Public Health England

Protecting and improving the nation's health

PHE national polio guidelines

Local and regional services

About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-leading science, research, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health and Social Care, and a distinct delivery organisation with operational autonomy. We provide government, local government, the NHS, Parliament, industry and the public with evidence-based professional, scientific and delivery expertise and support.

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Executive summary

This document provides guidance for the surveillance, investigation and management of suspected polio cases and response to a facility-associated release for the UK to meet World Health Organization (WHO) global requirements as part of the polio eradication programme. This includes guidance on enhanced enteroviral and environmental surveillance.

Introduction

WHO continues its efforts to eradicate polio worldwide and believes that this goal is attainable, even in the most challenging settings in the world. Once eradication is achieved, and prior to any decision to stop mass immunisation against polio, it is essential to demonstrate that all countries are free of poliovirus circulation. Certification of a country or region as polio free requires demonstration that surveillance systems are adequate to detect any endemic poliovirus infections.

In 1997 to 1998, the Public Health Laboratory was asked to prepare part of the UK submission to the WHO commission for the certification of eradication of polio in the European region. This aimed to demonstrate that current clinical and laboratory practice was adequate to detect cases of paralytic illness, aseptic meningitis and asymptomatic infection due to wild poliovirus.

The UK submission was forwarded from the Department of Health in spring 1998 and it was accepted by the commission that the UK was free of wild poliovirus. Formal certification could not proceed, however, until the whole European region had been free of wild polio for 3 years. Europe was declared polio free in 2002.

It is essential that enhanced surveillance of poliovirus continues as importation from remaining affected countries is still possible. Furthermore, outbreaks of poliomyelitis caused by vaccine derived strains have occurred in countries certified as polio-free and where vaccine uptake has fallen.

Once poliovirus has been eradicated and countries establish essential facilities where the virus is handled (PEFs), there remains the possibility of facility-associated containment breaches, which necessitates a plan for the response and management of those who are exposed.

In 2004, the UK changed from using live oral polio vaccine (OPV) to inactivated vaccine (IPV). All poliovirus detections should now be investigated.

Surveillance

Rationale for surveillance

Although the UK has been certified as polio free, in order to maintain this status there is a need to demonstrate that cases with a possible diagnosis of poliomyelitis are adequately investigated to exclude infection with wild poliovirus. Supporting evidence is also provided by the ability to identify correctly non-polio enteroviruses and vaccine strains of poliovirus. Detailed review of the clinical and laboratory data from all suspected cases of paralytic poliomyelitis (including cases of acute flaccid paralysis with persistent paralysis) should be performed by the UK Expert Panel. Cases of paralysis which are not adequately investigated should also be subjected to clinical review.

Surveillance of cases with neurological symptoms

Investigations of suspected poliovirus cases (see Appendix 1 for case definition) are undertaken by laboratories and the local Public Health England (PHE) health protection teams (HPTs) with advice from PHE National Infection Service (NIS), Colindale. Information from local laboratories, HPTs and clinicians is collated by NIS, Colindale. Public health response to a suspected case should be coordinated between the local health protection teams and NIS.

A particularly high priority is to obtain 2 fresh stool specimens (at least 24 hours apart) within 7 days of onset of symptoms in cases

Laboratories should discuss all cases of suspected polio with the PHE Virus Reference Department or NIS Colindale at an early stage. Such cases should also be reported to the local PHE Health Protection Team or equivalent in the devolved administrations. Laboratories should recommend the following additional investigations in cases of suspected polio:

- enterovirus PCR and/or viral culture of stool
- enterovirus PCR on throat swabs / NPAs
- enterovirus PCR on CSF
- biochemistry, microscopy and viral culture of CSF specimens
- viral culture of throat swabs / NPAs
- viral culture and/or PCR of stool from household contacts
- acute and convalescent serum samples

(see Appendix 1 for details)

The appropriate samples from clinically suspect cases should be sent urgently to PHE Virus Reference Department regardless of local testing result to ascertain if there is evidence of enterovirus and if any detected enterovirus is a polio-vaccine or wild-type strain. Poliovirus-specific investigations detailed on the next page are available at PHE VRD:

- poliovirus-specific PCR on stool, CSF or throat swabs/NPA
- virus isolation from stool and/or throat swabs/NPA
- intratypic poliovirus typing (to help differentiate between wild strains and vaccine-like strains)
- acute and convalescent serum for the detection of neutralising antibody to poliovirus 1, 2 and 3 in acute and convalescent serum samples (available at Virus Reference Department)

Laboratories should assist PHE NIS and the local health protection team with the public health response to suspected cases (see Appendix 2).

NIS will collate data on cases of suspected poliomyelitis from any source (samples reporting ‘paralysis’ referred to either the Enteric Virus Unit or Polio Reference Service, Virus Reference Department or reported to NIS) according to agreed case definitions (see Appendix 2).

PHE NIS will obtain clinical information on cases of suspected paralytic polio (see questionnaire Appendix 4). Assistance should be given to obtain further clinical information whenever a poliovirus is detected in the laboratory. This includes:

- demographic information
- clinical history (presence of any polio-like symptoms, clinical course and outcome)
- additional investigations (e.g. MRI, nerve conduction studies)
- immune status (immunocompromised or immunocompetent)
- full documented polio vaccination history from the GP
- recent (<4 weeks) travel history in case and family members

Enhanced surveillance of enterovirus meningitis and other syndromes

To supplement acute flaccid paralysis surveillance, enhanced surveillance of aseptic meningitis and other clinical syndromes is also recommended. It is recommended that enterovirus positive CSF samples and positive nucleic acid extracts are also submitted to the Virus Reference Department for typing. It is very important that throat swabs/NPA and stool samples are also taken from acute cases.

Local laboratories should refer the following to either the Enteric Virus Unit or the Polio Reference Service, Virus Reference Department (see Appendix 1):

- all poliovirus isolates or clinical samples from which poliovirus has been detected by molecular or serological methods (PRS)
- untypable enterovirus isolates
- CSF samples that are enterovirus positive by PCR
- enterovirus isolates and PCR-positive enterovirus samples from cases with paralytic symptoms
- enterovirus isolates and PCR-positive enterovirus samples from cases with neurological conditions (include those that mention AFP/meningitis / encephalitis / meningism / irritability / headache / convulsions / apnoea and sudden death on the request form)
- enterovirus isolates and PCR-positive samples from immunosuppressed persons
- enterovirus PCR-positive clinical samples and enterovirus isolates from people with myocarditis

NB: RNA extracts or cDNA should only be sent if original clinical material is unavailable and further clinical material cannot be obtained. If cDNA has to be sent, it should be generated through reverse transcription with random priming (random hexamers).

The NIS will collate information on poliovirus and enterovirus isolates and identifications reported to NIS and referred to the Enteric Virus Unit, Virus Reference Department.

Surveillance of environmental samples

Environmental surveillance for poliovirus is recommended by WHO in populations as a supplement to existing surveillance approaches including enhanced enterovirus and acute flaccid paralysis (AFP) surveillance where conditions exist that render the population at risk for poliovirus circulation (for example, low polio vaccination coverage or risk of poliovirus importation).

