TECHNICAL REPORT

Poliomyelitis situation update

24 April 2023

Key messages

- The European Region was declared polio-free in 2002. Since then, renewed circulation of wild poliovirus type 1 (WPV1) and outbreaks of circulating vaccine-derived poliovirus (cVDPV) has been observed globally. In the European Region, there was an increase in the detection and reporting of VDPV (vaccine-derived poliovirus) in environmental samples compared with previous years. cVDPV cases from genetically linked strains were reported in the US and Israel. In the UK, cVDPV strains genetically linked to strains detected in the US and Israel were detected through environmental sampling and prompted a supplementary vaccination campaign in infected areas. These events highlight the potential for international spread of polioviruses, including in EU/EEA countries.
- The percentage of one-year-olds who have received three doses of polio vaccine in a given year is used globally to monitor coverage of immunisation services and to guide polio disease eradication and elimination efforts. In the EU/EEA, in 2021, 23 out 29 countries reported a vaccination coverage of 90% or above for three doses of poliovirus containing vaccine (POL3).
- As the result of sustained efforts and catch-up campaigns where necessary, published estimates indicate that the COVID-19 pandemic did not significantly impact polio vaccine coverage levels in the EU/EEA.
- Despite these vaccine coverage levels and based on estimates by ECDC, approx. 2.4 million inhabitants in the 12 to 23 months old cohort in the 2012 to 2021 period were assessed as not having received three doses of polio containing vaccine by the time of assessment. This corresponds to approximately 240 000 inhabitants per year at potential risk in the 12 to 23 months old cohort in the study period. This figure should be interpreted with caution as many children could have received the vaccination after the date of assessment and older individuals not vaccinated are not captured by this calculation. Despite the limitations of the data, it illustrates that additional efforts are needed to ensure full and timely protection of the EU/EEA population.
- Sustaining or reaching high vaccination coverage, including at the subnational level is essential to ensuring the protection of the population. Clustering in time and space of individuals with low vaccination coverage poses a risk for the occurrence or spread of poliovirus in the EU/EEA following an introduction of the virus and especially in the absence of poliovirus eradication worldwide.
- Identification of Acute Flaccid Paralysis (AFP) cases is the gold standard for surveillance for detecting polio cases and essential for global polio eradication. However, environmental surveillance (detecting poliovirus in sewage water) may be a more sensitive tool to detect the transmission of poliovirus up to five weeks before clinical cases occur and when there may still be time to intervene to prevent disease and plays an increasingly important role for the Global Polio Eradication Initiative (GPEI) in its efforts to achieve and maintain a polio-free world.

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To limit the risk of reintroduction and sustained transmission of WPV and cVDPV in the EU/EEA, it is therefore crucial:

- to ensure timely and high vaccine coverage in the general population by adherence to vaccine recommendations;
- to increase vaccination uptake through targeted communication and vaccination campaigns, particular in subnational areas with low vaccine coverage;
- to implement systems, such as immunisation information systems, to identify and reach out to the unvaccinated or partially vaccinated population with the primary immunisation series and/or booster doses and offer these individuals vaccination.

EU/EEA countries should:

- ensure there are no immunity gaps in the population, through review of polio vaccination coverage data at subnational and local level, and make efforts to close immunity gaps in geographic areas and population groups with inadequate vaccination uptake;
- ensure capacity to identify virus circulation through timely, sensitive and efficient surveillance systems including AFP surveillance and environmental surveillance whenever possible;
- remind healthcare providers that any opportunity should be used to check vaccination status, including that of polio, and update it according to national vaccine recommendations when needed;
- promote and monitor adherence to IHR recommendations for individuals undertaking international travel in areas considered at risk;
- ensure availability of up-to-date preparedness plans to detect and respond to WPV or VDPV detection or an outbreak;
- adhere to the Global Containment Strategy, and strive towards certification.

Background

Poliomyelitis (polio) is a highly infectious disease caused by polioviruses that can be prevented by vaccination (more information on the Disease Background can be found in Annex 1). In 1988, the forty-first World Health Assembly adopted the Global Polio Eradication Initiative (GPEI) resolution for the worldwide eradication of polio, The WHO European Region was declared polio-free in June 2002. The continuing circulation of wild poliovirus type 1 (WPV1) in Pakistan and Afghanistan and the detection of WPV1 cases in Mozambique in 2022 that were genetically linked to a strain from Pakistan show that the virus circulates across countries and continents, and that there is a persisting risk of the virus being imported into the EU/EEA. Furthermore, the occurrence of outbreaks of circulating vaccine-derived poliovirus (cVDPV) mainly in the African region, which emerges and circulates due to a lack of polio immunity in the population, highlights the potential risk for further international spread. In 2022, cVDPV have been identified in human polio cases in the US and in Israel and in environmental samples in the UK. On 2 February 2023, the World Health Organization (WHO) determined that the poliovirus situation continues to constitute a Public Health Emergency of International Concern (PHEIC) with respect to WPV1 and cVDPV [1].

Scope of the document

In light of the ongoing circulation of poliovirus globally and the detection of vaccine-related strains in areas declared as free from polio, this document offers an overview of the recent global poliomyelitis epidemiological situation and provides public health considerations to support adequate and timely vaccination against poliomyelitis in the EU/EEA population.

The public health considerations presented in this document are based on:

- a review of current epidemiological trends globally;
- an overview of current vaccination policies in the EU;
- a review of vaccine uptake in the EU/EA and an estimation of the population that may have missed out on poliomyelitis vaccination early in life;
- a literature review describing levels of immunity against poliomyelitis in adult population groups in the EU/EEA.

Epidemiological update

In 2023, globally as of 11 April, one case of AFP due to WPV1 and 47 AFP cases due to circulating vaccine derived poliovirus (cVDPV) have been reported. The WPV1 case was reported in Pakistan. The cVDPV cases were reported in ten countries. cVDPV1 cases have been reported in the Democratic Republic of Congo (9), Madagascar (5) and Mozambique (1). The 32 cVDPV2 cases have been reported in: the Democratic Republic of Congo (14), Central African Republic (5), Chad (5), Indonesia (3). Benin (2), Israel (1), Nigeria (1) and Somalia (1) [2,3].

In 2022, renewed WPV1 circulation (Afghanistan, Pakistan and Mozambique), outbreaks of cVDPV and increased detection of VDPV in environmental samples was noted globally and in the European region.

In 2022, globally, as reported by 11 April 2023, 30 cases of AFP due to WPV1 and 830 AFP cases due to circulating vaccine-derived poliovirus (cVDPV) were reported. The WPV1 cases were reported from two endemic countries, Pakistan (20) and Afghanistan (2), and one non-endemic country, Mozambique (8) [2]. Genomic sequencing analysis showed that the eight WPV1 cases reported in 2022 in Mozambique and one WPV1 case reported in Malawi in 2021 originated from Pakistan [4]. The 830 cVDPV cases were reported in 25 countries, with 79% of the cases attributed to cVDPV2. 172 cases of AFP caused by cVDPV1 have been reported from five countries: Democratic Republic of Congo (132), Madagascar (14), Mozambique (21), Malawi (4) and Congo (1). 657 cases of AFP caused by cVDPV2 have been reported from 20 countries: Democratic Republic of Congo (344), Yemen (162), Nigeria (48), Chad (44), Niger (15), Benin (11), Central African Republic (5), Somalia (5), Mozambique (4), Ghana (3), Algeria (3), Cameroon (3), Mali (2), Togo (2), Burundi (1), Eritrea (1), Ethiopia (1), Indonesia (1), Sudan (1) and USA (1). One case of AFP caused by cVDPV3 has been reported from Israel [3].

The case of AFP due to cVDPV3 that was identified in Israel was confirmed on 7 March 2022, in an unvaccinated girl in Jerusalem City [5]. cVDPV3 was identified with genetic links to VDPV3-strains detected in environmental samples collected from the Jerusalem and Bethlehem regions between September 2021 and January 2022. As of 15 April 2022, a total of seven VDPV3 positive cases were confirmed, including the index case and six asymptomatic children [6]. As an immediate response, immunisation activities with IPV and catch-up vaccination were initiated in Jerusalem, and a bivalent oral polio vaccine (bOPV) campaign started on 4 April 2022 in the Jerusalem district which was extended to the entire country as of 13 April 2022 [6]. In addition to the cVDPV3 case, sewage samples collected between January to June 2022 from the Jerusalem district were found positive for cVDPV2 [7,8]. On 2 March 2023, a case of AFP with onset of paralysis on 13 February 2023 was reported in an unvaccinated child from the Safed region, in Israel. The case was confirmed as cVDPV2 case and linked to cVDPV2-positive environmental samples previously detected in the country (55 samples in total were reported in 2022, the most recent sample was collected on 24 October 2022) [9].

