

Good afternoon, I'm Commander Ibad Khan and I'm representing the Clinician Outreach and Communication Activity, COCA, with the Emergency Risk Communication Branch at the Centers for Disease Control and Prevention. I would like to welcome you to today's COCA Call, Polio in New York: How to Recognize and Report Polio, and Reinforce Routine Childhood Polio Vaccination.

All participants joining us today are in listen only mode. Free continuing education is offered for this webinar. Instructions on how to earn continuing education will be provided at the end of the COCA Call.

In compliance with continuing education requirements, all planners and presenters must disclose all financial relationships in any amount within eligible companies over the previous 24 months, as well as any use of unlabeled products or products under investigation of use. CDC, our planners, and presenters wish to disclose they have no financial relationships with ineligible companies whose primary business is producing, marketing, selling, reselling, or distributing healthcare products used by or on patients. Content will not include any discussion of the unlabeled use of a product or a product under investigational use with the exception of Dr. Janell Routh's discussion of Pocopavir as an IND investigative agent to stop poliovirus shedding. CDC did not accept financial or any kind of support from ineligible companies for this continuing education activity.

At the conclusion of this session, participants will be able to accomplish the following; discuss the history of polio globally and the United States, outline the current investigation and response to the case of paralytic polio New York, describe how to recognize, diagnose, and report suspected paralytic polio cases in the United States, and distinguish the differences between inactivated polio vaccine and oral polio vaccine and the importance of maintaining high polio vaccination coverage.

After the presentations, there will be a Q and A session. You may submit questions at any time during today's presentation. To ask a question using Zoom, click the Q and A button at the bottom of your screen then type your question in the Q and A box. Please note, we receive many more questions than we can answer during our webinars.

If you're a patient, please refer your questions to your healthcare provider. If you're a member of the media, please contact CDC media relations at 404-639-3286, or send an email to [media@cdc.gov](mailto:media@cdc.gov).

I would now like to welcome our presenters for today's COCA Call. We're pleased to have with us; Lieutenant Commander Farrell Tobolowsky who's the Clinical Task Force Lead for CDC's 2022 New York State Polio Response. Dr. Emily Lutterloh, who's the Director of the Division of Epidemiology with the New York State Department of Health. Captain Janell Routh, who's the Incident Manager for CDC's 2022 New York State Polio Response. And Dr. Georgina Peacock, who's the Director of the Division of Humanization Services in CDC's National Center for Immunization and Respiratory Diseases.

Before we begin, the following presentation contains some content made by external presenters and not by the Centers for Disease Control and Prevention, or the Department of Health and Human Services. This presentation is for informational purposes only and should not be construed to represent any agency or department determination or policy, any mention of a product or company in the presentation does not indicate endorsement or recommendation by the United States Government, CDC, or HHS.

It is now my pleasure to turn it over to Lieutenant Commander Tobolowsky. Please proceed.

Good afternoon. My name is Farrell Tobolowsky and I'm the Clinical Task Force Lead of the New York State Polio Response. I'm happy to be with you all here today to present an overview and history of poliovirus. Next slide.

Today we will fulfill the following objectives; understand the history of polio in the U.S. and globally, describe polioviruses, understand the incubation period and transmission of poliovirus, and understand the impact of polio vaccination and the different types of vaccine. Next slide.

First, I will provide an overview of the poliovirus. Next slide.

Poliovirus is a type of anaerobe virus and consists of an RNA genome enclosed in a capsid. There are three different types of capsids, and they are defined as three serotypes; type 1, type 2, and type 3. If an individual is infected with one of the serotypes, they will not obtain any immunity to the other serotypes. Next slide.

Those who are infected with poliovirus can have paralytic polio or nonparalytic polio, where a person can present with constitutional, respiratory, or gastrointestinal symptoms only. Paralytic polio occurs in less than 1 percent of infections and the proportion with paralysis varies by serotype. For this reason, one case of paralytic polio indicates an outbreak and there are likely many infected with about 25 percent that have a mild clinical illness and the majority, or about 75 percent, have an asymptomatic infection. Next slide.

Following poliovirus exposure, the incubation period to develop signs or symptoms is on average three to six days for nonparalytic polio and it can take up to 21 days for paralytic polio to present. When the virus enters the body, it mainly replicates in the gastrointestinal system and oropharynx, which will be important for transmission, and we will discuss that on the next slide.