See Appendix 5 (protocol for environmental surveillance)

Containment

The UK will minimise the risk of reintroduction of polio through release from facilities holding poliovirus or samples that may contain poliovirus. Substantial steps have already been made towards meeting the requirements of the initial phase of the WHO Global Action Plan, third edition. (WHO Global Action Plan, third edition.) http://polioeradication.org/wp-content/uploads/2016/12/GAPIII_2014.pdf

As part of the initial UK response to the WHO initiative the Public Health Laboratory Services compiled a national inventory of facilities holding polio materials, starting in 2001 (see Annex 4.5). An inventory maintained by Public Health England (the successor to Public Health Laboratory Services) shows that <10 sites across the UK now knowingly retain poliovirus. Any additional laboratory that acquires or isolates wild poliovirus or vaccine virus or stores untyped enterovirus should inform the UK polio containment co-ordinator (polio@phe.gov.uk). All laboratories are encouraged to find an alternative to the use of wild poliovirus and to destroy all unneeded material.

In laboratories that continue to isolate, store or use poliovirus, the current legal requirements for work with biological agents that present a risk to human health are outlined in the Control of Substances Hazardous to Health (COSHH) 2002 regulations (http://www.hse.gov.uk/COSHH/index.htm). At present in the UK, poliovirus type 2 is now a hazard group 3 pathogen, and the other polio types are group 2 pathogens. Work involving this virus, or materials containing the virus, should be undertaken at CL2 or 3 as required. The WHO guidelines are detailed in the Global Action Plan, third edition (http://polioeradication.org/wp-content/uploads/2016/12/GAPIII_2014.pdf)

To contribute to containment**,** if wild or vaccine related polio is isolated in the laboratory then all relevant sample(s) should be dealt with through either one of the following methods:

- sent to Virus Reference Department, Colindale
- notified to the ‘Poliovirus register’ if the samples are to be retained in local laboratory
- inactivated and then discarded

Public health management of a potential polio exposure within a laboratory or vaccine manufacturer (a containment breach)

Possible polio exposure by ingestion or inhalation

1. A risk assessment will be performed by a medical consultant as soon as possible. Information required for the assessment will include:

- what material was involved (that is potentially infected material (PIM): clinical samples, environmental surveillance material, virus culture, or known virus stocks)
- the potential virus load and volume of the material involved in the exposure
- which polioviruses may have been involved (polio type and whether vaccine related, vaccine derived or wild-type) (appendix 2)
- use of adequate PPE at the time of the break
- the potential for ingestion or inhalation of poliovirus in the incident
- the immune status of the exposed individual and their vaccination history
- the immediate actions taken following the incident to limit exposure and decontaminate the individual

2. A report of the incident will be given as soon as possible to the local Health Protection team and to PHE Immunisation Deputy Director or their acting deputies.

3. If the incident involves a known polio virus (that is not PIM) the incident must be reported to HSE and WHO in a timely manner. If a PIM it must be notified to HSE and WHO if polio virus is confirmed in the sample.
4. If there is any potential for ingestion or inhalation of poliovirus, the management of the exposed person will depend on the material exposed. The following control measures, and collection of samples should be implemented.

	Vaccine-related poliovirus 1 or 3	Vaccine-related poliovirus 2, or PIM containing vaccine related poliovirus 2	Wild-type polio or vaccine-derived polioviruses including PIM with confirmed virus/VDPV
Isolation	None	At home	At home provided good compliance
Isolation duration	n/a	7 days if all testing negative	7 days if all testing negative
Management of faeces	General sewerage.	General sewerage. Dedicated (own use) toilet if possible	Dedicated, own use toilet. Faecal material collected and incinerated
Cleaning/disinfection	Household bleach	Household bleach	Effective disinfection

			including hypochlorite, glutaraldehyde and or formaldehyde
Waste disposal	Good practice	Good practice	Managed as infectious waste
Food handling (for other people)	Not permitted	Not permitted	Not permitted
Visitors	n/a	Should be discouraged, but may be permitted if appropriate vaccination history	Only family /friends with proven vaccination history or immunity

5. Daily testing of a nose/throat sample and stool sample for at least 7 days, beginning 3 days after the possible exposure. If any of the samples are positive then manage as a confirmed case (see next section)

Public health management of a case and consideration of post-exposure prophylaxis

Detection of poliovirus in a person or the environment including a containment breach

In such cases:

- Health Protection Team (HPT) to initiate appropriate investigations of case and contacts immediately (see Appendix 2 for definitions) – report immediately to PHE NIS (Colindale/Virus Reference Department)
- begin rapid risk assessment undertaken led by NIS Colindale and decide risk level (or equivalent in devolved administrations)
- HPT to ensure appropriate samples (see Appendix 1) are taken and sent to EVU for rapid polio virus characterisation
- HPT to immediately investigate vaccination coverage in population at risk (e.g. school, residential community, locality).
- NIS Colindale to inform Department of Health of Social Care (DHSC) and WHO
- NIS Colindale to ensure supply of IPV-containing vaccine (Td-IPV) available:
- HPT to ensure all close family contacts are vaccinated with IPV immediately if case in person – regardless of vaccination status.

Level 1: Vaccine related (type 1 or 3) poliovirus in person or environment

Level 1 (clinical surveillance)

A. Single case of vaccine-related poliovirus detection (type 1 or 3) in an otherwise healthy person.

Defined as a vaccine poliovirus (non-drifted variant) isolated from a healthy person with one of:

- recent oral polio vaccination or history of travel to an area using OPV
- contact with family member with recent history of OPV vaccination or recent travel to an area using OPV
- no recent vaccination or travel history and no family or vaccination history

Actions level 1

In such cases:

- Health Protection Team is to ensure appropriate investigations are initiated in cases and contacts (see Appendix 2 for definitions)
- HPT to ensure report made to NIS Colindale/Virus Reference Department
- NIS Colindale to inform DHSC
- HPT to ensure case and all household contacts are resampled and tested at 4 weekly intervals
- HPT to ensure sampling repeated until 2 negative samples obtained 48 hours apart
- HPT to advise adequate personal hygiene and exclusion from food handling work
- HPT to ensure close family contacts are fully vaccinated with IPV-containing vaccine
- if no clear risk factor for acquisition, HPT to discuss further management and contact tracing urgently with NIS Colindale and DHSC

B. Single case of vaccine related poliovirus (type 1 or 3) in an immunosuppressed person

Defined as a vaccine-related polioirus (non-drifted variant type 1 or 3) isolated from immunosuppressed person with/without paralysis.

Actions level 1

In such cases:

- HPT to ensure appropriate investigations are initiated in case and contacts (see Appendix 2 for definitions)
- HPT to ensure report to NIS Colindale / Virus Reference Department
- NIS Colindale to inform DHSC
- HPT to ensure case is referred to infectious disease clinician
- HPT to advise adequate personal hygiene and exclusion from food handling work
- HPT to ensure stools screened monthly for continued excretion until 3 stools negative for polio at monthly intervals − then review with NIS Colindale and Virus Reference Department
- HPT to ensure case seeks specialist advice before travel
- HPT to ensure close family contacts are screened and vaccinated with IPV-containing vaccine regardless of vaccination status

C. Single case of suspected vaccine associated paralytic polio

Defined as a compatible polio-like illness in recent oral polio vaccine recipient (with or without poliovirus isolate).