On 22 June 2022, the UK declared a national standard incident after detection of VDPV2 in wastewater samples in London [10]. Between 8 February and 4 July 2022, 118 genetically linked poliovirus isolates related to the serotype 2 Sabin vaccine strain were detected in 21 of 52 sequential sewage samples collected in London [11]. On 10 August 2022, following the discovery of the additional poliovirus samples in north and east London, the Joint Committee on Vaccination and Immunisation (JCVI) had advised that a targeted IPV booster dose should be offered to all children between the ages of one to nine years in all London boroughs to ensure a high level of protection against the virus and to limit its further spread [12]. On 2 September 2022, the UK Health Security Agency announced environmental surveillance to be expanded to several areas outside of London [13]. As of 22 March 2023, no further VDPV2 isolates have been detected since early November 2022 and sampling will continue until there is evidence of 12 months of environmental surveillance with no detections [14].

On 21 July 2022, the US health authorities reported a polio case in Rockland County, New York State, in a 20-year-old unvaccinated male [15,16]. Following further investigations this case was classified as cVDPV2 [17]. As of 22 March 2023, a total of 101 wastewater samples positive for poliovirus type 2 have been identified from four New York State counties and New York City. The majority of these samples (94) were genetically linked to the cVDPV2 case [18]. [15,16]. Following further investigations this case was classified as cVDPV2 [17]. On 9 September 2022, the Governor of New York State declared a state of emergency for a month for the entire state in relation to poliovirus to boost vaccination rates [19].

On 28 July 2022, WHO was notified that sequences from sewage samples collected in Israel, the US, the UK and the sequence from the AFP case in Rockland, USA are genetically linked. All three countries agreed on the classification of these related VDPV2 as 'circulating' [7]. On 21 March 2023, the Pan American Health Organization (PAHO/WHO) reported a polio case due to VDPV1 in a 16-month-old unvaccinated child in Loreto department, Peru. The case had onset of symptoms in December 2022 [20].

Previous to the detections of VDPV and cVDPV environmental samples in 2022 in the European Region, Ukraine reported two cases of AFP due to cVDPV2 in 2021 [21]. The first case, an unvaccinated 17-month-old child from the Rivne region had disease onset on 3 September 2021. The second case, an unvaccinated child from the Zakarpattia region had disease onset on 13 December 2021. Following these detections, the virus has also been detected in 19 asymptomatic contacts. AFP surveillance in combination with environmental surveillance had been intensified across the country.

No human case of AFP due to cVDPV has ever been reported in EU/EEA countries.

Vaccination policies in the EU/EEA

Immunisation is the only effective method of providing protection against severe disease caused by polio.

Most EU/EEA countries started their polio vaccination programmes with tOPV, but today all countries use IPV for the primary and booster vaccination schedule [22].

Primary vaccination

Primary vaccination is given early in life and is typically completed before six months of age. The number and timing of the doses in the primary series differs among EU/EEA countries and varies between three and four doses. Recommendations for individual countries can be reviewed in the ECDC Vaccine Scheduler [22].

Across EU/EEA countries, primary vaccination starts as early as six weeks of age as part of a combined vaccine, most often the hexavalent vaccine (hexavalent combined diphtheria and tetanus toxoids and acellular pertussis (DTaP) adsorbed, inactivated poliovirus (IPV), Haemophilus influenzae type b (Hib) conjugate (meningococcal protein conjugate) and hepatitis B (HepB) (recombinant vaccine) with few exceptions.

The primary vaccination series administered by the age of 12 months can be grouped as follows:

- '3p+0' schedule that includes three primary doses at two, four and six months of age in Ireland. There are no booster doses given in the second year of life but rather given at four to five years of age.
- '2p+1' schedule that includes two primary doses and a booster dose, with the doses administered at three, five and 11 or 12 months (booster) in Austria, Czechia, Denmark, Finland, Italy, Denmark, Iceland, Liechtenstein, Netherlands, Norway, Slovakia, Slovenia and Sweden and at two, four and 11- 12 months (booster) in France, Germany, Romania, Spain.
- '3p+1' schedule that included three primary doses given in the first year of life, starting as early as two months, with a booster in the second year of life (in Belgium, Bulgaria, Croatia, Cyprus, Estonia, Germany, Greece, Hungary, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal).

Booster doses

The frequency of booster dose administration after 24 months varies across countries. In general, by school entry, children should have received four to five doses of polio-containing vaccines. This is expected to provide at least 99% protection against severe disease. WHO recommends that individuals receive at least four doses of polio-containing vaccine to ensure protection against polio [23]

A limited number of EU/EEA countries recommend polio booster vaccination with an IPV containing vaccine at adolescence and adulthood. The frequency of booster dose administration varies across EU/EEA countries and some countries recommend regular boosting with IPV containing vaccines every 10 years in adulthood.

Travel vaccination

Specific temporary recommendations that apply for travellers to and from endemic areas are detailed by WHO and are endorsed by ECDC [1,23]. These recommendations vary according to the state of infection, the evidence of local transmission and the potential for international spread and are regularly revised.

Residents and long-term visitors (>four weeks) to countries infected with WPV1, cVDPV1 or cVDPV3 with potential risk of international spread as defined by WHO should receive a dose of bivalent oral poliovirus vaccine (bOPV) or inactivated poliovirus vaccine (IPV) between four weeks and 12 months prior to international travel. Those undertaking urgent travel (within four weeks) from infected areas, who have not received a dose of bOPV or IPV in the previous four weeks to 12 months, should receive a dose of polio vaccine at least by the time of departure.

Residents of or long-term visitors (>four weeks) to countries with local transmission of cVDPV2 with risk of international spread should be encouraged to receive a dose of IPV four weeks to 12 months prior to international travel.

Review of the vaccination status of the traveller, including polio, before international travel and completion of missing doses as needed is important.

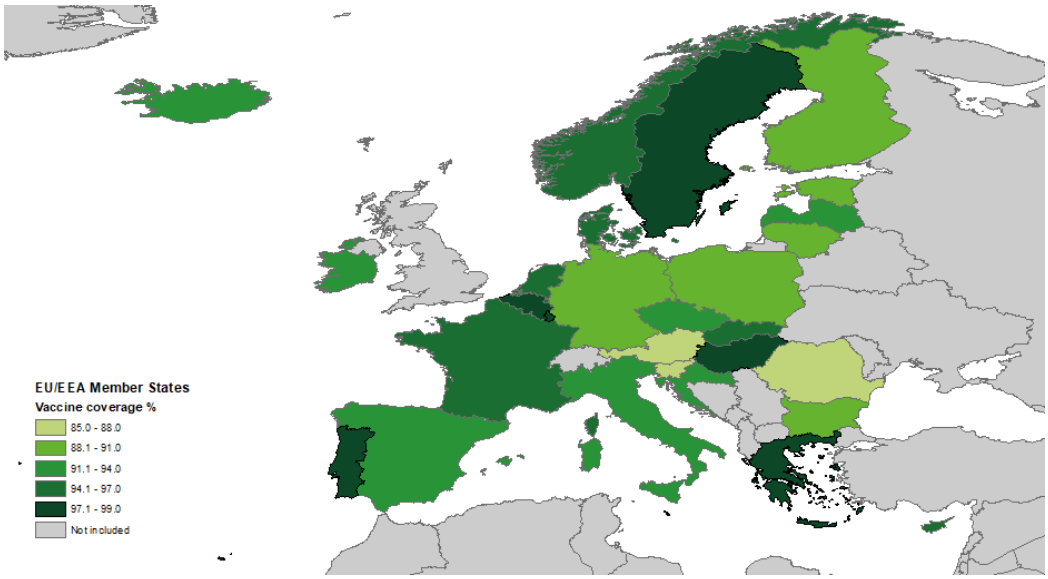
Vaccination coverage in the EU/EEA

Polio vaccination coverage is published on a yearly basis by WHO, following a data collection established by WHO and UNICEF [24]. Here we present an overview and analysis of the data related to the third dose of polio containing vaccine (POL3), WHO and UNICEF estimates of national immunization coverage (WUENIC) estimates.