Once the virus enters the bloodstream, it can infect central nervous system cells and when the motor neurons are destroyed, distinctive paralysis can occur. This type of paralysis will be discussed in the clinical section of this COCA Call. Next slide.

Poliovirus is a highly infectious pathogen and can spread very easily. Generally, person to person spread occurs via the fecal oral route. However, it can spread less commonly through the oral to oral route. Fecal oral spread can occur when an individual has contact with the feces of an infected person, through direct contact, or contamination of food or water and unsanitary conditions. Patients are most infectious during the days immediately before and after the onset of symptoms. But they can shed the virus in their stool on average for 3-6 weeks and sometimes

longer. Most importantly, even those with asymptomatic or mild infection, can shed the virus. Next slide.

Luckily, we have two types of polio vaccine used globally to prevent paralysis and aid in decreasing transmission. The inactivated polio vaccine, or IPV, and the oral polio vaccine, or OPV. Next slide.

We will start by discussing inactivated polio vaccine. It contains all three types of poliovirus, 1, 2, and 3. The virus contained is chemically killed and cannot replicate, infect, or cause disease. This vaccine does induce humoral immunity but very limited mucosal or gut immunity, therefore it is very effective in preventing paralysis but less so in stopping transmission. It is the vaccine of choice in non-outbreak countries and is the only vaccine currently used in the U.S. since the year 2000. Next slide.

The oral polio vaccine is a live attenuated vaccine, which means that it contains live and weakened polioviruses. For this reason, the vaccine replicates and produces immunity in the gut and then shed into stool, therefore the oral polio vaccine prevents both paralysis and transmission and has been instrumental in eradicating wild polioviruses around the world because it stops the spread of the virus. It is given orally and is the current vaccine of choice for most countries experiencing outbreaks.

Because this vaccine contains weakened live virus and is shed into stool, it can circulate in a community. If it is allowed to circulate in an under immunized population for long enough, this strain can revert to a form that causes paralysis. Next slide.

Next we are going to briefly discuss the history of polio in the United States and the impact of vaccination. Next slide.

This figure displays the number of polio cases over time with number of cases on the y-axis and the year on the x-axis. As you can see, in the 1950s, pre-vaccination, up to tens of thousands were diagnosed with paralytic polio, which peaked in 1952. Cases generally peaked in the summer and during large outbreaks, travel and commerce were restricted and quarantines were imposed. Then, in 1955, the inactivated polio vaccine was introduced and paralytic polio cases rapidly decreased. Afterwards, in 1961, the oral polio vaccine was introduced.

The last indigenous case of wild poliovirus was identified in 1979 and the Americas were certified polio free in 1994. Lastly, in 2000, as mentioned previously, inactivated polio vaccine became the only vaccine used in the U. S. Next slide.

Now let's talk about the global polio eradication progress over the years and some of the key time points over the last 30 years. Next slide.

In 1988, the Global Polio Eradication Initiative, or GPEI, was established. This collaboration currently includes the Centers for Disease Control and Prevention, the World Health Organization, the Bill and Melinda Gates Foundation, the United Nations International

Children's Emergency Fund, or UNICEF, and Rotary International. Since its establishment, the annual number of wild poliovirus cases has declined by more than 99.9 percent worldwide.

Moving forward to 2015, type 2 wild poliovirus was eradicated. As a result, in 2016, the type 2 virus was withdrawn from the oral polio vaccine and only vaccine with types 1 and 3 were used. A few years later, in 2019, type 3 wild poliovirus was eradicated, however, around this same time, type 2 vaccine derived poliovirus outbreaks begin to emerge. Because of the many type 2 outbreaks, there are multiple countries that have recently used a monovalent or trivalent oral polio vaccine that contains type 2 on a national or subnational level. Now in 2022 there are only two countries with endemic wild poliovirus which is type 1, with some recent imported cases and many vaccine derived poliovirus outbreaks. Next slide.

Now let's further define the categories of poliovirus. Wild poliovirus, or WPV, and vaccine derived poliovirus or VDP. We briefly talked earlier about the oral polio vaccine containing live attenuated virus. Individuals who have received this vaccine shed the weakened vaccine strain virus which can infect other individuals and if allowed to circulate under or unimmunized populations for long enough, the vaccine virus can revert to a form called vaccine derived poliovirus that continues to spread and can cause paralytic polio. Outbreaks are most commonly caused by type 2. Next slide.