Actions level 1

In such cases:

- HPT to ensure appropriate investigations (see Appendix 2) are initiated in case and contacts (see appendix 2 for definitions)
- HPT to report to NIS Colindale and Virus Reference Department
- HPT to identify clinical history in particular where and when OPV was given
- HPT to ensure IPV-containing vaccine offered to unvaccinated close (household /health carer) contacts

Level 1 (Environmental surveillance)

Environmental surveillance – a detection of one or more vaccine-related-poliovirus(type 1 or 3) in an environmental sample

Actions level 1

In such cases:

- communicate information – report immediately to PHE NIS Colindale
- expedite genome characterisation of the VDPV isolate

Level 2: Wild poliovirus, vaccine-related type 2 or VDPV in person (import related) or environment

Level 2 (clinical surveillance)

A. Confirmed single case of wild poliovirus (import related)

Defined as a poliovirus isolate confirmed as wild by intratypic differentiation or sequencing at Virus Reference Department from a person with or without paralytic symptoms

Actions level 2

1. Report immediately to NIS Colindale.

2. NIS Colindale to inform DHSC and WHO.

3. IMT convened.

4. HPT to gather clinical history (including travel and vaccination) and relevant samples

5. HPT to collect stool samples from household contacts and send to Colindale VRD – consider collection of stool samples from wider population.

6. HPT to ensure IPV-containing vaccine offered to unvaccinated close (household / health carer) contacts.

7. HPT to institute active surveillance for paralytic and non-paralytic infection in locality, including retrospective case finding to:

- advise local laboratories and clinicians
- encourage stool samples in all acute neurological illnesses (meningitis/AFP)
- contact local laboratories to obtain any recent enterovirus isolates

8. If the infection appears to be indigenous based on a risk assessment see level 3.

9. HPT to investigate vaccination coverage in population at risk (for example, school, residential community, locality). If vaccine coverage in local childhood population is suspected to be below 85% consider a mop up campaign with Td-IPV, initially obtained through DHSC, involving:

- a single dose of IPV-containing vaccine to persons of all ages if case occurs in a well-defined community (regardless of vaccine history) or
- a single dose of IPV-containing vaccine in all children of pre-school and school age in locality (regardless of vaccine history) and opportunistic IPV vaccination (encourage completion of vaccine course in all unvaccinated and partially vaccinated persons in the locality)

B. Confirmed single circulating vaccine-derived poliovirus (c-VDPV), immune-deficiency associated VDPV (iVDPV) or type-2 vaccine-related case

Actions level 2

It will be important to determine if the case is indigenous or imported based on history of travel and to determine recent exposure to any known immunodeficient person shedding iVDPV. If indigenous go to Level (3).

Public health management as level 2 Wild Polio Virus

Level 2 (environmental surveillance)

A. Detection of one VDPV or WPV in an environmental sample

B. Detection of more than one VDPV or WPV in environmental samples with genetic AND/OR epidemiological features NOT consistent with indigenous transmission or local circulation

Isolates contain sequences which are more closely related to other sequences available in the GenBank and in the other laboratories of the Global Polio Laboratory Network (known as circulating in other countries) than to each other suggesting that they represent separate importations of virus.

Or the molecular analysis revealed that the repeated isolation of the same or a genetically distinct but related virus is the result of viral evolution in (a) chronically infected immunosuppressed individual(s).

This can be cVDPV, iVDPV or aVDPV (see appendix 2).

C. Detection of one or more vaccine-related poliovirus (type 2) in an environmental sample

Actions Level 2 (Environmental surveillance):

1. Communicate information:

Report immediately to NIS Colindale.

NIS Colindale to inform advise HPTs in affected areas; DHSC and WHO.

2. Institute active surveillance for paralytic and non-paralytic infection in locality. NIS Colindale:

- together with HPTs to advise local laboratories and clinicians
- to encourage stool samples in all acute neurological illnesses (meningitis/AFP)
- to consider stool survey in general population in the affected community (if it is well defined)

3. Enhance virological investigations, with:

- NIS RVU to expedite genome characterisation of the wild poliovirus or VDPV isolates to assist in the investigation of their possible source and possible chains of transmission
- NIS to request that all untyped or non-typeable virus isolates from faecal and environmental samples be submitted to a WHO-accredited laboratory for further investigations
- HPTs to ensure a “Flag” for all subsequent environmental samples and faecal samples from the area of where WPV or VDPV were isolated

4. Enhanced environmental sampling.

NIS Colindale to review information on the population represented by the sampling site and the frequency of environmental sampling, and determine whether there are opportunities for increasing sensitivity of virus detection (i.e. upstream surveillance). Ongoing transmission may be deduced from repeated wild poliovirus detection through intensified sampling (for example, weekly sampling).

NIS Colindale to investigate additional sampling sites for surveillance of sub-populations and/ or neighbouring or contact populations.

5. Enhanced clinical sampling.

HPTs to initiate an active case search in the suspected community – assess the value of stool surveys, taking into consideration issues related to timing, representative sampling, logistic arrangements for samples collection/handling, and assuring adequate laboratory support. The main aim of this active case search will be to identify the infected person as soon as possible, to offer him/her the appropriate management and adequate advice for prevention and hygiene measures to the close contacts, in order to protect him/her and his/her contacts from infection, as well as the whole community.

6. Assess polio immunisation coverage and consider mop up vaccination in the affected community.

If the virus isolated (WPV or cVDPV) appears to be imported. HPT to immediately investigate vaccination coverage in population at risk (residential community, locality). If vaccine coverage in local childhood population is suspected to be below 85% consider a mop up campaign with Td-IPV involving a single dose of IPV-containing vaccine:

- to persons of all ages if case occurs in a well-defined community (regardless of vaccine history) or
- in all children of pre-school and school-age in locality (regardless of vaccine history) and opportunistic IPV vaccination (encourage completion of vaccine course in all unvaccinated and partially vaccinated persons in the locality)

If the target population (defined in 3) refuses vaccine, consider giving a single dose of vaccine to persons in adjacent communities.

Level 3: Wild poliovirus or cVDPV in person or environment (with evidence of local transmission)

Level 3 (clinical surveillance)

A. Confirmed single case of wild poliovirus (non-import related)

B. Epidemiologically linked cases of wild polio virus

Defined as a poliovirus isolate occurring in one person with no recent travel history from a person with or without compatible illness OR 2 or more people with or without compatible illness with poliovirus isolate in the same locality within an 8-week period.

Actions level 3

In such cases:

1. HPT to initiate appropriate investigations of case and contacts immediately (see appendix 2 for definitions)
2. HPT to report immediately to NIS Colindale and/or Virus Reference Department
3. An IMT will be convened
4. NIS Colindale to inform DHSC and WHO
5. HPT to ensure close family contacts are vaccinated with IPV-containing vaccine immediately, regardless of vaccination status
6. A catch-up campaign will be required. IMT will lead a full risk assessment including assessment of vaccination coverage in population at risk (residential community, locality) and scale (age-groups and geographical area) of potential catch-up
7. IMT will need to consider following issues in relation to catch-up:

- consider IPV (m/bOPV once available) to persons of all ages if case occurs in a well-defined community (regardless of vaccine history) or
- consider IPV (m/bOPV once available) in all children of pre-school and school-age in locality (regardless of vaccine history) and
- opportunistic vaccination (completion of vaccine course in all unvaccinated persons in locality)
- if the target population refuses vaccine consider giving a single dose of vaccine to person in adjacent communities

- consider a mop-up campaign in other age groups / populations depending on the epidemiological circumstances