Review of 2021 data

Data related to the year 2021 indicates that the average for EU/EEA countries was >90% (Figure 1, range 85-99%). The data refers to the national level and the existence of pockets of population sub-groups that are under immunised or not immunised where the coverage could be much lower is an important factor to consider, as the highest risk of reintroduction and sustained circulation of poliovirus in Europe occurs where susceptible populations are clustered together [25].

Figure 1. Vaccine coverage of three doses of polio containing vaccine in the EU/EEA 2021



Source: WUENIC POL3 estimates in WHO Immunization Data portal [24]

Review of vaccination coverage data for recent years, 2018-2021

This report has calculated the percentage change for POL3 vaccine coverage for the 2018 to 2021 period (table 1).

Analysing the WUENIC estimates for POL3 vaccination coverage (Annex 2) for the last four years with data available and which includes 2020 and 2021, years were health systems and immunisation programs could have been affected by the public health response measures implemented in light of the COVID19 pandemic, it is observed that 11 EU/EEA countries reported a decreased vaccination coverage during this four year period, with seven countries reporting a decrease of 2% or less. Overall, the range of decrease observed was between -1% and -8%, with a median of -2.8%. On the other hand, seven countries reported higher POL3 vaccination coverage estimates in 2021 than in 2018, six had an increase of 2% or less, with a median of 1.9%. The remaining countries reported the same vaccination coverage over this period.

These results highlight heterogeneity among countries, but also that despite the vaccine coverage for POL3 varying between 2021 and 2018 in EU/EEA countries, these changes were limited (≤2%) in the majority of the countries that experienced a change in vaccination coverage, indicating sustainment of vaccination programmes over the period which includes the most critical period related to the pandemic. In some situations, the impact of the COVID-19 pandemic on the overall performance of the vaccination programmes was subsequently or more recently counteracted.

Table 1. Vaccination coverage estimates presented in this report were obtained from the *WHO Global Health Observatory* website, WUENIC estimates [24]. The method of calculating POL3 coverage are outlined in the metadata available online

Country	2018	2021	Percentage of change between 2021-2018*
Austria	85	85	0
Belgium	98	98	0
Bulgaria	92	89	-3
Croatia	94	92	-2
Cyprus	97	96	-1
Czechia	96	94	-2
Denmark	97	97	0
Estonia	92	89	-3
Finland	91	89	-2
France	96	96	0
Germany	91	91	0
Greece	99	99	0
Hungary	99	99	0
Iceland	91	92	1
Ireland	94	94	0
Italy	95	94	-1
Latvia	96	94	-2
Lithuania	92	90	-2
Luxembourg	99	99	0
Malta	97	99	2
Netherlands	93	95	2
Norway	96	97	1
Poland	87	91	5
Portugal	99	99	0
Romania	86	86	0
Slovakia	96	97	1
Slovenia**	93	86	-8
Spain	96	92	-4
Sweden	97	98	1

Source: WHO Immunisation data portal, WUENIC estimates.
**Percentage of change between 2021-2018 was calculated as the percentage change in the mentioned period expressed in percentage i.e. [(coverage in 2021 – coverage in 2018)/coverage in 2018 x 100]*

*** Bilateral discussions with Slovenia indicate higher POL3 vaccine estimates for 2022.*

N.B: Liechtenstein was not included in this analysis as no national data for the POL3 WUENIC vaccine estimates was available.

Accumulation over time of susceptible population groups

When susceptible individuals are clustered in a population, including individuals who are under immunised or not immunised, this may lead to a higher risk of outbreaks occurring, as previously reported in measles outbreaks [26,27]. A review of the existing literature available highlights different factors that can drive the decrease of vaccination coverage observed across EU/EEA countries for multiple childhood vaccines. Among these factors, vaccine misinformation, vaccine accessibility, vaccine policies, vaccine hesitancy or delays in vaccine procurement could have a direct impact on the vaccine coverage observed [28,29].

In the EU/EEA, vaccination programs are defined in all countries to offer all new birth cohorts vaccines as programmed according to the national vaccination schedules. These schedules, including for IPV containing vaccines, are offered on an equitable basis, in accordance with international and national consensus. However, every year, a considerable proportion of infants do not receive the vaccines scheduled for their age group on time, due to multiple determinants [30]. Such vaccination gaps might pose a risk to the community especially when they cluster together, as low vaccination rates with three doses of poliovirus containing vaccine (POL3) might lead or facilitate poliovirus outbreaks in the community.

As described in Annex 2, WUENIC estimates for POL3 vaccination coverage in one year old infants (12 to 23 months of age) between 2012 to 2021 has varied across time and EU/EEA countries. The lowest POL3 vaccination coverage observed during the period under analysis corresponds to Romania in 2017 (82%), whereas in 2021 (most recent year with data available) the lowest POL3 vaccination coverage was observed in Austria (85%), followed by Romania (86%), Slovenia (86%), Bulgaria (89%), Estonia (89%) and Finland (89%).

While variation across the years and countries might reflects changes in methodology and data collection, they also suggest that protection at population level could be improved.

POL3 vaccination gap estimates for the 2012 to 2021 period

In order to estimate an approximate number of individuals not fully immunised with three doses in EU/EEA countries, a calculation to establish the number of individuals from the 12 to 23 months old cohort during 2001-2021 who may not have received three doses of polio-containing vaccine by date of ascertainment was performed (Table 2).

Results (Annex 3) indicated that 2 459 588 inhabitants among the 12-23 months old cohort in the 2012 to 2021 period were assessed as not having received three doses of polio-containing vaccine, and therefore to be at potential risk, at the time of the vaccine coverage assessment. This estimate of approximately 2.4 million inhabitants not having received the three doses by the time of assessment must be read with caution. Firstly, it is important to underline that these individuals might be protected by partial protection with one or two doses. Secondly, these individuals could have been vaccinated at a subsequent encounter with their healthcare provider after the formal assessment/calculation. Thirdly, countries have different methods of implementation of immunisation systems, with some countries using coverage surveys at a frequency that is less than annual [31]; for other countries with electronic immunisation registries, lack of registration for some parts of the health sector or delays in registration might affect these data.

These estimates also reflect the proportion of individuals who may not have been immunised in a timely manner with other antigens as part of combination vaccines including polio.

Following these calculations, only four countries (Belgium, Hungary, Malta and Sweden) are assessed as having an estimated accumulated immunisation gap of less than 2.5% for the 12 to 23 months old cohort over the 2012-2021 period (Table 2) according to the data reported.

Table 2. Cumulated 12-23 months old cohort and corresponding cumulated number of individuals not having received three doses of poliovirus containing vaccines in the EU/EEA, period 2012-2021

Country	Cumulated 12-23 months old cohort in the 2012 to 2021 period	Estimation of individuals of the 12-23 months old cohort in the 2012-2021 period not having received three doses of poliovirus containing vaccine by date of ascertainment	Percentage of individuals calculated as not having received three doses among the specific birth cohorts in the 2012 to 2021 period
Austria	840 358	89 659	10.7
Belgium	1 266 277	20 103	1.6
Bulgaria	669 181	54 579	8.2
Croatia	395 735	23 495	5.9
Cyprus	95 586	2 554	2.7
Czechia	1 135 846	37 223	3.3
Denmark	609 761	27 447	4.5
Estonia	145 038	11 123	7.7
Finland	571 122	36 364	6.4
France	7 750 723	237 529	3.1
Germany	7 363 467	608 548	8.3
Greece	991 954	9 920	5.9
Hungary	924 435	9 244	1.0
Iceland	44 401	3 971	8.9
Ireland	664 052	34 294	5.2
Italy	5 059 671	267 189	5.3
Latvia	206 606	9 100	4.4
Lithuania	300 327	22 464	7.5
Luxembourg	642 33	642	5.9
Malta	44 879	860	1.9
The Netherlands	1 765 876	87 768	5.0
Norway	607 260	26 938	4.4
Poland	3 916 335	333 601	8.5
Portugal	894 858	14 412	5.9
Romania	1 983 788	236 762	11.9
Slovakia	583 741	18 001	3.1
Slovenia	212 790	13 042	6.1
Spain	4 398 024	194 321	4.4
Sweden	1 184 110	28 434	2.4
Total EU/EEA	44 690 434	2 459 588	5.5

N.B: Liechtenstein was not included in this analysis as no national data for the POL3 WUENIC vaccine estimates was available.