Unfortunately, polio outbreaks continue to be identified globally with 249 laboratory confirmed cases already this year. This map displays both the wild and vaccine derived polioviruses identified as of August 23, 2022. You can see the type 2 vaccine derived polioviruses in green, which is also the virus type that caused the case in New York State, and our presenter will discuss this case in more detail. Next slide.

Now we have arrived at the self-knowledge check, true or false, inactivated polio vaccine prevents paralysis caused by both wild polioviruses and vaccine derived polioviruses. Next slide. This statement is true. In summary, polio is caused by three serotypes of enteroviruses, 1, 2, and 3.

There are two types of polio vaccines; inactivated polio vaccine and oral polio vaccine. However, inactivated polio vaccine is the only vaccine currently given in the U. S. since 2000. Wild poliovirus is currently only endemic in two countries, with some imported cases.

Vaccine derived poliovirus cases continue to increase globally. At the risk of importations of wild poliovirus and vaccine derived poliovirus from other countries continues. It is critical to maintain high vaccination coverage worldwide, including in the United States. Next slide.

Thank you for your time and I will turn it over to our next presenter, Dr. Lutterloh.

Hello, thank you. Today I'm going to talk about a case of paralytic polio in New York State. Next slide.

So in mid-July, we got a call from Wadsworth Center, the New York State Public Health Laboratory, to tell us that they had detected poliovirus in a specimen that was submitted as part of a routine acute flaccid myelitis, or AFM, surveillance. Next slide.

As you can imagine, this set off all kinds of alarm bells, we asked more questions and the Wadsworth Center had received stool, an NP swab, an OP swab, and CSF, and it turned out the stool specimens had been positive by enterovirus PCR. Wadsworth took the next step and sequenced the virus and was able to identify not a more typical enterovirus that we might expect with AFM, but rather, vaccine derived poliovirus type 2. This was confirmed by CDC and the sequence showed 10 nucleotide changes in the region that encoded viral capsid protein 1, as compared to the Sabin 2 strain, which might imply circulation for some time and reversion to capability of causing paralysis. Next slide.

So the patient was an unimmunized immunocompetent young adult who had developed fever, neck stiffness, back pain, abdominal pain, and constipation. Then over the next few days developed lower extremity weakness and about two days after the weakness began, presented to an emergency department and was admitted to the hospital with flaccid weakness. After a stay of several days, the patient was discharged to a rehabilitation facility. Next slide.

So as it turns out, the clinicians caring for the patient were aware of an advisory that had been disseminated by New York State Department of Health in late June, that was reminding healthcare providers to submit specimens for cases of AFM and that's what led to submission of specimens in this case and the fortuitous detection of poliovirus. Next slide.

Further investigation revealed that the patient did not have any international travel during the 21 days before onset of paralysis, but had attended a large gathering about 8 days before the onset of first symptoms and of course we don't know if that's where the virus was acquired but it is within the exposure period. Next slide.

So the detection of poliovirus naturally has led to a very large response that has involved education and outreach in partnership with our local health departments, healthcare providers and health centers, various community based organizations, and trusted community leaders, with ongoing awareness and education and outreach efforts. We've also worked on engaging healthcare providers with notifications to providers to increase awareness about the detection of this case, and ask for their assistance in conducting surveillance and also asking them to proactively support the on time administration of polio immunization. We've been doing a variety of things to drive up immunizations, we've been deploying vaccine to the affected areas, and really focusing on initiating the primary series of vaccine for those people who are completely unvaccinated in addition to completing the primary series for those who are under vaccinated, and we've really also been urging the on time administration of the childhood vaccine series and trying to combat delays in catching children up.

We know that there are some people who like to delay the vaccine series until right before the child enrolls in school, where it's required, but unfortunately that leaves very young children with their less than ideal hygiene and the fact that they are often cared for in groups, it leaves them unprotected. We've also recommended boosters for a very narrow group of individuals who

are at high risk exposures such as those in contact with our case and certain healthcare workers who might care for polio patients. Next slide.

So here's a description of the surveillance we're undertaking; we're doing some active case finding to make sure that we detect any paralytic polio cases such as via syndromic surveillance and of course we're also continuing our routine AFM surveillance, which is what happened to pick up this case. We're also doing some enhanced surveillance for enterovirus positive illness, nonparalytic in nature, particularly in unimmunized individuals in the infected counties to see if we can pick up nonparalytic disease and hopefully get a sense for how widely this might be spreading.