8. An IPV-containing vaccine will be used initially. If agreed, an urgent request would be made to WHO to access appropriate OPV stock (mOPV or bOPV). WHO have indicated that OPV stock would be available to member states even following a single case/environmental detection.
9. As OPV vaccine is not licensed for use in the UK, permission from the MHRA (Medicines and Healthcare products Regulatory Agency) would need to be sought by NIS Colindale to import an unlicensed vaccine. The procedures for doing this include completing "A notification of intent to import an unlicensed product Form" which is available on the MHRA website and sending it as a national emergency requirement to imports@mhra.gsi.gov.uk. This is in addition to alerting MHRA officials by phone.
10. HPT(s) to institute active surveillance and retrospective case-finding for paralytic and non- paralytic infection in locality. To do this:

- advise local laboratories and clinicians
- encourage stool samples in all acute neurological illnesses
- perform stool survey in healthy contacts
- contact local laboratories to obtain any recent enterovirus isolates

C. Confirmed single case of cVDPV (non-import related)

D. Epidemiologically linked cases of c-VDPV

Defined as 2 or more poliovirus isolates from persons in the same locality presenting with paralytic/non-paralytic/or no symptoms and confirmed as cVDPV on sequencing at Virus Reference Department

Public health management as level 3 wild polio-virus incident

Level 3 (Environmental surveillance)

A. Detection of 2 or more cVDPV or WPV in the environment with genetic and epidemiological features strongly consistent with indigenous transmission or local circulation:

Isolates from the same surveillance site (collection date of samples are more than 2 months apart) or from different sites (no overlapping of catchment areas) contain sequences, which are more closely related to each other than to other sequences available in the GenBank and in the other laboratories of the Global Polio Laboratory Network (known as circulating in other countries) and show patterns of genetic divergence consistent with local transmission.

B. Detection of a cVDPV or WPV in the environment and detection of related poliovirus in a clinical sample with genetic features strongly consistent with indigenous transmission or local circulation.

Isolates contain sequences which are more closely related to each other than to other sequences available in the GenBank and in the other laboratories of the Global Polio Laboratory Network, (known as circulating in other countries) and show patterns of genetic divergence consistent with local transmission.

C. Multiple VDPV or WPV in people or the environment with genetic and epidemiological features strongly consistent with widespread transmission in different communities across the country.

Scenarios of Level 3 (environmental surveillance) with multiple and geographically spread detection in different communities across the country (assess whether there is a single community moving across the country).

Actions Level 3 (Environmental surveillance)

1. Report immediately to NIS Colindale and/or Virus Reference Department.
2. An IMT will be convened.
3. NIS Colindale to inform DHSC and WHO.
4. IMT to be convened.

5. Institute active surveillance for paralytic and non-paralytic infection in locality

- advise local laboratories and clinicians and obtain any recent enterovirus isolates
- encourage stool samples in all acute neurological illnesses (meningitis/AFP)
- consider stool survey in healthy contacts of any cases of poliomyelitis or in general population in the affected community (if it is well defined)
- perform retrospective case-finding

6. Enhance virological investigations:

- expedite genome characterisation of the wild poliovirus or VDPV isolates to assist in the investigation of their possible source and possible chains of transmission
- request that all virus negative faecal and respiratory specimens from AFP cases and untyped or non-typable virus isolates from faecal and environmental samples be submitted to a WHO-accredited laboratory for further investigations
- 'flag' all subsequent environmental samples and faecal samples from the area of where WPV or VDPV were isolated

7. Enhanced environmental sampling:

- review information on the population represented by the sampling site and the frequency of environmental sampling, and determine whether there are opportunities for increasing sensitivity of virus detection (i.e. Upstream surveillance) – ongoing transmission may be deduced from repeated wild poliovirus detection through intensified sampling (for example, weekly sampling).
- investigating additional sampling sites for surveillance of sub-populations and/or neighbouring or contact populations

8. Search for poliovirus-infected persons:

- initiate an active case search in the suspected community – assess the value of stool surveys taking into consideration issues related to timing, representative sampling, logistic arrangements for samples collection/handling, and assuring adequate laboratory support

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9. Urgently assess the necessity for a vaccination mop up campaign:

A catch-up campaign will be required. IMT will lead a full risk assessment including assessment of vaccination coverage in population at risk (residential community, locality) and scale (age-groups and geographical area) of potential catch-up.

- Consider IPV (m/bOPV once available) to persons of all ages if case occurs in a well-defined community (regardless of vaccine history) or

- consider IPV (m/bOPV once available) in all children of pre-school and school-age in locality (regardless of vaccine history) and
- opportunistic vaccination (completion of vaccine course in all unvaccinated persons in locality).
- If the target population refuses vaccine consider giving a single dose of vaccine to person in adjacent communities.
- Consider a mop-up campaign in other age groups / populations depending on the epidemiological circumstances

An IPV-containing vaccine will be used initially. If agreed, an urgent request would be made to WHO to access appropriate OPV stock (mOPV or bOPV). WHO have indicated that OPV stock would be available to member states even following a single case/environmental detection.

As OPV vaccine is not licensed for use in the UK, permission from the MHRA (Medicines and Healthcare products Regulatory Agency) would need to be sought by NIS Colindale to import an unlicensed vaccine. The procedures for doing this include completing “A notification of intent to import an unlicensed product Form” which is available on the MHRA website and sending it as a national emergency requirement to: imports@mhra.gsi.gov.uk. This is in addition to alerting MHRA officials by phone.

HPT(s) to institute active surveillance and retrospective case-finding for paralytic and non- paralytic infection in locality. To do this:

- advise local laboratories and clinicians
- encourage stool samples in all acute neurological illnesses
- perform stool survey in healthy contacts
- contact local laboratories to obtain any recent enterovirus isolates

In order to maximise OPV coverage, professional information concerning poliovirus and vaccination should be made available to physicians throughout the country as well as to the public, using diverse communication channels – traditional media, social media, and the Internet.

Appendix 1: technical information on the laboratory diagnosis of poliovirus infection

Appropriate specimens

Throat swabs	first week of illness
Faeces	up to fourth week of illness; fresh stool 24 to 48 hours apart
CSF	early
Serum	first week and 2 - 3 weeks later

Virus isolation

Preparation of specimens

Throat swabs: clarify transport medium containing swab by low speed centrifugation. Faeces: make 10% suspension and clarify by low speed centrifugation.CSF: use neat.

Inoculation of cell cultures

Inoculate specimens into cell cultures following local laboratory procedures. Examine cell sheet daily for cytopathic effects. If no cytopathic effects are visible after 1 week, scrape cells into tissue culture medium, freeze and thaw and reinoculate into fresh cells.

Recommended cells

Poliovirus grows in a wide range of all cultures of human and primate origin. RD (Rhabdomyosarcoma) cells are particularly sensitive for isolation of poliovirus and enteroviruses (and can be supplied by Virus Reference Department if required). Other suitable cells include MRC5 or other human fibroblasts, primary and secondary monkey kidney, Hep2, Hep2C, HeLa, L20B and PLC/PRF5.

Virus typing

Isolates should be identified and typed eg by neutralisation, fluorescence etc. Commercial fluorescence tests are available for the identification of polioviruses and a limited range of enteroviruses.

Poliovirus isolates

Poliovirus isolates should be sent to PRS, Virus Reference Department for intratypic vaccine marker tests and genotyping, together with the completed form for Enhanced Surveillance of Polio.

PCR

PCR can be used for the detection of polioviruses and enteroviruses in faeces, throat swabs, CSF and early serum specimens.

Serology

Antibody tests for polio infection are available at Polio Reference Service, Virus Reference Department (minimum volume required is 300 uL). Sera should be sent together with the 'Polio Surveillance' form.

Polio serology may be requested for:

- diagnosis of poliovirus infection when the diagnosis cannot be established by molecular or culture-based methods, by comparing titres in acute and convalescent sera
- serological confirmation of poliovirus infection following detection of poliovirus using molecular and/or culture-based assays
- quantifying antibody levels in individuals who work in laboratories where there is deliberate handling of poliovirus

Further information

Contact either EVU or PRS, Virus Reference Department on: 020 8327 6225.

Main switchboard and out of hours: 020 8200 4400.

Appendix 2: surveillance case definitions and classifications

Definition of a case of paralytic poliomyelitis

A patient with clinical features compatible with paralytic poliomyelitis from whom either vaccine or wild poliovirus has been isolated from a clinical specimen.

Clinical features compatible with paralytic poliomyelitis include:

- acute flaccid paralysis
- decreased or absent tendon reflexes in affected limbs
- no sensory or cognitive loss
- no other cause identified despite laboratory investigation
- neurological deficit present 60 days after onset of symptoms unless patient died
- neurophysiological investigations (nerve conduction and electromyography) consistent with neuronopathy affecting the anterior horn cell

Definitions of categories of cases

Vaccine recipient (Va R)

Clinical features compatible with paralytic poliomyelitis.

No laboratory evidence of wild-type virus*.

Paralysis onset between 4 and 30 days after patient received oral polio vaccine†

vaccinated abroad or patient with underlying immunodeficiency previously OPV vaccinated
* confirmation by isolation of vaccine virus
† for immunocompromised individuals these periods can be considerably longer

Vaccine contact (Va C)

Clinical features compatible with paralytic poliomyelitis.

No laboratory evidence of wild-type virus*.

Contact with a vaccinee.

Paralysis onset between 4 and 75 days after vaccinee received oral polio vaccine†.

* confirmation by isolation of vaccine virus
† for immunocompromised individuals these periods can be considerably longer

Wild indigenous

Clinical features compatible with paralytic poliomyelitis.

Wild-type virus isolation.

No travel to and no contact with anyone who has travelled to, or resided in, an area where wild poliovirus is known to circulate within 30 days before symptom onset.

Wild imported

Clinical features compatible with paralytic poliomyelitis.

Wild-type virus isolation.

Travel to or residence in a country where wild poliovirus is known to circulate within 30 days before symptom onset (see 5 below).

Other categories

1. Wild virus – import related

Clinical features compatible with paralytic poliomyelitis.

Wild-type virus isolation.

Contact with anyone who has travelled to or resided in a country where wild poliovirus is known to circulate within 30 days before symptom onset, or contact with anyone who has acute poliomyelitis thought to have travelled to or resided in a country where wild poliovirus is known to circulate within 30 days before symptom onset.

2. Vaccine associated case – possible or no known contact

Clinical features compatible with paralytic poliomyelitis.

Vaccine virus isolation but no known direct contact with a vaccinee and no history of the patient receiving oral polio vaccine.

3. Compatible case*

Clinical features compatible with paralytic poliomyelitis.

No poliovirus isolation from clinical specimens.
With or without serological evidence of recent poliovirus infection.

No evidence for infection with other neurotropic viruses.

4. Vaccine-derived polioviruses

A. **Vaccine-derived poliovirus (VDPV):** OPV virus strains that are > 1% divergent (or >= 10 nt changes, for types 1 and 3) or > 0.6% divergent (>= 6 NT changes, for type 2) from the corresponding OPV strain in the complete VP1 genomic region.
B. **Circulating VDPV (cVDPV):** VDPV isolates for which there is evidence of person-to-person transmission in the community with genetically linked VDPVs, isolated:

- from at least 2 individuals (not necessarily AFP cases) who are not direct (for instance, household) contacts
- from one individual and one or more environmental surveillance (ES) samples, or
- from 2 or more ES samples if they ere collected at more than one distinct ES collection site (no overlapping of catchment areas), or from one site if collection was more than 2 months apart1

.

C. **Immune-deficiency associated VDPV (iVDPV)**: VDPVs isolated from persons with evidence of primary immunodeficiency (PID).

D. **Ambiguous VDPV (aVDPV):** a VDPV isolate from individuals or from environmental samples, without evidence of circulation and from individuals with no known immunodeficiency. A VDPV isolate should only be classified as 'ambiguous' once additional investigations have excluded that it is part of an ongoing chain of transmission, i.e. a cVDPV, or derived from an iVDPV. Such investigations should include enhanced surveillance for AFP cases in the area and collection of stool specimens from healthy persons in the community. Efforts to rule out local circulation should be particularly intense if sequencing of the index VDPV isolate is consistent with prolonged independent replication.

Appendix 3: Letter to Clinicians

Polio eradication

Dear Dr _____

RE: Case name / identifier _____ Reported on/by _____

As you may know, WHO aims to eradicate wild poliovirus. Before any decision to stop vaccination can be made, however, it will be important to demonstrate that wild poliovirus is absent in every country. This requires a process of certification, where the surveillance data from each country is presented to the WHO regional commission for critical review. The UK has been certified as polio-free. To maintain this status, the UK needs to demonstrate that it has appropriate surveillance systems in place to rapidly detect and investigate suspect polio cases.

The criteria that will be used will be extremely stringent and, in particular, evidence that wild poliovirus infection was excluded in **each** case of paralysis is required. The WHO has established a gold standard that **all** suspected cases of acute flaccid paralysis should be investigated by the submission of stool samples for virology. In the UK, however, where the diagnosis of paralytic polio is considered extremely unlikely, many such cases are excluded by clinical or other criteria. It will therefore be necessary for us to document the clinical findings and investigations in all suspected cases and to submit these for expert review. I am therefore writing to the clinicians of all cases which have been reported as acute flaccid paralysis, **including those where the diagnosis of poliomyelitis has since been rejected**, to obtain further details for this review.

I would therefore be very grateful if you could send to me a copy of the discharge summary and/or outpatient letters (or the notes if you prefer) from the above case which was reported in (enter year). In particular we are interested in history of vaccination or travel, in laboratory investigations (eg. specimens sent for virology, examination of cells in the CSF), in the clinical presentation (eg. presence of sensory or upper motor neurone symptoms), in the results of nerve conduction studies and electromyography and in the outcome (residual paralysis at least 60 days after onset). If you could please forward any information that we may not already have as soon as possible I would be very grateful.
With many thanks for your help with this important initiative.

Consultant Epidemiologist
Immunisation Division
Public Health England National Infection Service

Appendix 4: Case questionnaire

PART I. Acute neurologic illness with limb weakness:

ID _____

Form to be completed by, or in conjunction with, a physician who provided care to the patient during the neurologic illness. Once completed, submit to Public Health England.

Today's date /__ /_____(dd/mm/yyyy)
Name of person completing form: _____
Affiliation _____
Phone:_____
Email: _____
Name of physician who can provide additional clinical/lab information, if needed
_____
Affiliation: _____
Phone: _____Email: _____
Name and address of main hospital that provided patient's care: _____
Patient NHS number:
_____
Patient's sex: □M □F
Patient's age: _____months
Patient's residence _____ years AND_____ months
address:_____
Post code:_____
Ethnicity: □Asian/Asian British □Black / African / Caribbean / Black British
□Mixed / Multiple ethnic groups □White □Other groups(specify)__

Date of onset of limb weakness:_____/_____/_____(dd/mm/yyyy)
Was patient admitted to a hospital? □yes □no □unknown
Date of admission to first hospital_____/_____/__ _____
Date of discharge from last hospital_____/_____/_____(or □still hospitalised)
Current clinical status: □recovered □not recovered, but improved □not improved □Deceased:
Date of death_____/_____/ _____

Signs/symptoms/condition at ANY time during the illness:				
	Right Arm	Left Arm	Right Leg	Left Leg
19. Since neurologic illness onset, which limbs have been acutely weak? [indicate yes(y), no (n), unknown (u) **for each limb**]	Y N U	Y N U	Y N U	Y N U
20. Date of neurological exam (recorded at worst weakness thus far) (dd/mm/yyyy)	_____/___/__ _____			
21. Reflexes in the **affected** limb(s): (recorded at worst weakness thus far)	☐ Areflexic/hyporeflexic (0-1) ☐ Normal (2) ☐ Hyperreflexic (3-4+)			
22. Any sensory loss/numbness in the **affected** limb(s), at any time during the illness? (paresthesias should not be considered here)	Y N U			
23. Any pain or burning in the **affected** limb(s)? (at any time during illness)	Y N U	Y N U	Y N U	Y N U

	Yes	No	Unknown
24. Sensory level on the torso (ie, reduced sensation below a certain level of the torso)? (at any time during illness)			
25. At any time during the illness, please check if the patient had any of the following cranial nerve signs:			
☐Diplopia/double vision (If yes, circle the cranial nerve involved if known: 3 / 4 / 6)			
☐Loss of sensation in face ☐ Facial droop ☐Hearing loss ☐ Dysphagia ☐ Dysarthria			
26. Any pain or burning in neck or back? (at any time during illness)			
27. Bowel or bladder incontinence? (at any time during illness)			
28 .Cardiovascular instability (e.g, labile blood pressure, alternating tachy/bradycardia)? (at any time during illness)			
29. Change in mental status (e.g, confused, disoriented, encephalopathic)? (at any time during illness)			
30. Seizure(s)? (at any time during illness)			
31. Received care in ICU because of neurologic condition? (at any time during illness)			
32. Received invasive ventilatory support (e.g, intubation, tracheostomy) because of neurological condition?			

ID _____

Other patient information:

Within the 4-week period **BEFORE onset** of **limb weakness**, did patient:	Yes	No	Unk	
33. Have a respiratory illness?				**34**. If yes, date of onset_____/___/__ _____
35. Have a fever, measured by parent or provider and ≥ 38.0°C?				**36**. If yes, date of onset_____/___/__ _____
37. Receive oral, IM or IV steroids?				
38. Receive any other systemic immunosuppressant(s)?				**39.** If yes, list:
40. Travel outside the UK?				**41.** If yes, list country
42. Does patient have any underlying illnesses?				**43.** If yes, list
44. On the **day of onset of limb weakness**, did patient have a fever? (see definition above)				

Polio vaccination history:	
45. How many doses of **inactivated polio vaccine (IPV**) are **documented** to have been received by the patient before the onset of weakness?	doses ☐unknown
46. How many doses of **oral polio vaccine (OPV)** are **documented** to have been received by the patient before the onset of weakness?	_____doses ☐unknown
47. If you do not have documentation of the type of polio vaccine received: **a.** What is total number of **documented** polio vaccine doses received before onset of	_____doses ☐unknown

Neuroradiographic findings: *(Indicate based on <u>most abnormal</u> study)*

<u>MRI of spinal cord</u> **48.** Date of study_____/_____/__ _____ *(mm/dd/yyyy)*

49. Levels imaged: ☐cervical ☐thoracic ☐lumbosacral ☐unknown

50. Gadolinium used? ☐yes ☐no ☐unknown

52. What levels of the cord were affected?	☐cervical cord ☐thoracic cord ☐conus ☐cauda equina ☐unknown
53. What areas of spinal cord were affected?	☐predominantly gray matter ☐predominantly white matter ☐both equally affected ☐unknown
54. Was there cord edema?	☐yes ☐no ☐unknown
55. Did any lesions enhance with GAD?	☐yes ☐no ☐unknown
56. Did the **ventra**l nerve roots enhance with GAD?	☐yes ☐no ☐unknown
57. Did the **dorsal** nerve roots enhance with GAD?	☐yes ☐no ☐unknown

ID _____

MRI of brain **58.** Date of study___/__ /__ _____
(dd/mm/yyyy)

59. Gadolinium used? ☐ yes ☐no ☐unknown

60. Any **supratentorial** (i.e, lobe, cortical, subcortical, basal ganglia, or thalamic) lesions	☐yes ☐no ☐unknown
61.If yes, indicate location(s)	☐cortex ☐subcortex ☐basal ganglia ☐thalamus ☐unknown
62. If yes, did any lesions enhance with GAD?	☐yes ☐no ☐unknown
63. Any **brainstem** lesions?	☐yes ☐no ☐unknown
64. If yes, indicate location	☐midbrain ☐pons ☐medulla ☐unknown
65. If yes, did any lesions enhance with GAD?	☐yes ☐no ☐unknown
66. Any **cranial nerve** lesions?	☐yes ☐no ☐unknown
67. If yes, indicate which CN(s):	CN_____☐unilateral ☐bilateral CN_____☐unilateral ☐bilateral
68. If yes, did any lesions enhance with GAD?	☐yes ☐no ☐unknown
69. Any lesions affecting the **cerebellum**?	☐yes ☐no ☐unknown

70. Was an EMG done? ☐yes ☐no ☐unknown
If yes, date_____/__/__ _____ (mm/dd/yyyy)

71. If yes, was there evidence of acute motor neuropathy, motor neuronopathy, motor nerve or anterior horn cell involvement? ☐yes ☐no ☐unknown

CSF examination: **72.** Was a lumbar puncture performed? ☐yes ☐no ☐unknown
If yes, complete 73 (If more than 2 CSF examinations, list earliest and then most abnormal)

	Date of lumbar puncture	WBC/mm^3	% neutrophils	% lymphocytes	% monocytes	% eosinophils	RBC/mm^3	Glucose mg/dl	Protein mg/dl
73a. CSF from LP1									
73b. CSF from LP2									

Pathogen testing performed:

74. Was a **stool specimen** tested for the following pathogens?	Date of specimen collection_____/__ /_____ ☐ Not done
Enterovirus PCR:	☐ Positive ☐ Negative ☐ Not done If positive: type: ☐ Not typed
Poliovirus PCR:	☐ Positive ☐ Negative ☐ Not done
Poliovirus culture:	☐ Positive ☐ Negative ☐ Not done

Other pathogen identified:	Specify: Type of test:

75. Was **CSF** tested for the following pathogens?	Date of specimen collection____/__ /_____ ☐ Not done
Enterovirus PCR:	☐ Positive ☐ Negative ☐ Not done If positive: type: ☐ Not typed
Herpes Simplex Virus PCR:	☐ Positive ☐ Negative ☐ Not done