Source: WUENIC POL3 estimates in WHO Immunization Data portal and EUROSTAT population data [24,32].

Review of selected published studies on seroprotection

A number of studies conducted in Europe have assessed the level of seroprotection conferred across time by IPV and OPV vaccines in the general population in the EU/EEA. A review of this peer-reviewed publications has been carried out in this report and the main results are summarised in Table 3. This section presents a review of recent literature available in Pubmed carried out in February 2023 using 'poliovirus' AND 'seroprevalence' as free-text descriptors in English language (n=234). Only articles published from 2000 onwards in peer reviewed journals and conducted in EU/EEA countries were included in this analysis, regardless of the language of the manuscript (n=20). Other studies focusing on the migrant or refugee population conducted during the study period in the EU/EEA (n=5), were excluded from this analysis as their immunisation status may not be representative of the average immunisation status of citizens in EU/EEA countries.

Table 3. Poliovirus seroprevalence studies in the EU/EEA referenced in Pubmed, 2000-2023

Publication	Year of publication	Country of analysis	Target population under analysis	Main seroprevalence results
Seroprevalence of antibodies to poliovirus in individuals living in Portugal, 2002 [33]	2002	Portugal	All population >2 year of age. (n=3525)	The overall neutralising antibody prevalence was 91.6%, 94.2% and 75.1% for poliovirus types 1, 2 and 3, respectively.
A seroprevalence study of poliovirus antibody against a collection of recombinant and non-recombinant poliovirus vaccine strains in the population of southern Greece [34]	2010	Greece	0–40 years age group in the general population. (n=160)	Better seroprotection against poliovirus types 1 and 2 than poliovirus 3. Heterogenous results among age groups.
Is Italian population protected from Poliovirus? Results of a seroprevalence survey in Florence, Italy [35]	2018	Italy	0-65 age group in the general population. (n=328)	The overall neutralising antibody prevalence was 75.3%, 69.2% and 46% for poliovirus types 1, 2 and 3, respectively. The protective titres of neutralising antibodies were generally higher in children up to 14 years of age. From the age of 11 years, most of the study subjects were seronegative for poliovirus type3.
Assessment of seroprevalence against poliovirus among Italian adolescents and adults [36]	2019	Italy	12-50 age group in the general population. (n=1073)	The overall neutralising antibody prevalence was 92.9%, 96.2% and 83.4%, for poliovirus types 1, 2 and 3, respectively. With increasing age, a decreasing trend in seropositivity was observed, in particular for poliovirus type 3.
Immunity against vaccine-preventable diseases in Finnish paediatric healthcare workers in 2015 [37]	2017	Finland	Paediatric health care workers in Helsinki Children's Hospital (n=157)	All cohort had measurable levels of antibodies against all three polioviruses and were most likely protected against the disease. The lowest titers were almost exclusively seen against poliovirus type 3.
Immunity to Poliomyelitis in the Netherlands [38]	2001	The Netherlands	0-79 age group in the general population and a group of orthodox reformed persons. (n=7773; n=236)	The overall neutralising antibody prevalence was 96.6%, 93.4% and 89.7%, for poliovirus types 1, 2 and 3, respectively in the general population group. The overall neutralising antibody prevalence was 65.0%, 59.0% and 68.7%, for poliovirus types 1, 2 and 3, respectively in the orthodox reformed persons group.
Age-specific seroprevalence of poliomyelitis, diphtheria and tetanus antibodies in Spain [39]	2002	Spain	2-39 age group in the general population. (n=3932)	Prevalence of antibodies against all three types of polioviruses exceeded 94% across all age groups. Heterogenous results among age groups.
A seroprevalence study of poliovirus antibody in the population of northern Greece [40]	2005	Greece	3-month-old to >70 age group in the general population. (n=1064)	The overall neutralising antibody prevalence was 91.1%, 92.1%, and 83.1% for poliovirus types 1, 2 and 3, respectively. For poliovirus type 3, a gap in immunity was found in individuals aged 10–29 years.
Long-term persistence of poliovirus neutralizing antibodies in the era of polio elimination: An Italian retrospective cohort study [41]*	2021	Italy	Medical students and residents of the University of Bari. (n=6105)	The overall neutralising antibody prevalence was >99%, > 98%, and almost 93% for poliovirus types 1, 2 and 3, respectively. Protective antibodies against all three viruses persisted for at least up to 18 years after administration of the last OPV dose.
Seroepidemiology of polioviruses among university students in northern Italy [42]	2012	Italy	Healthy students from Padua University. (n=318)	The overall neutralising antibody prevalence was 73.3%, 92.8%, and 77.4% for poliovirus types 1, 2 and 3, respectively.
Prevalence of anti-poliovirus type 1, 2 and 3 antibodies in unvaccinated Italian travellers [43]	2006	Italy	50-59 years age group from general population, mainly travellers. (n=98)	The overall neutralising antibody prevalence was 86.7%, 89.9%, and 86.7%, for poliovirus types 1, 2 and 3, respectively. All travellers presented protective antibody titres against at least one of the three poliovirus types.

Publication	Year of publication	Country of analysis	Target population under analysis	Main seroprevalence results
Immunity status against poliomyelitis in Germany: Determination of cut-off values in International Units [44]	2002	Germany	1-79 years age group from general population. (n=2564)	The overall neutralising antibody prevalence was 96.2%, 96.8% and 89.6% for poliovirus types 1, 2 and 3, respectively.
Immunity against poliomyelitis in the Netherlands, assessed in 2006 to 2007: the importance of completing a vaccination series [45]	2014	The Netherlands	0-79 years age group from general population and a group of low vaccination uptake. (n=6386; n=1581)	In the general population group, the overall neutralising antibody prevalence was 94.6%, 91.8% and 84.0%, for poliovirus types 1, 2 and 3, respectively. In the orthodox protestant group, the overall neutralising antibody prevalence was 64.9%, 61.0% and 62.1%, for poliovirus types 1, 2 and 3, respectively.
Evaluation of the immunity level achieved with the oral polio vaccine in schoolchildren aged 6 to 12 years of Catalonia (Spain) [46]	2006	Spain	Schoolchildren aged 6-12 years of age in Catalonia. (n=197)	The overall neutralising antibody prevalence was 94.4%, 98.5% and 73.1%, for poliovirus types 1, 2 and 3, respectively.
Child and Youth Health Survey (KiGGS): Immunity situation against poliomyelitis [47]	2007	Germany	0-17 age group (n=2046)	The overall neutralising antibody prevalence was 97.4%, 97.6% and 93.6%, for poliovirus types 1, 2 and 3, respectively. 91.7% of the sample tested had antibodies against all three poliovirus types. Only 26 children simultaneously lacked neutralizing antibodies for all three serotypes (1.3% of total sample).
Antibodies against vaccine-preventable diseases in pregnant women and their newborns [48]	2004	Germany	Pregnant women and their newborn babies. (n=290 women)	The overall neutralising antibody prevalence was 62.4%, 64.1% and 63.8%, for poliovirus types 1, 2 and 3, respectively, in the pregnant women group. The seroprevalences of the antibodies in the newborn group were not significantly different from those of their mothers.
Poliovirus Antibody Seroprevalence among Laboratory Staff at the National Center of Infectious and Parasitic Diseases, Sofia, Bulgaria [49]	2020	Bulgaria	Laboratory staff employed at the National Center for Infectious and Parasitic Diseases in Sofia, Bulgaria. (n=24)	The overall neutralising antibody prevalence was 100% and 79% for poliovirus types 1 and 3, respectively, among the personnel employed who is handling stool specimens. Poliovirus type 2 antibodies were not assessed in this study.
Status of immunity against poliomyelitis in the acute flaccid paralysis (AFP) cases in Romania between 2009-2012 [50]	2014	Romania	Cases of acute flaccid paralysis reported across Romania between 2009 and 2012. (n=76)	The overall neutralising antibody prevalence was 80%, 79% and 71%, for poliovirus types 1, 2 and 3, respectively.
Immunity status against poliomyelitis in childbearing women in a province of northern Italy [51]	2013	Italy	Healthy mothers in the obstetrics department at University Hospital in Parma. (n=493)	The overall neutralising antibody prevalence was 74.8%, 85.21% and 91.2%, for poliovirus types 1, 2 and 3, respectively.

