

EPIDEMIOLOGICAL SURVEILLANCE OF ACUTE FLACCID PARALYSIS FOR ERADICATION OF POLIOMYELITIS (A BRIEF REVIEW)

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Abstract. In May 1988 the World Health Assembly set to World Health Organization (WHO) the goal to achieve a global eradication of poliomyelitis by the year 2000. Surveillance of the acute flaccid paralysis (AFP) remains the 'gold standard' for the detection of polio. The criterion of sensitivity of the surveillance system is the incidence from non-polio related AFP, in children under 15 years of age. The aim is to detect more than 1 case of AFP, per 100,000 children. In 2019, WHO announced the eradication of wild poliovirus 3, and poliovirus 2 was eradicated in 2015. Wild poliovirus 1 continues to circulate. The main goals of the WHO Polio Eradication Strategy for the period 2022-2026 are: permanently interrupt all poliovirus transmission in endemic countries (Afghanistan and Pakistan), stop cVDPV (circulating vaccine-derived poliovirus) transmission and prevent outbreaks in non-endemic countries.

Key words: poliomyelitis, polio eradication, acute flaccid paralysis (AFP), inactivated polio vaccine (IPV), oral polio vaccine (OPV), circulating vaccine-derived poliovirus (cVDPV)

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INTRODUCTION

In May 1988, the World Health Assembly set the World Health Organization (WHO) the goal of achieving a global eradication of polio by 2000. Many strategies were developed. For the 2019-2023 period, including the eradication, integration and safe storage of available viable polioviruses. WHO's last strategy concerns the 2022-2026 period.

The main aims of WHO Polio Eradication Strategies are: achieving a high level of commitment to

the provision of qualified personnel; cooperation between health services and humanitarian programs; administration of a polio vaccine, in the most effective way, in order to stop the transmission of wild polioviruses; reaching a high immunization coverage; application of immediate anti-epidemic actions in all possible cases of poliomyelitis and acute flaccid paralysis (AFP). The two goals of Polio Eradication Strategy 2022–2026 are to permanently interrupt all poliovirus transmission in endemic countries in order to stop cVDPV (vaccine-derived poliovirus) transmission and prevent outbreaks in non-endemic coun-

tries. These goals are to be achieved by investigating any suspected case of polio, isolating the virus from fecal samples and conducting emergency immunization in the event of outbreak; a more comprehensive and systematic approach to the presentation and risk management at all levels of polio eradication; raising the level of sensitivity of AFP oversight systems, community engagement, and research of case studies in the Afghanistan and Pakistan regions [1, 2, 3].

The sensitivity of the surveillance system is the criterion of incidence from non-polio-related AFP, in children under 15 years of age. The aim is to detect more than 1 case of AFP, per 100,000 children under 15 years of age.

An AFP case is defined as any person, up to 15 years of age with a disease including Guillain-Barré syndrome and transverse myelitis, which is characterized by a varying severity, acute onset with weakness or paralysis of a muscle group. [4].

AFP had appeared in medical textbooks since 1789. In 1840 an epidemic was registered in Sweden followed by an epidemic in 1881 in the United States. Early epidemics were called “polio”, from the Greek “inflammation of the gray matter.” [5].

Etiology and modes of transmission

Enterovirus infections are acute infectious diseases with different clinical features. They are transmitted by fecal-oral and airborne routes of transmission, through food, water and contaminated hands. The group of enterovirus infections is characterized by significant polymorphism in the clinical picture, as well as with different severity and variables in the course of the disease. The incubation period is 2-18 days, most often 3-6 days. The pathogenesis is similar to that of poliomyelitis. The entrance doors are the digestive system or nasopharynx.

In the 1970s, the so called “new enteroviruses” were discovered, with neurological symptoms- types 70 and 71. In 1975 in Bulgaria, an epidemic of enterovirus 71 was registered with a high case-fatality rate, especially in young children [6]. Respiratory and cardiac paralysis occurred in bulbar forms. During that epidemic, 89 paralytic cases with 29% case fatality rate in ages 1-3 years were observed [7].