And finally, we're trying to discern the prevalence of asymptomatic infection in the affected areas and one example is working with pediatricians to collect stool samples from diapers if a patient happens to provide a soiled diaper while in the office and the parent agrees. And then finally, we're doing waste water surveillance in Rockland County, which is where our case resides and the surrounding areas. Next slide.

So here's a self-knowledge check; which of the following is true about vaccine derived poliovirus, type 2? A, it can cause paralytic illness similar to wild poliovirus. B, it's detection in the U.S. implies that the affected individual either recently received oral polio vaccine outside the U. S. , or had close contact with someone who did. C, it can spread widely and can cause mild illness but does not cause paralysis. And then D would be, A and B, and E, all of the above. And next slide.

So the answer here is A, as we've heard, it can cause paralytic illness just like wild poliovirus, when it's detected in the U.S., that does not imply that the affected individual recently received OPV or was in contact with someone who did.

The poliovirus, including vaccine derived poliovirus, spreads easily so there might be a lengthy transmission chain with any number of unaffected people between someone who received OPV abroad and an individual who develops paralysis. And then C, as we've heard, yes, it can cause paralysis. Next slide.

So thank you very much, and now I will turn it over to Captain Routh.

Thank you very much, Dr. Lutterloh and good afternoon and good morning everyone. Next slide please.

The objectives of this presentation are to provide an overview of the clinical presentation of patients with paralytic polio myelitis. To discuss the initial evaluation and clinical management. And outline how to report suspected polio cases to public health. Next slide. So let's start with the clinical characteristics of paralytic polio. Next slide.

After a person is infected with poliovirus, the virus is carried by retrograde axonal transport to the spinal cord. It is the gray matter of the spinal cord that is affected, shown here in the cartoon on the right, by the blue box. Poliovirus specifically infects the anterior horn cells of the motor

neurons which leads to weakness and paralysis. Motor neuron damage and paralysis is usually permanent, although improvement with rehabilitation is possible. Paralytic polio cases are mostly in children, but adults can be infected and their infections are more likely to result in paralysis. Next slide.

Sagittal magnetic resonance imaging images to the right, show typical T2 weighted hyperintense lesions seen in polio. Here, the entire central gray matter of the cervical cord is affected and that's shown by the blue arrow and the blue box. Multiple levels of the cord are often involved and in patients presenting with bulbar involvement, a brain MRI should be considered as there is often enhancement of the cranial nerves. Next slide.

There are key signs and symptoms of polio myelitis that clinicians should be listening for. Most patients have a preceding illness before the onset of acute flaccid limb weakness. The illness is often gastrointestinal in nature, which may include symptoms of fever, sore throat, abdominal pain, muscle aches, and malaise. This preceding illness may occur 1-3 weeks before the development of limb weakness. Weakness onset is often accompanied by a recurring fever and neck or back pain and pain in the affected limbs. Next slide.

Onset of weakness is rapid within a few hours to a few days. We instruct parents and frontline clinicians to think acute flaccid myelitis or polio when faced with a child with limb weakness in whom the limb has loss of muscle tone and reflexes. So in other words, that limb is floppy, not spastic. For paralytic polio, weakness is usually in the lower extremities and is often asymmetric. This is contrasted to acute flaccid myelitis where, although we see that same asymmetry, it is mostly the upper extremities that are infected in that disease.

And in bulbar polio, it presents with cranial nerve findings like drooping eyelids or difficulty with eye movement, facial droop or difficulty swallowing and slurred speech. It's definitely important to note these symptoms because they can signal respiratory impairment. And these findings might present with a weak or hoarse cry in infants. Next slide.

Medical history should include critical questions on travel and vaccination. Red flags are recent international travel to areas where poliovirus is circulating within the incubation period, again, usually 7-21 days. Or exposure to somebody who has been infected with poliovirus. And a patient who is either unvaccinated, undervaccinated, or unsure of their polio vaccination status. That's really the critical question I think when I walk into an examination room and a child who has acute flaccid weakness, that first question out of my mouth should be, does that patient have the full complement of recommended polio vaccinations?

Please note any GI symptoms with or without fever, before the onset of weakness and ask about difficulty breathing or shortness of breath because again, that could indicate bulbar involvement. Young children or their parents may not describe limb impairment as actual weakness, so it's definitely important to ask questions about limb function; have they lost their age appropriate ability to feed themselves? Dress themselves? Throw a ball? Do they stumble or fall when they walk or try to squat? Next slide.