**This study has assessed the same population as "Long-Term Immunogenicity of Inactivated and Oral Polio Vaccines: An Italian Retrospective Cohort Study" [52] published in 2022 which has not been included in the above table.*

The peer-reviewed literature assessed in this document indicates that a majority of the individuals analysed have neutralising antibody levels. The presence of neutralising antibodies against poliovirus is considered a reliable correlate of protection against poliovirus [31]. Heterogenous results were observed among the different age groups analysed and the respective poliovirus assessed, but neutralising antibodies against all three types of poliovirus were present in the majority of individuals analysed and good protection against poliovirus types 1 and 2 was present in most of the age groups in the studies assessed in this analysis. Lower antibody titres were observed for poliovirus type 3 in most of these studies, although still conferring protection against the disease to a majority of the samples analysed.

While a majority of the individuals sampled had neutralising antibodies against poliovirus types 1, 2 and 3, an important minority of the population assessed in these studies showed an insufficient level of antibody titres, especially for poliovirus type 3. Additionally, studies assessed in this review also identified the existence of individuals with substantially lower proportions of protective levels against all types of poliovirus compared to the general population.

Nevertheless, these results need to be interpreted with caution, as seroprevalence may not be fully indicative of the immune status of these populations as scientific evidence is lacking that loss of detectable antibodies to poliovirus puts immunocompetent individuals at risk of paralytic disease [53].

Proceedings from the European Regional Certification Commission for Poliomyelitis Eradication

The Regional Certification Commission for the Poliomyelitis Eradication established by WHO carries out a careful and detailed annual review of the documentation that each country presents to demonstrate its progress and contributions to the eradication of polio.

Based on the surveillance data and the reports submitted by Member States, the RCC for the WHO European Region concluded that the evidence gave no indication of WPV and VDPV circulation in the European Region in 2021 and that the region continued to be free of endemic polio [31]. The RCC nevertheless expressed concern about possible undetected circulation in countries and highlighted increased circulation of cVDPV globally and in the European region as an area of concern. The RCC called upon Member States to maintain high-quality surveillance and sustain or achieve high vaccination coverage to prevent importation and transmission. In the EU, one Member States was reported as being at high risk of a sustained polio outbreak in the event of importation of WPV or emergence of circulating vaccine-derived poliovirus. Other non-EU Member States were also classified at high-risk, and these could represent potential routes of importation into the EU. The classification from the RCC includes a number of elements to categorise a risk, including reported population immunity, surveillance quality and other factors. Polio laboratory containment risks as well as the presence of preparedness and action plans are also discussed.

The RCC reinforced the importance of clinical and laboratory surveillance and the need for all countries to have updated outbreak response plans.

Considerations for the EU/EEA

The European Region was declared polio-free in 2002 and the last indigenous case of wild poliovirus was reported in 1998.

Owing to adequate surveillance methods and high vaccination coverage in the EU/EEA, any introduction of poliovirus in its wild form or as a vaccine-derived strains has not led to sustained transmission. These remain very rare events that have been managed successfully [25].

In 2022 there have been reports of the circulation of imported VDPV in the environment in Europe in areas where cVDPV were not detected previously but no cases were notified in the EU/EEA [31]. The worrying occurrence of outbreaks in other regions of cVDPV, which emerges and circulates due to lack of population polio immunity in some countries, shows the potential risk for further international spread. Genetic linkages could be established in the detections reported in Israel, USA and the United Kingdom. This highlights that every country remains at risk and that the likelihood of detection through environmental sampling in several places in the EU/EEA cannot be excluded.

The ongoing outbreaks of WPV1 in Pakistan and Afghanistan and the detection of WPV1 cases in Mozambique in 2022, genetically linked to a strain from Pakistan, further highlights the potential of international spread and indicates that there is still a risk of the disease being imported into the EU/EEA. This situation stresses the importance of maintaining and improving where necessary immunisation coverage against polio and the continued efforts that need to be sustained to reach global efforts of polio elimination.

On 2 February 2023, WHO announced that the international spread of polio remains a PHEIC and advised to maintain preventive measures that should be followed to prevent local and international spread. The IHR statement details the preventive measures that apply in case of travel to and from affected areas and calls for supplementary vaccination. ECDC endorses WHO's temporary recommendations with regard to EU/EEA citizens who are residents or long-term visitors (>four weeks) in countries with the potential risk of international spread of polio, as defined by WHO. They are recommended to receive an additional dose of poliovirus vaccine between four weeks and 12 months prior to international travel [1].

In Europe, in light of the detection of cVDPV2, but without evidence of local transmission, the United Kingdom has advised that for their population a targeted IPV booster dose should be offered to all children between the ages of 1 and 9 in defined geographical areas to ensure a high level of protection against the virus and to limit its further spread.

As highlighted in this report, according to the latest estimates from 2021, 23 out 29 countries reported a vaccination coverage of 90% or above for three doses of poliovirus containing vaccine (POL3). However, over the years, unvaccinated cohorts have built up over time and remain at risk of infection. Under immunised or unimmunised pockets of people in EU/EEA countries may represent potential risks for localised outbreaks of paralytic polio in the event of virus importation into these communities or widespread 'silent' circulation in the population [54].

To limit the risk of reintroduction and sustained transmission of WPV and cVDPV in the EU/EEA, it is therefore crucial:

- to ensure timely and high vaccine coverage in the general population by adherence to vaccine recommendations;
- to increase vaccination uptake through targeted communication and vaccination campaigns in particular in subnational areas with low vaccine coverage;
- to implement systems, including the use of immunisation information systems, in order to identify and reach out to the unvaccinated or partially vaccinated population with primary immunisation series and/or booster doses and offer these individuals vaccination.

EU/EEA countries should:

- ensure there are no immunity gaps in the population, through a review of polio vaccination coverage data at subnational and local level, and make efforts to close immunity gaps in geographic areas and population groups with inadequate vaccination uptake;
- ensure capacity to identify virus circulation through timely, sensitive and efficient surveillance systems including AFP surveillance and environmental surveillance whenever possible;
- remind healthcare providers that any opportunity should be used to check vaccination status including that of polio and update it according to national vaccine recommendations when needed;
- promote and monitor adherence to IHR recommendations for individuals undertaking international travel in areas considered at risk;
- ensure availability of up-to-date preparedness plans to detect and respond to WPV or VDPV detection or outbreaks;
- adhere to the Global Containment Strategy, and strive towards certification [55].

Consulted experts (in alphabetical order)

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Annex 1

Disease background

Wild polioviruses (WPV)

Poliomyelitis (polio) is a highly infectious disease caused by polioviruses. Humans are the only reservoir of the infection and poliovirus is targeted for eradication [56,57]. The virus is transmitted directly from person-to-person through the faecal-oral and oral-oral routes, and via faecal contamination of water or foods. The virus multiplies in the intestine and infected people excrete large quantities of the virus in their faeces. The majority of infected persons (95%) do not develop symptoms but if the virus invades the nervous system, it can cause acute flaccid paralysis (AFP) within a matter of hours. No specific therapy is available against the virus. Polio mainly affects children under five years of age. One in 200 infections leads to irreversible paralysis. Among those paralysed, 5–10% die when their breathing muscles become immobilised [58,59].

Wild polioviruses (WPV) are classified into types 1, 2 and 3 (WPV1, WPV2, WPV3) and there is limited cross-immunity between the types. Effective control and eradication of polio is based on achieving universally high vaccine induced immunity.

Poliovirus vaccination

There are two types of polio vaccines: oral live attenuated (weakened) vaccines (oral polio vaccine; OPV) and inactivated (killed) vaccine (inactivated polio vaccine; IPV) usually administered alongside other antigens as part of combination vaccines.

IPV contains all three virus types. OPV vaccines are produced in different combinations; trivalent OPV (tOPV), bivalent OPV (bOPV) containing types 1 and 3, and monovalent OPV (mOPV) containing weakened strains of type 1, 2 or 3, respectively. Until 2016, tOPV was the most used polio vaccine in the world. In 2016, there was a globally synchronized 'switch' to replace tOPV with bOPV containing only types 1 and 3. This was due to the longstanding absence of WPV2, and the burden of paralytic cases caused by both type 2 vaccine-associated paralytic polio (VAPP[1]) and circulating vaccine-derived poliovirus type 2 (cVDPV2). Indeed, for OPV2 fewer mutations are required to revert to virulence than for the other poliovirus types [60]. However, since the switch, inadequate outbreak response to new detections, delayed campaigns, and insufficient coverage with monovalent type 2 oral poliovirus vaccine (mOPV2) have contributed to widespread and persistent transmission of cVPDV2 in countries with initial outbreaks, importations into neighbouring regions and seeding of new cVDPV2 lineages [53].

Since the withdrawal of tOPV from routine immunisation in 2016, any type 2-containing OPV vaccines (tOPV or mOPV2) are used exclusively in supplementary immunisation activities such as outbreak response to type 2 poliovirus. In 2020, the WHO Prequalification Programme authorised the use of type 2 novel poliovirus vaccines (nOPV2) to be used in countries with cVDPV2 outbreaks. nOPV2 is a modified version of mOPV2 shown to be more genetically stable than mOPV2, making it significantly less likely to revert into a form which can cause paralysis in low immunity settings. This means a reduced risk of seeding new cVDPV2 outbreaks compared to mOPV2, which remains a safe and effective vaccine that protects against polio and has successfully stopped cVDPV2 outbreaks in the past. Stocks on nOPV2 are held by the WHO [53]. In March 2023, seven cVDPV2 cases due to nOPV were reported in Burundi (1) and Democratic Republic of Congo (6). To date, close to 600 million doses of nOPV2 have been administered across 28 countries globally, and the majority of countries have seen no further transmission of cVDPV2 after two immunization rounds [61].

IPV has the advantage of having no risk of causing VAPP or the development of virulent vaccine-derived polio viruses (VDPV[2]). OPV is more effective in inducing intestinal antibody production and hence more effective in interrupting virus transmission. The cost of OPV is very low and the oral administration facilitates rapid mass vaccination.

[1] Vaccine-associated paralytic polio (VAPP): AFP case occurring within 4–35 days of receipt of OPV with all of the following: (1) Sabin or Sabin-like strain poliovirus is isolated from stool specimens, (2) residual paralysis 60 or more days following onset, and (3) national expert review committee determines that there is clinical compatibility with poliomyelitis that cannot be associated with ongoing circulation of WPV or vaccine-derived poliovirus. (https://www.who.int/publications/m/item/vaccine-preventable-diseases-surveillance-standards-polio)

[2] Vaccine-derived poliovirus (VDPV): OPV-derived virus strains that have diverged from their parent type-specific Sabin strain by > 1%, (≥ 10 nucleotide changes) for types 1 and 3, or by > 0.6% (≥ 6 nucleotide changes) for type 2 in the complete VP1 genomic region (https://www.who.int/publications/m/item/vaccine-preventable-diseases-surveillance-standards-polio)

Vaccine-derived polioviruses

VDPV are genetically mutated OPV strains that have lost key attenuating mutations and resemble WPVs biologically. The live attenuated oral polio vaccine virus replicates in the intestine after vaccination and the vaccine-virus is usually excreted in the faeces for six to eight weeks. On rare occasions, and only in under-immunised populations, VDPV develop through a series of mutations and acquisition of genetic materials from other enteroviruses, a process that is estimated to take on average at least one year. The critical risk factor for VDPV development is the duration for which the vaccine virus circulates in a population. Average circulation time for OPV virus increases with lower vaccination coverage in the population, hence increasing the risk that VDPV strains will emerge. cVDPV[3] are strains that have taken on the neurovirulence and transmissibility of WPV and are associated with person-to-person transmission. Polio disease caused by cVDPV presents with the same symptoms as polio caused by WPV. An outbreak of cVDPV is defined by the appearance of a single or multiple cases of polio due to cVDPV.

While cVDPVs are rare, they have been increasing in recent years in some communities due to low-immunisation rates. After a region or a country observes interrupted circulation and transmission of WPV, cVDPV become the only form of the poliovirus that may affect a given region or country. When this happens, several rounds of high-quality supplementary immunisation activities are needed to interrupt circulation and the risk of outbreaks. The first documented cVDPV outbreaks were in Hispaniola in 2000 and in the Philippines in 2001 and since then detected in several regions and countries around the world.

cVDPVs are not related to, nor indicative of a re-emergence of wild poliovirus. The appearance of cVDPVs outbreaks is a key challenge in the final stage of polio eradication.

Risk factors for cVDPV emergence

A fully immunised population is protected against both vaccine-derived and wild polioviruses. It takes many months for a cVDPV to emerge. cVDPV outbreaks have the ability to become endemic, can be spread in any under-vaccinated community, and can be imported to other countries. Some of the factors favouring cVDPV emergence and spread are the same as for WPV circulation: low polio vaccine coverage rates or poorly conducted supplementary immunisation activities in areas where OPV use continues. The duration and extent of spread are dependent on the magnitude of the immunity gap and the intensity of other risk factors favouring poliovirus circulation (poor sanitation, high population density and tropical conditions) in the absence of high rates of polio vaccine coverage and naturally-acquired immunity. The previous elimination of indigenous WPV circulation increases the risk because the number of susceptible individuals will increase rapidly. Outbreaks occur when the density of non-immune persons rises to the point where the chains of cVDPV transmission can propagate. The size of a cVDPV outbreak is a function of the size of the non-immune population and the potential for the outbreak virus to transport to susceptible communities elsewhere. Countries that were (or are) major reservoirs for WPV circulation, and where the potential for person-to-person poliovirus transmission is greatest, are at particularly high risk of cVDPV emergence, and maintenance of high rates of polio vaccine coverage in these settings is essential.

Polio eradication

In 1988, the forty-first World Health Assembly adopted a resolution for the worldwide eradication of polio, the Global Polio Eradication Initiative (GPEI). Since then, global efforts to immunise children with the OPV have reduced WPV cases by 99.9%. WPV2 and WPV3 were declared eradicated in 2015 and 2019, respectively. Since then, WPV1 has been the only circulating WPV. In 2023, only two countries (Afghanistan and Pakistan) remain endemic for WPV1.

The last case of endemic paralytic polio in the WHO European Region (i.e. with the source of the infection originating in the Region) was reported in Türkiye in November 1998, and the Region was declared polio-free in June 2002. The most recent outbreaks linked to importations of WPV into the WHO European Region occurred in 2010 in Tajikistan and in 2013–2014 in Israel where WPV1 was circulating in the environment without causing clinical cases [62]. In the EU/EEA the latest cases of AFP due to WPV were reported in 2001 (three cases among Roma children in Bulgaria that were considered imported as the viruses were closely related to a strain isolated from India in 2000) and in 1992 (outbreak in a religious community opposing vaccination in the Netherlands) [63,64].

On 5 May 2014, WHO declared the international spread of WPV a Public Health Emergency of International Concern (PHEIC) following the confirmed circulation of WPV in several countries and the documented exportation

[3] cVDPV are defined as VDPV isolates for which there is evidence of person-to-person transmission in the community. These isolates must be genetically linked VDPVs, isolated from one the following: (i) at least two individuals (not necessarily AFP cases), who are not direct (household) contacts; (ii) one individual and one or more environmental surveillance (ES) samples; (iii) two or more ES samples if they were collected at more than one distinct ES collection site (no overlap of catchment areas), or from one site if collection was more than two months apart (https://www.who.int/publications/m/item/vaccine-preventable-diseases-surveillance-standards-polio).

of WPV to other countries. On 2 February 2023, WHO announced that the international spread of polio remains a PHEIC and renewed preventive measures to be followed to prevent local and international spread [1]. The IHR statement details the current global epidemiological situation and the preventive measures that apply in case of travel from and to affected areas.