Enteroviruses belong to the genus Enterovirus (EV) from the family Picornaviridae. They were classified into twelve species according to the International Committee on the Taxonomy of Viruses (ICTV). Although five species infect only animals (EVE – J), the remaining seven species are known to infect humans: EV A – D and rhinovirus A – C (RV A – C). These species include hundreds of serotypes, such

as polioviruses (PV), and coxsackievirus A and B (CV-A and -B), ECHO viruses and human rhinovirus (HRVs), including several human pathogens such as PV, CV-A16, CV-B3, EV-A71, EV-D68 and HRV [8].

AFP is not a diagnosis. AFP is a clinical syndrome – i.e., a collection of signs and symptoms. There are many infectious and non-infectious causes of AFP. Polio, caused by the wild polio virus (the natural circulating strain of polio) is one of the causes of AFP. As a part of the world-wide campaign to eradicate polio, all countries in the world do surveillance for polio by looking for clinical cases of AFP and investigating each one thoroughly in order to assure that it is not caused by wild polio virus. The clinical syndrome of AFP is defined as the acute onset of weakness or paralysis, with reduced muscles tone in children < 15 years. Persons over the age of 15, who develop a paralytic illness and in whom polio is suspected, are also classified as AFP cases. AFP usually has a progressive and acute onset, but it may become chronic. AFP can be fatal if the paralysis affects the diaphragm, as persons may develop respiratory failure [9].

The detection of at least one case of AFP per 100,000 children under 15 serves as an indicator for the country's ability to identify polio even in its absence. When the initiative of the World Health Assembly (for global eradication of poliomyelitis) was launched there were more than 350,000 new cases of paralytic polio worldwide, in 125 countries altogether. In 2015, WHO announced the eradication of the wild poliovirus 2, followed by an eradication of the wild poliovirus 3 in 2019. Wild poliovirus 1 continues to circulate, however. In 2018, the incidence has decreased to 33 cases in the region of Afghanistan and Pakistan (poliovirus type 1), while in 2019 the detected cases reached 71. Since the eradication initiative of 2000 did not achieve its goals, hopes are being postponed for 2026. More than 2.5 billion children have been vaccinated worldwide as part of the global polio eradication strategy [10, 11].

Epidemiological studies of outbreaks of AFP in the world

Data supports the emergence of AFP in 2014 in the United States. The detected cases were seasonal and occurred between August-December of 2014. 120 cases of AFP were reported. Patients who have developed AFP were aged 2 to 5 years and displayed a pronounced clinical syndrome, with an acute onset and flaccid paresis and lesions of the gray matter of the spinal cord. Poliomyelitis-like viruses are targeted as etiological agents: enteroviruses, flavoviruses, herpes viruses, adenoviruses. The etiological study

revealed enterovirus D68, in 54% of cases enterovirus A71 [12].

Cases of aseptic meningitis, encephalitis; hand, foot, and mouth disease have been studied. AFP is a widespread syndrome worldwide. Between 2008-2017, 2666 cases have been studied in Cyprus. In 26.1% of the cases echovirus 30 has been proved; echovirus 6 – in 14.2%, and coxsackievirus A6- in 10.9%. In addition to paresis, they cause myocarditis, neonatal sepsis, conjunctivitis, and hepatitis. The infectious agents are unstable in the external environment. EV-71 circulates in the region of Southeast Asia, while Coxsackie A6 and A16 in Europe [13].

Russia was certified as a polio-free country in 2002, (CDC, 2002). From 1998 to 2014, 146 cases of polio were reported, 19 of which were caused by the wild type 1 poliovirus imported into Russia in 2010. The remaining 127 were associated with the VAPP (vaccine-associated paralytic poliomyelitis) due to immune disorders in children [14].

In Germany 72 cases of aseptic meningitis and AFP – with proven etiological agents ECHO 18 and ECHO 30 – were studied in 2013. Their seasonality is in late summer and early autumn. Young patients are affected and the mechanism of transmission is fecal-oral or airborne. The disease is benign, with fever, nausea and vomiting being the most common symptoms [15].

According to the WHO, AFP affects children under the age of 15, with a sudden onset of muscle weakness in one or more limbs. In a study carried out in Australia between April 2015 and March 2017, in 24 of the AFP cases, enterovirus D-68 was identified as the causative agent [16].

Polio was an important medical problem before the immunization era. Nowadays, patients with polio (PP) suffer from polio sequelae or have developed post-polio syndrome (PPS) with increasing paresis, pain and fatigue. A total of 65 hospitalized patients were studied in the Malcesine hospital in Northern Italy. The following data were summarized in a telephone interview – the presence of post-polio syndrome, concomitant diseases, hypertension, cardiovascular disease, diabetes mellitus [17].

A study conducted by the Taiwanese Centers for Disease Control (July 2015 to August 2016) has shown that 23 out of 74 cases exhibit neurological symptoms and has proved EV D-68 as a new associated pathogen associated with acute flaccid paralysis [18].

A retrospective study between 2014-2018 was performed in Iran, in which two stool specimens were collected from each AFP patient up to 14 days from the onset of paralysis within 4 days with confirmation in

Atlanta, Georgia, U.S.A. Patients with severe immunodeficiency – agammaglobulinemia associated with the X chromosome, neutropenia, chronic granulomatous disease, complement deficiency, have proven to hold the highest risk for asymptomatic infection. The reason for polioviruses societal reintroduction could be linked to the so-called immunodeficiency-associated vaccine-derived poliovirus (iVDPV) after the polioeradication [19].

During the COVID-19 pandemic, in August 2020, WHO announced that all 47 countries in its African Region were certified free of wild poliovirus. Currently endemic Afghanistan and Pakistan are the places where wild poliovirus remains circulating in the environment. In 2022, cVDPV type 2 and type 3 have been found in unvaccinated patients in the U.K. (and in external environment such as in sewage samples collected from north and east London), U.S.A., Ukraine and Israel [20].

Epidemiological surveillance of AFP

WHO recommends monitoring cases of AFP and polio, as well as poliovirus circulation in order to achieve polio eradication. Polio is considered to be eradicated if absent for 3 consecutive years. Pakistan and Afghanistan remain endemic areas. They should be monitored and the migration processes related to them should be followed, in view of the immunization status of the children. Two Italian regional reference centers conducted a pilot study in 1996 and they reported and registered the following diagnoses: Guillain-Barré syndrome, polyradiculoneuritis, traumatic neuritis and neoplastic neuritis. An active surveillance system – established in 1997 – was introduced. The objectives of the system include the processing of the results of the control examination after the 60th day, as well as the introduction of the terms “probable” and “confirmed” case. The results of the fecal samples are also important. The examination materials include serum, cerebrospinal fluid, nasopharyngeal lavage, PCR [12, 21].

In order for the epidemiological surveillance to be effective, it is important to detect enteroviruses in clinical materials, environmental samples, trace circulating strains, and typing those. Completeness of reporting is important – up to 80% of weekly alert information. The correct and targeted epidemiological diagnosis is a way to timely and correct clinical diagnosis. Reporting the “zero case” is also important. Importantly, 80% of the cases must be investigated within 48 hours of the initial notification. All fecal samples must be taken in two consecutive days up to 14 days from the onset of paralysis, stored below 80C temperature, and submitted for examination to

the National Reference Laboratory within 3 days of their collection. Of note, 80% of the AFP cases must undergo a follow-up examination 60 days after the onset of paralysis.

Up to 100,000 “suspected cases” are reported each year to rule out polio. Environmental monitoring is carried out in more than 70 countries worldwide. The tests have to be sent to the Global Polio Laboratory Network, which includes the samples of wastewater in accordance with Resolution WHA71.16, on the restriction of poliovirus adopted in 2018 by the 71st World Assembly. All countries in the world are committed to minimizing the places determined for the retention of poliovirus [1, 22, 23].

Local surveys for Stara Zagora region, Bulgaria

As of April 26, 1991, in the children’s ward of Kazanlak, Bulgaria, there were eight patients with polio. Four of the children were without immunization – outside the immunization age, one of the patients had one dose, two with three doses and one not covered due to temporary contraindications. It was con-

sidered to be a nosocomial outbreak of polio during the winter season with a probable source of infection the first hospitalized child by a fecal-oral or air-borne mode of transmission of infection [24].

Between 1999-2010, 1585 at the age ≤ 15 years old with facial paralysis and 2 patients with paralysis of nervi oculomotorius were studied in Bulgaria. From fecal samples were isolated three vaccine polioviruses and 46 NPEV (non-polio enteroviruses): 1 Coxsacki A9; 9 Coxsacki B and 36 ECHO viruses. The largest numbers of NPEV were isolated in the months between June-November, which coincides with the period of increased seasonal activity of enteroviruses. 11 cases of acute flaccid paralysis for the period 2012-2021 (5 cases – Guillain-Barré syndrome, 1 – encephalomyelopolyradiculoneuritis, 1 – meningopolyradiculoneuritis, 1 – damage to the lumbosacral plexus, 2 – damage to the nervus fibularis sinistra, 1 – damage to the nervus suralis dextra), other than facial paralysis (81 patients), were registered for Stara Zagora region, in children up to 15 years of age [23, 25].

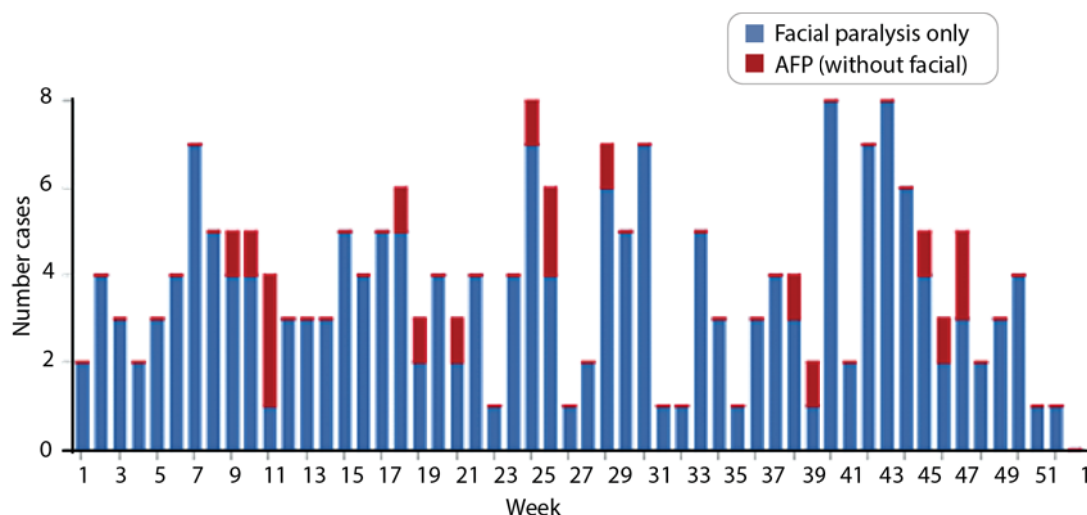


Fig. 1. Registered AFP cases in Bulgaria by weeks in 2022 and 2023 (22)

CONCLUSION

Epidemiological surveillance for AFP with timely epidemiological anamnesis, proper diagnosis and monitoring of the taken clinical materials are key to monitoring progress toward polioeradication. Completeness of the conducted control examinations is required after the 60th day. Monitoring of waste and sewage waters is recommended, twice during the year, each 6 months. Of critical importance is compliance with the mandatory Immunization Schedule, strict periodic control of poliomyelitis immunizations and maintenance of a high immunization coverage.

The activation of inter-institutional contacts – Health system, medical facilities, pre-hospital structures, NGOs, volunteers, mediators in the work on immunization coverage is of key importance. Surveillance of acute flaccid paralysis remains the “gold standard” for the detection of poliomyelitis.

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