A thorough age appropriate neurological examination is important to diagnose acute flaccid weakness, especially in a child. On examination in a patient with polio myelitis, you would expect decreased muscle tone in the affected limbs, again, that presents as a floppy limb, not spastic, diminished or absent reflexes, muscle weakness that is usually asymmetric and more proximal than distal. We know that sensory and bowel or bladder function is usually spared but that is not always the case. So definitely ask questions about those functions and then most importantly, because bulbar paralysis can result in respiratory failure, it's critical to assess the patient's ability to protect their airway and please do document respiratory sufficiency. Next slide, please.

As mentioned, it is important to ascertain strength in the proximal muscles as well as distal as they are more often affected and can be easily missed on examination, this includes muscle groups like the shoulder muscles, the hips, and the trunk muscles as well. CDC has developed a poster with the title: Head Shoulders Knees and Toes, to provide questions and activities for clinicians to be able to assess these muscle groups and this can be downloaded from the AFM webpages at CDC.gov. Next slide.

The differential diagnosis of acute flaccid paralysis is broad. Paralytic polio may resemble acute flaccid myelitis, another disease with acute flaccid weakness that's thought to be caused by other enteroviruses, acute cord compression, transverse myelitis, spinal stroke, Guillain Barre syndrome, and other illnesses that affect the spine and motor neurons. A careful medical history, neurologic examination, lab testing and MRI of the brain and spine can help guide diagnosis and they should be made together with specialists in both infectious disease and neurology. Next slide, please.

Now we'll talk a little bit about diagnostic studies that might help guide you towards a diagnosis of polio myelitis. Next slide.

So neuroimaging should be done using magnetic resonance imaging, or MRI, with and without contrast of the entire spine and brain using the highest tesla scanner available and that's ideally a 3 tesla scanner. Sagittal and axial images are most helpful in identifying those T2 hyperintense lesions in the gray matter that are consistent with polio myelitis.

For laboratory testing, we recommend collection of cerebrospinal fluid, or CSF, serum, stool, and a nasopharyngeal and oropharyngeal swab and any additional pathogen specific tests that should be done as clinically indicated. These should be done as soon as possible to maximize the chance of pathogen yield. In-house enterovirus testing on a multiplex assay is an important first step for many of those specimen types but it won't detect stool enteroviruses which are the gold standard for polio.

For suspected poliovirus, collect two whole stool and two oropharyngeal swabs, taken at least 24 hours apart during the first 14 days after onset of limb weakness. That whole stool can be placed in a stool collection cup, we recommend a sample about the size of a large pea, and it does not need to be preserved in any media. The directions are found on the CDC website. All specimens should be routed through the state or local health department for initial enterovirus testing and then will be sent to CDC for confirmation. Next slide, please.



Alright, and next slide.

The initial management of polio is based on symptoms so hospitalize a patient with acute flaccid weakness for diagnostic workup and monitor respiratory status as progression of weakness can be rapid. As I mentioned, neurology and infectious disease specialists should be consulted to provide expertise in the workup, and rehabilitation therapy such as physical and occupational therapy, speech and swallow, should be initiated as soon as the patient is stable as our work from acute flaccid myelitis suggests that early initiation of rehabilitation can lead to improvements. And finally, at this time there are no FDA approved antivirals, medications, or biologics for treating polio myelitis. Pocopavir, which is a capsid inhibitor, is available under an FDA investigational new drug application but it is most often used in immunocompromised persons to stop shedding in stool and not for the prevention of weakness. Next slide.

And next slide.

It's very important to report suspected polio cases to public health. Just like acute flaccid myelitis, reporting of cases should not delay a patient's diagnosis and treatment or management plan. Reporting is a slower process. It has to go through the health department to CDC and then CDC has a process by which we review the case. So it is slow and clinicians should not wait for the results of either specimen testing or that CDC case confirmation to manage the patient appropriately.

Please contact your state or local health department for any suspected polio case. Paralytic polio has been classified as immediately notifiable, extremely urgent, which does require that the state and local health department contact CDC within 4 hours of getting a clinical report. Nonparalytic polio has been classified as immediately notifiable urgent, which requires the state and local health departments to contact CDC within 24 hours.

Health departments will assist in the completion of the patient summary form and request MRI reports and images and neurology notes from the hospital. This information will be sent to CDC's expert neurology panel for review and classification and can be done while lab testing is underway. A classification of polio myelitis does not depend on laboratory results and so we should get this review process started as soon as possible. And then health departments will also assist with the coordination of specimen shipment from the clinical lab to the state lab and then to CDC as necessary for confirmation. