Laboratory Containment of Poliovirus Materials: Risks and Risk Mitigation

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Background: Polio Vaccines

- **Oral polio vaccine (OPV; Sabin)**
  - Live-attenuated (Sabin strains)
  - Inexpensive, easy to deliver
  - Trivalent (tOPV) and bivalent (bOPV; types 1 and 3)

- **Inactivated polio vaccine (IPV; Salk)**
  - Formalin-inactivated, uses wild polio strains
  - Delivered by IM injection
  - Trivalent formulation, sometimes in combination with other antigens
Background: Status of Polio Eradication

- **Wild poliovirus**
  - WPV1: Ongoing (AFG, PAK)—48 cases to date in 2015
    - Last case in Africa in Aug 2014
  - WPV2: Declared eradicated, Sep 2015 (last case: India, 1999)

- **Vaccine-derived poliovirus (VDPV; reversion of Sabin strains)**
  - VDPV1: (2015) Madagascar (9 cases); 2 cases in Ukraine
  - VDPV2: (2015) 2 cases (Guinea, Nigeria); **Highest emergence risk**
  - VDPV3: (No cases since 2013) Relatively rare

Data as of 7 Oct 2015
Post-Eradication withdrawal of Type 2 from OPV

- Reduce risk of VDPV2 emergence
- Synchronized global Switch from tOPV to bOPV, Apr 2016
  - At least one dose of IPV in all countries to confer type 2 immunity
- Post-eradication, poliovirus becomes “exotic”
  - Risk of accidental or intentional reintroduction
  - Type 2 is immediate priority
Risk: Poliovirus Content in Specimens and Cultures

Dowdle and Birmingham, 1997, J Infect Dis 175(Suppl 1): S286-S292; GAPIII (Figure 2)
Global Action Plan ("GAP III")

- WHO global action plan to minimize poliovirus facility-associated risk after type-specific eradication of wild polioviruses and sequential cessation of OPV use
  - Based on risk assessment and risk mitigation
  - Endorsed by World Health Assembly, May 2015
- Inventory of materials
  - Type-specific, starting with type 2
    - But all “infectious” and “potentially infectious” polio materials must be inventoried by end 2015
  - Virus-specific: Wild/VDPV vs OPV/Sabin

Or google “gap iii polio”
Survey of Facilities/Laboratories

- **Original 2004 survey**
  - Asked only about wild polio materials
    - Did not ask about Sabin materials
  - Not differentiated by serotype

- **2015 survey**
  - Emphasis on WPV2 (and VDPV2) and OPV2/Sabin2
    - Identify WPV2/VDPV2 and OPV2/Sabin2, “infectious” and “potentially infectious” materials
  - Will also capture inventory of type 1 and type 3 materials
Definition: Poliovirus “Infectious Materials”

- Presence of poliovirus confirmed and storage consistent with maintaining infectivity (stored at <20°C)
- Virus isolates identified as poliovirus, e.g. by antigenic typing, rRT-PCR, or sequencing
  - Specimens from person/animal known to be infected, e.g. stool from which a poliovirus isolate was obtained
Definition: Poliovirus “Potentially Infectious Materials”

- Presence of poliovirus unknown but collected in a place and time where poliovirus was circulating or OPV was used (starting with type 2), and storage consistent with maintaining infectivity (stored at <20°C*)

- Fecal, sewage, or respiratory samples, extracted nucleic acid
  - Working on risk assessment/management/mitigation language to minimize disruption in non-polio labs, especially for respiratory samples and extracted nucleic acid

Containment applies to all laboratories, not just polio labs (and not just virology/microbiology labs)

*Or stored at 4°C for less than 1 year
Importance of Place and Time

- **WPV2**
  - WHO developing a list of last year of WPV2 for each country (pre-2000)

- **VDPV2**
  - More complicated—may be specific range(s) of years
  - Confirmed cases/outbreaks in at least 15 countries
  - Emergence always possible with continued tOPV use

- **OPV2/Sabin2**
  - 1961-Apr 2016 for ~150 countries
  - USA: pre-2001
What Does “Containment” Mean?

- Destroy (and document): Autoclave, incinerate
- Transfer: To an “essential” laboratory facility
- Contain: *Become* an “essential” laboratory facility
  - Work with materials in appropriate containment space
“Essential” vs “Non-Essential” Facilities

- **Essential:** It is *essential* that facility retains live poliovirus materials
  - Vaccine (IPV) manufacturers
  - Key reference laboratories
  - Key laboratories performing essential research to directly inform endgame and post-eradication decision-making

- **Non-essential:** It is *not essential* that facility retains live poliovirus materials
  - Diagnostic labs—can perform diagnostics regardless of specimen source, but procedures must prevent generation of live polio
    - If “containable” virus detected, materials must be forwarded to an essential facility
Technical Requirements for Containment

- Biorisk Management
- Poliovirus inventory and information
- General safety
- Personnel and competency
- Good microbiological technique
- Clothing and personal protective equipment
- Human factors

- Healthcare
- Emergency response and contingency planning
- Accident/incident investigation
- Facility physical requirements
- Certification
- Decontamination, disinfection, and sterilization
- Transport procedures
- Security

GAPIII, Annex 2
Facility Physical Requirements

- Located in area with high polio vaccine coverage
  - Immunization of staff
- Controlled entry to lab, through double doors
- Decontamination
  - Pass-through autoclave, airlock/decon chamber, dunk tank
- Animal facility requirements
- HEPA-filtered exhaust (post-eradication)
- Effluent waste treatment (post-eradication)
- Controlled exit, mandatory shower-out
  - Shower not required if using Class III BSCs

Basically, BSL-3 plus shower-out
Containment Implementation 2015 – 2019

- Contain WPV2 and VDPV2 by 31 Dec 2015
- Contain Sabin2 3 mo after OPV2 withdrawal (by 31 Jul 2016)
- Countries must certify compliance; WHO to audit
- Types 1 and 3 to follow after complete eradication (~2019)
Infrastructure to Support US National Containment

- **National Polio Containment Coordinator: Dr. Olen Kew**
  - Technical POC
  - Responsible for US national survey of poliovirus materials
    - Planning online survey: expect to see it soon
  - Developing an MMWR article to communicate containment issues
  - Reports to National Certification Committee

- **National Certification Committee**
  - Assures absence of polio in US and compliance with containment guidelines
  - Reports to Assistant Secretary for Health, DHHS, through NVPO
CDC contacts for polio containment questions:

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.