In 2020, the GPEI launched a revision of the strategy for polio eradication [65]. The Polio Eradication Strategy 2022–2026 aims to achieve and sustain a polio-free world through a focus on implementation and accountability. The main goals of the revised strategy are to permanently interrupt all poliovirus transmission in the final WPV-endemic countries and to stop cVDPV transmission and prevent outbreaks in non-endemic countries. The GPEI plans to achieve these goals by limiting circulation of WPV to core reservoirs and shared corridors of transmission and interrupting all poliovirus within the reservoirs, by continuing to respond to breakthrough events to stop cVDPV2 transmission, shifting to an emergency management structure with clearly defined roles and responsibilities, developing and implementing a comprehensive accountability framework, increasing government ownership though political advocacy, and strengthening regional and country capacities for sensitive surveillance and rapid, high-quality response.

Polio surveillance

Acute flaccid paralysis and environmental surveillance

According to the EU case definition a polio case is any person <15 years of age with AFP from whom poliovirus (either WPV, VDPV or Sabin-like[4]) has been isolated or any person in whom polio is suspected by a physician and from whom poliovirus (either WPV, VDPV or Sabin-like) has been isolated.

AFP surveillance is the gold standard for detecting polio cases and essential for global polio eradication. AFP surveillance can work well in areas with limited resources and a high level of polio; however, since the polio virus only causes clinical illness in approximately 1/100–1/1 000 persons infected, AFP surveillance is a blunt surveillance tool because the virus may have been transmitting quite widely in a community before clinical cases are detected. AFP surveillance includes case finding, sample collection, laboratory analysis and mapping of the virus to determine the origin of the virus strain. To ensure sensitivity of surveillance, at least one case of non-polio AFP should be detected annually per 100 000 population aged below 15 years. In endemic regions, to ensure even higher sensitivity, this rate should be two per 100 000.

Environmental surveillance (detecting poliovirus in sewage water) may be a more sensitive tool to detect the transmission of poliovirus up to five weeks before clinical cases occur and when there may still be time to intervene to prevent disease. Environmental surveillance plays an increasingly important role for GPEI in its efforts to achieve and maintain a polio-free world. Through the examination of composite human faecal samples from untreated wastewater collection systems typically located downstream from high-risk populations, environmental surveillance provides valuable information on the presence or absence of poliovirus circulation in defined geographical areas. Though it cannot link poliovirus directly with infected individuals, it enhances the sensitivity of surveillance for AFP and can provide an early warning indicator on potentially multiple silent polio infections during an outbreak or in an endemic area. Therefore, to maintain poliovirus surveillance at the high sensitivity and specificity levels required to achieve and certify eradication, countries can rely on a combination of environmental and AFP surveillance.

The International Health Regulations (IHR) require that all countries have the ability to detect, assess, report, and respond to public health events. This includes the obligation to notify each polio case due to WPV [1]. In addition, national competent authorities of the EU Member States or the EU Commission shall notify an alert of a polio case in the EWRS according to EC decision 1082, Article 9 [66]. Furthermore, the EU/EEA countries should report confirmed polio cases to The European Surveillance System (TESSy) on an annual basis. This includes the reporting of zero cases if no cases have occurred. Countries are encouraged to use the 2018 EU case definition [67].

ECDC is not collecting information on environmental surveillance and is informed through the information shared by the EU/EEA countries via EWRS. Europe experiences constant importation of Sabin-like polioviruses and VDPV through international travel from OPV-using countries. Some self-limited local circulation is expected due to lack of mucosal immunity in countries using IPV only. Not all signals warrant an emergency response, but all environmental detections are a reminder of the constant pressure of poliovirus importation and the importance of filling known immunity gaps.

[4] Sabin-like: Any poliovirus isolate from human or environmental sample with any nucleotide difference from Sabin less than the number that meets the definition of a VDPV (https://www.who.int/publications/m/item/vaccine-preventable-diseases-surveillance-standards-polio).

Annex 2

Historic third dose of polio containing vaccine (WUENIC estimates) coverage among 1-year-olds estimates for the EU/EEA countries for the 2012-2021 period expressed in percentage

	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012
Austria	85	85	85	85	90	87	93	98	95	92
Belgium	98	98	98	98	98	98	99	99	99	99
Bulgaria	89	91	93	92	92	92	91	88	95	95
Croatia	92	94	94	94	92	93	94	95	96	96
Cyprus	96	96	96	97	97	97	97	99	99	99
Czechia	94	96	97	96	94	96	97	99	99	99
Denmark	97	97	97	97	98	94	93	94	94	94
Estonia	89	91	91	92	93	93	93	93	94	94
Finland	89	90	91	91	89	92	97	98	98	99
France	96	96	96	96	96	96	97	98	99	99
Germany	91	91	91	91	91	91	92	93	93	94
Greece	99	99	99	99	99	99	99	99	99	99
Hungary	99	99	99	99	99	99	99	99	99	99
Iceland	92	93	93	91	89	91	92	90	91	89
Ireland	94	94	94	94	95	95	95	96	96	95
Italy	94	94	96	95	95	93	93	95	96	96
Latvia	94	99	99	96	98	98	94	92	94	91
Lithuania	90	91	92	92	94	94	93	93	93	93
Luxembourg	99	99	99	99	99	99	99	99	99	99
Malta	99	98	98	97	98	97	97	99	99	99
Netherlands	95	94	94	93	94	95	95	96	97	97
Norway	97	97	97	96	96	96	95	93	94	95
Poland	91	91	87	87	90	92	92	94	95	95
Portugal	99	99	99	99	98	98	98	98	98	98
Romania	86	87	88	86	82	89	89	94	88	92
Slovakia	97	97	97	96	96	96	96	97	98	99
Slovenia	86	95	95	93	94	94	95	95	95	96
Spain	92	94	95	96	95	97	97	97	96	96
Sweden	98	97	98	97	97	98	98	97	98	98

Source: WUENIC third dose of polio containing vaccine estimates in WHO Immunization Data portal.

Annex 3

In this annex, an expanded table with the 2012-2021 series for the 12 to 23 months old cohort vaccination gap estimate for the EU/EEA country is available.

Variable definition and data sources:

Country cohort population: Total number of two-year-old infants (12-23 months) per corresponding country and year. Source: Eurostat, Population on 1 January by age and sex [DEMO_PJAN] last update: 22/06/2022) 23:00 [32]

POL3 coverage: Vaccine coverage of three doses of poliovirus containing vaccine in specific country and year. Source: WUENIC POL3 estimates in WHO Immunization Data portal [24]

Individuals as not having received three doses among the specific birth cohorts in the 2012 to 2021 period: Estimated susceptible population to poliovirus defined as not having received a completed course of three doses by the time of assessment of poliovirus containing vaccine among the two-year-old birth cohort (12-23 months) applying the methodological calculations detailed above.

Methodology:

For the purpose of estimating the number of individuals susceptible to poliovirus, defined as not having received a complete course of 3 doses of IPV containing vaccine by the time of assessment, the following equation has been used: Immunity gap among cohort population = country cohort population (month 12 – month 23) under analysis in specific year "Y" x POL3 coverage in specific year "Y"/100 - country cohort population under analysis in specific year "Y".

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria (cohort population)	77 993	80 661	80 215	81 485	82 654	85 379	86 505	89 401	88 978	87 087
POL3 coverage	92%	95%	98%	93%	87%	90%	85%	85%	85%	85%
Immunity gap among cohort population	6 239	4 033	1 604	5 704	10 745	8 538	12 975	13 410	13 346	13 063
Belgium (cohort population)	130 525	132 111	130 248	129 363	127 278	127 120	124 212	123 554	121 595	120 271
POL3 coverage	99%	99%	99%	99%	98%	98%	98%	98%	98%	98%
Immunity gap among cohort population	1 305	1 321	1 302	1 294	2 546	2 542	2 484	2 471	2 432	2 405
Bulgaria (cohort population)	72 786	69 058	68 720	67 320	65 022	67 376	65 935	65 440	64 683	62 841
POL3 coverage	95%	95%	88%	91%	92%	92%	92%	93%	91%	89%
Immunity gap among cohort population	3 639	3 453	8 246	6 059	5 202	5 390	5 275	4 581	5 821	6 913
Croatia (cohort population)	44 149	43 341	40 968	41 748	39 649	39 023	36 828	37 049	36 296	36 684
POL3 coverage	96%	96%	95%	94%	93%	92%	94%	94%	94%	92%
Immunity gap among cohort population	1 766	1 734	2 048	2 505	2 775	3 122	2 210	2 223	2 178	2 935
Cyprus (cohort population)	10 058	10 102	9 576	9 985	9 280	9 257	9 168	9 452	9 379	9 329
POL3 coverage	99%	99%	99%	97%	97%	97%	97%	96%	96%	96%
Immunity gap among cohort population	101	101	96	300	278	278	275	378	375	373
Czechia (cohort population)	121 285	119 504	109 287	109 591	108 700	111 538	112 137	113 801	115 264	114 739
POL3 coverage	99%	99%	99%	97%	96%	94%	96%	97%	96%	94%
Immunity gap among cohort population	1 213	1 195	1 093	3 288	4 348	6 692	4 486	3 414	4 611	6 884
Denmark (cohort population)	6 3842	6 4422	6 0046	59 134	57 484	58 520	59 523	62 675	62 148	61 967
POL3 coverage	94%	94%	94%	93%	94%	98%	97%	97%	97%	97%
Immunity gap among cohort population	3 831	3 865	3 603	4 139	3 449	1 170	1 786	1 880	1 864	1 859
Estonia (cohort population)	15 765	15 864	14 657	14 149	13 879	13 833	14 202	14 241	13 903	14 545
POL3 coverage	94%	94%	93%	93%	93%	93%	92%	91%	91%	89%
Immunity gap among cohort	946	952	1026	990	972	968	1136	1282	1251	1600