	ID _____
Cytomegalovirus PCR:	☐ Positive ☐ Negative ☐ Not done
Varicella Zoster Virus PCR:	☐ Positive ☐ Negative ☐ Not done
Other pathogen identified:	specify: Type of test:

76. Was a **respiratory tract specimen** tested for the following pathogens?	Date of specimen collection____/__ /_____ ☐ Not done
Enterovirus/rhinovirus PCR:	☐ Positive ☐ Negative ☐ Not done If positive: type: ☐ Not typed
Adenovirus PCR:	☐ Positive ☐ Negative ☐ Not done If positive: type: ☐ Not typed
Influenza virus PCR:	☐ Positive ☐ Negative ☐ Not done If positive: type: ☐ Not typed
Other pathogen identified:	Specify: Type of test:

77. Was **serum** tested for the following pathogens?	Date of specimen collection_____/__ /_____ ☐ Not done
West Nile Virus:	☐ Positive ☐ Negative ☐ Not done If positive, test type: ☐ IgM ☐ PCR
Other pathogen identified:	specify: Type of test:

78. Describe any other laboratory finding(s) considered to be significant_____

_____

_____

79. Was/Is a **specific etiology** considered to be the most likely cause for the patient's neurologic illness? ☐yes ☐no ☐unknown

80. If yes, please list etiology and reason(s) considered most likely cause

_____

_____

_____

Treatment: 81. Were any of these therapies administered for the acute neurological illness? (as of time of form completion)

	Yes	No	Unknown	If yes, date first administered:____/_____/_____
a. Antibiotics				If yes, specify; date first administered:__/___/_____
b. Antivirals				If yes, date first administered:____/_____/_____
c. Corticosteroids				If yes, date first administered:____/_____/_____
d. Intravenous immune globulin (IVIG)				If yes, date first administered:____/_____/_____
e. Plasma exchange or Plasmapheresis				If yes, specify_____; date first administered:_____/__ /

f. Interferon				If yes, specify_____; date first administered:____/__ /__
g. Other immunosuppressive therapy				If yes, date first administered:____/_____/_____

82. Other information you would like us to know

_____

_____

_____

_____

Appendix 5: Environmental surveillance protocol

Summary

Environmental surveillance for poliomyelitis is recommended by WHO in populations where AFP surveillance is not in use and where conditions exist that render the population at risk for poliovirus circulation (e.g. low polio vaccination coverage or risk of poliovirus importation). The identified risk of extensive transmission of Polio in the United Kingdom (UK) following importation is low. This document describes a protocol for implementation of this environmental approach for poliovirus surveillance in England, and evaluates its added value for national polio surveillance

Introduction

In 2013 WHO released its 5 year global polio eradication and endgame strategic plan (2013-2018) which puts increasing scrutiny on national polio surveillance to provide assurance of elimination status [1]. The UK has been polio-free for 20 years based on vaccine coverage, acute flaccid paralysis (AFP) case surveillance and enhanced enterovirus surveillance and characterisation. The 2017 annual report of the European Regional Certification Commission identified the risk of extensive transmission of polio in the UK following importation as being intermediate for the year 2012, but low for all subsequent years so far [2]. The value of environmental monitoring for polio has been highlighted during the recent outbreak in Israel, where extensive circulation of poliovirus was demonstrated in the absence of any recognised clinical cases [3]. Its use is recommended by WHO. Many countries (21/51) in Europe have introduced environmental monitoring programmes for polio in sewage to strengthen surveillance and provide greater assurance of polio-free status [1].

Following recommendations from the UK National Certification Committee for Polio regarding the need to establish environmental surveillance initial discussions were held between Reference Microbiology, Food, Water and Environmental Microbiology Services, Immunisation, Hepatitis and Blood Safety, and the National Institute for Biological Standards and Control (NIBSC) to identify a project to establish systematic environmental surveillance of sewage to address potential gaps in UK polio surveillance. A pilot study was undertaken using samples collected as part of an externally funded project.

Environmental surveillance using sewage samples is a way of sampling microbial populations circulating in the human population. There are good examples of best

practice in the published literature [3, 4]. Therefore this project is opportune since molecular biological approaches to environmental detection are becoming increasingly more robust and the next generation of technologies (including meta-genomic approaches) will offer greater analytical data potentially providing human population based surveillance. The components of this polio surveillance system are currently: enhanced enterovirus surveillance, and polio vaccine uptake surveillance in the general population and high risk groups (as a proxy for population immunity). We propose to further develop and evaluate the environmental approach for polio surveillance as well as a range of indicator organisms, to establish its added value for national polio surveillance.

The following sections explain the principles of the environmental surveillance for polioviruses according to the WHO Guidelines on environmental surveillance for detection of polioviruses [5].

Sampling principles and logistics

Potential target populations

Groups at higher risk of polio-virus circulation include those with inadequate vaccine coverage (<90%) and risk of importation (due to cultural/travel links to countries where there is evidence of recent circulation of wild poliovirus (WPV) or vaccine derived poliovirus (VDPV). In the UK, this would include those geographical areas with a higher proportion with ethnicity from countries where polio is currently circulating (for example, Aghanistan and Pakistan).

Sampling frequency:

Should, preferably, be twice a month, but at least once a month.

Sampling location

Converging sewer network serving the target population is preferable because it enables monitoring of large groups of people by analysing samples collected at a single site, from a main collector sewer.

Industrial waste, increase of temperature and UV irradiation from sunlight inactivate poliovirus in a time-dependent manner, a fact that has to be taken in account in designing environmental surveillance.

Size of Source population

The preferable size of the source population is 100 000–300 000. In practice, the size of the source population in established systems where WPV and VDPV have been detected has varied from tens of thousands to a few million persons.

Sampling plan

The sampling plan has been developed to indicate who is responsible for collecting samples at each site.

Collecting models

There are 2 principal modes of collecting environmental samples for virological analysis, referred to as grab sampling and trap sampling. In the grab method an amount of raw sewage is collected at a selected sampling site, either at one point in time, or, preferably, at different predetermined times to form a time-adjusted composite sample. Many sewage treatment plants use automated equipment for collecting samples at regular intervals during a 24-hour period or over the peak hours of household sewage flow. Manual collection of composite samples is also possible but sustained adherence to the relatively tedious practice may be difficult to guarantee. If automated collectors are not available and peak hours of household sewage flow are not known, samples collected at one point in time can readily be used. Grab sample volumes of one litre are recommended.

Trap samples are collected by hanging a bag of non-specifically absorbing material in the sewage stream. After one or more days the bag is taken out of the sewage and shipped to the laboratory, where the absorbed material is eluted and analysed for the presence of (polio) viruses. Grab sampling is preferred to trap sampling as it is more feasible for quantitative analysis.

Whatever the sampling principle, collected samples should be immediately refrigerated and kept at 4°C during transport to arrive at the NPL within 48 hours of collection. The laboratory should be notified.

Satisfactory performance and interpretation of results

Satisfactory performance

A useful criterion of satisfactory overall performance of the surveillance is detection of non-polio enteroviruses in the samples. At least 30% of concentrated sewage from grab

samples should reveal non-polio enterovirus (NPEV) and at least 10% of the ground glass traps should reveal NPEV.

