuated virus• given orally• immunity is both humoral and intestinal. induces antibody quickly• Prevents paralysis and prevents reinfection• Can be effectively used in controlling epidemics.• Easy to manufacture and is cheaper• Requires to be stored and transported at subzero temperatures, and is damaged easily.

Polio Vaccination Schedule

<u>Age</u>	<u>Vaccine</u>	<u>Minimum Interval</u>
At birth with BCG	IPV	---
2 months	IPV	4 wks
4 months	IPV	4 wks
6-18 months		

4-6 years*

the fourth dose of IPV may be given as early as 18 weeks of age

Polio Vaccine Adverse Reactions

- Rare local reactions (IPV)
- No serious reactions to IPV have been documented
- Paralytic poliomyelitis (OPV)

Vaccine-Associated Paralytic Polio

- Increased risk in persons ≥ 18 years
- Increased risk in persons with immunodeficiency
- No procedure available for identifying persons at risk of paralytic disease
- 5-10 cases per year with exclusive use of OPV
- Most cases in healthy children and their household contacts

Polio Vaccine

Contraindications and Precautions

- Severe allergic reaction to a vaccine component or following a prior dose of vaccine
- Moderate or severe acute illness

B. Control of patient, contacts and the immediate environment:

- 1) Report to local health authority: Obligatory case report of paralytic cases as a Disease under surveillance by WHO, Class 1.
- 2) Isolation: Enteric precautions in the hospital for wild virus disease; of little value under home conditions because many household contacts are infected before poliomyelitis has been diagnosed.
- 3) Concurrent disinfection: Throat discharges, feces and articles soiled therewith. Terminal cleaning.
- 4) Quarantine: Of no community value.

5) Protection of contacts: Immunization of familial and other close contacts is recommended but may not contribute to immediate control; the virus has often infected susceptible close contacts by the time the initial case is recognized.

6) Investigation of contacts and source of infection: **Occurrence of a single case of poliomyelitis due to wild poliovirus must be recognized as a public health emergency prompting immediate investigation and planning for a large-scale response.**

A thorough search for additional cases of AFP in the area around the case assures early detection, facilitates control and permits appropriate treatment of unrecognized and unreported cases.

7) Specific treatment: None; however, Physical therapy is used to attain maximum function after paralytic poliomyelitis.

C. Epidemic measures:

- In any country, a single case of poliomyelitis must now be considered a public health emergency, requiring an extensive supplementary immunization response over a large geographic area.

D. Disaster implications:

- Overcrowding of non-immune groups and collapse of the sanitary infrastructure pose an epidemic threat.

E. International measures:

- Poliomyelitis is a Disease under surveillance by WHO and is targeted for eradication by 2005.
- National health administrations are expected to inform WHO immediately of individual cases and to supplement these reports as soon as possible with details of the nature and extent of virus transmission.
- Planning a large-scale immunization response must begin immediately and, if epidemiologically appropriate, in coordination with bordering countries.

E. International measures (cont.):

- Once a wild poliovirus is isolated, molecular epidemiology can often help trace the source.
- Countries should submit monthly reports on case of poliomyelitis AFP cases and AFP surveillance performance to their respective WHO offices.
- International travelers visiting areas of high prevalence must be adequately immunized.