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
population										
Finland (cohort population)	61 109	61 830	60 741	60 419	59 050	58 331	56 167	53 817	51 271	48 387
POL3 coverage	99%	98%	98%	97%	92%	89%	91%	91%	90%	89%
Immunity gap among cohort population	611	1237	1215	1813	4724	6416	5055	4844	5127	5323
France (cohort population)	803 643	811 397	803 353	798 153	784 803	781 440	763 306	748 343	734 914	721 371
POL3 coverage	99%	99%	98%	97%	96%	96%	96%	96%	96%	96%
Immunity gap among cohort population	8 036	8 114	16 067	23 945	31 392	31 258	30 532	29 934	29 397	28 855
Germany (cohort population)	669 579	684 310	672 324	694 369	715 608	753 217	770 628	802 651	802 415	798 366
POL3 coverage	94%	93%	93%	92%	91%	91%	91%	91%	91%	91%
Immunity gap among cohort population	40 175	47 902	47 063	55 550	64 405	67 790	69 357	72239	72217	71853
Greece (cohort population)	115 191	110 394	105 719	99 577	93 427	93 147	94 663	96 953	92 782	90 101
POL3 coverage	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
Immunity gap among cohort population	1 152	1 104	1 057	996	934	931	947	970	928	901
Hungary (cohort population)	96 679	90 027	88 050	90 971	89 987	93 369	92 247	95 429	94 481	93 195
POL3 coverage	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
Immunity gap among cohort population	967	900	881	910	900	934	922	954	945	932
Iceland (cohort population)	4 880	4 858	4 509	4 574	4 349	4 373	4 218	4 157	4 156	4 327
POL3 coverage	89%	91%	90%	92%	91%	89%	91%	93%	93%	92%
Immunity gap among cohort population	537	437	451	366	391	481	380	291	291	346
Ireland (cohort population)	72 015	70 922	71 127	67 994	66 327	64 513	63 051	63 519	62 937	61 647
POL3 coverage	95%	96%	96%	95%	95%	95%	94%	94%	94%	94%
Immunity gap among cohort population	3 601	2 837	2 845	3 400	3 316	3 226	3 783	3 811	3 776	3 699
Italy (cohort population)	554 608	549 886	546 986	535 706	511 760	502 078	486 949	470 813	457 314	443 571
POL3 coverage	96%	96%	95%	93%	93%	95%	95%	96%	94%	94%
Immunity gap among cohort population	22 184	21 995	27 349	37 499	35 823	25 104	24 347	18 833	27 439	26 614
Latvia (cohort population)	21 175	19 150	18 819	20 066	20 888	22 035	22 161	22 083	20 876	19 353
POL3 coverage	91%	94%	92%	94%	98%	98%	96%	99%	99%	94%
Immunity gap among cohort population	1 906	1 149	1 506	1 204	418	441	886	221	209	1 161
Lithuania (cohort population)	31 190	30 330	30 105	30 383	29 823	30 030	30 861	30 380	28 916	28 309
POL3 coverage	93%	93%	93%	93%	94%	94%	92%	92%	91%	90%
Immunity gap among cohort population	2 183	2 123	2 107	2 127	1 789	1 802	2 469	2 430	2 602	2 831
Luxembourg (cohort population)	5 894	6 230	6 296	6 347	6 558	6 574	6 495	6 489	6 645	6 705
POL3 coverage	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
Immunity gap among cohort population	59	62	63	63	66	66	65	65	66	67
Malta (cohort population)	4 068	4 013	4 339	4 421	4 329	4 457	4 743	4 892	4 821	4 796
POL3 coverage	99%	99%	99%	97%	97%	98%	97%	98%	98%	99%
Immunity gap among cohort population	41	40	43	133	130	89	142	98	96	48
The Netherlands (cohort population)	185 690	184 869	180 172	176 388	172 395	176 866	172 815	174 256	171 951	170 474
POL3 coverage	97%	97%	96%	95%	95%	94%	93%	94%	94%	95%
Immunity gap among cohort population	5 571	5 546	7 207	8 819	8 620	10 612	12 097	10 455	10 317	8 524

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Norway (cohort population)	63 713	63 427	62 163	62 098	60 435	60 572	60 482	60 347	57 881	56 142
POL3 coverage	95%	94%	93%	95%	96%	96%	96%	97%	97%	97%
Immunity gap among cohort population	3 186	3 806	4 351	3 105	2 417	2 423	2 419	1 810	1 736	1 684
Poland (cohort population)	429 002	413 175	388 716	388 715	369 496	375 502	372 037	385 622	405 022	389 048
POL3 coverage	95%	95%	94%	92%	92%	90%	87%	87%	91%	91%
Immunity gap among cohort population	21 450	20 659	23 323	31 097	29 560	37 550	48 365	50 131	36 452	35 014
Portugal (cohort population)	96 085	99 508	95 687	89 661	82 848	82 572	85 959	87 601	87 024	87 913
POL3 coverage	98%	98%	98%	98%	98%	98%	99%	99%	99%	99%
Immunity gap among cohort population	1 922	1 990	1 914	1 793	1 657	1 651	860	876	870	879
Romania (cohort population)	215 521	206 839	184 057	180 820	187 544	198 295	199 918	201 740	202 185	206 869
POL3 coverage	92%	88%	94%	89%	89%	82%	86%	88%	87%	86%
Immunity gap among cohort population	17 242	24 821	11 043	19 890	20 630	35 693	27 989	24 209	26 284	28 962
Slovakia (cohort population)	59 722	57 903	61 242	56 576	55 942	56 394	57 279	59 358	59 802	59 523
POL3 coverage	99%	98%	97%	96%	96%	96%	96%	97%	97%	97%
Immunity gap among cohort population	597	1158	1837	2263	2238	2256	2291	1781	1794	1786
Slovenia (cohort population)	22 057	22 683	22 178	22 109	21 222	21 209	20 614	20 461	20 410	19 847
POL3 coverage	96%	95%	95%	95%	94%	94%	93%	95%	95%	86%
Immunity gap among cohort population	882	1 134	1 109	1 106	1 273	1 273	1 443	1 023	1 021	2 779
Spain (cohort population)	494 158	481 415	472 652	452 560	427 406	432 142	428 572	421 914	405 115	382 090
POL3 coverage	96%	96%	97%	97%	97%	95%	96%	95%	94%	92%
Immunity gap among cohort population	19 766	19 257	14 180	13 577	12 822	21 607	17 143	21 096	24 307	30 567
Sweden (cohort population)	114 285	118 224	114 560	116 389	117 126	120 165	120 381	123 525	120 030	119 425
POL3 coverage	98%	98%	97%	98%	98%	97%	97%	98%	97%	98%
Immunity gap among cohort population	2 286	2 365	3 437	2 328	2 343	3 605	3 611	2 471	3 601	2 389

N.B: Liechtenstein was not included in this analysis as no national data for the third dose of polio containing vaccine WUENIC vaccine estimates were available.