Detection consequences

Isolation of wild or vaccine-derived poliovirus from an environmental specimen should raise the same question and result in similar actions as diagnosing a paralytic case caused by wild or vaccine-derived poliovirus, i.e. a determination should be made of whether the results represent recent importation of the virus or poliovirus circulation in the community. This should result in intensified surveillance for poliomyelitis in the community, more frequent and possibly redesigned environmental sampling and preparation for supplementary immunisation activities. Environmental findings should be assessed in the context of all other epidemiological information. The WHO regional office should be consulted about proposed programmatic actions.

Interpretation

Isolation of a wild poliovirus from an environmental specimen usually means that a number of individuals are excreting the virus. Vaccine-derived poliovirus isolation may reflect circulation in the population (cVDPV) or shedding by (a) immunosuppressed individual (s) who has previously been exposed to OPV (iVDPV)[6]. Negative results are more difficult to interpret and should be assessed in relation to the sampling design and efficiency of laboratory procedures. Repeated sampling will increase the probability of detecting low-level transmission of wild poliovirus or cVDPV in a population.

If a population is monitored using the recommended methods with acceptable quality indicators, consistently negative wild poliovirus results for 12 months suggest that wild poliovirus is not circulating in the population. If this situation continues for 3 successive years, wild poliovirus circulation is highly unlikely in the source population. These conclusions should be drawn with caution if there is a high risk of importation of wild poliovirus.

Actions in case of detection

In polio-free countries, wild polioviruses or cVDPV detected through either clinical or environmental surveillance strategies represent a public health emergency warranting immediate further investigation. Poliovirus detected in an environmental specimen may be derived from a single healthy person importing the virus from a non-polio-free country or region. Although it is possible to detect virus from a single person, on maximal theoretical sensitivity of environmental surveillance this should be considered as extremely rare.

Responding to a confirmed outbreak of wpv or vdpv (general).

A decision should be made as soon as possible as to whether a suspected outbreak has been confirmed or if there is a sufficiently high index of suspicion to warrant an immunization response.

An outbreak is confirmed if 2 or more isolates of WPV or VDPV are detected in environmental samples or people, with genetic features consistent with indigenous transmission.

Note:

1. Separate introductions cannot be ruled out if the number of nucleotide differences in the viral capsid protein 1 genes is significantly greater than expected for person to person transmission during the time interval between isolations and if each isolate has a closer similarity to viruses isolated outside of the country or region (sequences available in the GenBank and in the other laboratories of the Global Polio Laboratory Network) than the isolates have to each other.
2. If a VDPV strain in genetic characterization is found to resemble iVDPV, repeated isolation of the same or a genetically distinct but related virus from the same site does not necessarily indicate an emerging outbreak as it could be the result of viral evolution in (a) chronically infected immunosuppressed individual (s). The regional GPLN coordinator should be contacted immediately if VDPV is suspected. [6]

Hypothetical scenarios and examples

Level 2 (scenario 2)

Detection of one or more isolates of VDPV or WPV in environmental samples with genetic features NOT consistent with indigenous transmission or local circulation: Isolates contain sequences which are more closely related to other sequences available in the GenBank and in the other laboratories of the Global Polio Laboratory Network (known as circulating in other countries) than to each other suggesting that they represent separate importations of virus OR the molecular analysis revealed that the repeated isolation of the same or a genetically distinct but related virus is the result of viral evolution in (a) chronically infected immunosuppressed individual (s)

Example

In Finland, between December 2008 and March 2010 highly divergent VDPV of all 3 serotypes were recurrently isolated from a sewage system in the city of Tampere. The molecular analysis of the viral capsid protein 1 coding regions revealed that all strains had originated from an OPV dose given more than 10 years earlier. The source of the VDPV remained unknown, but both epidemiological and genetic data suggested that they might have been originally derived from (a) chronically infected still unidentified immunodeficient individual(s). No vaccination activities were carried out. [7]

Level 3 (Scenario 3).

Detection of a VDPV or WPV in the environment and detection of related poliovirus in a clinical sample with genetic features strongly consistent with indigenous transmission or local circulation: Isolates contain sequences which are more closely related to each other than to other sequences available in the GenBank and in the other laboratories of the Global Polio Laboratory Network, (known as circulating in other countries) and show patterns of genetic divergence consistent with local transmission.

Example

In Nigeria a cVDPV2 case was reported in Kwali Local Government Area (LGA), Federal Capital Territory (FCT) Abuja, onset of paralysis was May 2015. Genetic sequencing showed that this case was related to a cVDPV2 strain first isolated from an environmental sample from Zaria LGA of Kaduna state in August 2014, with cVDPV2 isolates of the same strain also detected in environmental samples collected in Zaria in November 2014 and in January 2015. In line with the national emergency action plan

for polio eradication, aggressive and rapid vaccination activities were conducted in response. Three case response 'mopping-up campaigns' using trivalent oral polio vaccine (tOPV) took place in the FCT and Kaduna and Kogi states, as well as in adjacent LGAs of Niger and Nasarawa states, to stop transmission of the persistent strain of cVDPV2 [9].

Level 3 (Scenario 1).

Detection of one or more isolates of VDPV or WPV in environmental samples with genetic features consistent with indigenous transmission or local circulation. Isolates contain sequences from the same surveillance site >2 months apart or from different sites which are more closely related to each other than to other sequences available in the GenBank and in the other laboratories of the Global Polio Laboratory Network (known as circulating in other countries) and show patterns of genetic divergence consistent with local transmission.

Example

In Israel in 2013, WPV1-specific analysis of samples indicated WPV1 introduction into that area. Environmental surveillance was extended and intensified. WPV was subsequently detected in different sites. IPV catch up vaccination campaign was immediately initiated and a national supplementary immunisation with oral polio vaccine was carried out. [8]

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Abbreviations

AFP	acute flaccid paralysis
bOPV	Bivalent oral polio vaccine
CPE	cytopathogenic effect
CIDSC	Centre for Infectious Disease Surveillance and Control (PHE)
DHSC	Department of Health and Social Care
EPI	expanded programme on immunization (WHO)
GPLN	Global Polio Laboratory Network
MHRA	Medicines and Healthcare products Regulatory Agency
MOH	Ministry of Health
mOPV	monovalent oral polio vaccine
NIBSC	National Institute for Biological Standards and Control
NIDs	national immunization days
NPEV	non polio enterovirus
NPL	national poliovirus laboratory
NSL	non-Sabin-like (wild) viruses (result reported from certain ITD tests of polioviruses)
OPV	oral polio vaccine
PEG	polyethylene glycol
PIM	Potentially infectious materials
PV	poliovirus
RRL	regional reference laboratory
SL	Sabin-like poliovirus
Td-IPV	Tetanus, diphtheria and polio vaccine (inactivated).
tOPV	trivalent oral polio vaccine
IPV	inactivated polio vaccine
ITD	intratypic differentiation of poliovirus isolates to determine whether wild or vaccine like
UNICEF	United Nations Children Fund
UK	United Kingdom
VDPV	vaccine-derived poliovirus (isolates of poliovirus demonstrating 1 to 15% difference from parent OPV strains by full VP1 sequence homology consistent with an extensive period of virus excretion or transmission in the community)
cVDPV	Circulating vaccine-derived poliovirus
iVDPV	vaccine-derived poliovirus virus excreted by one or at most a few individuals, likely to be shed by (a) immunosuppressed individual (s) individual who has previously been exposed to OPV (iVDPV)
WHO	World Health Organization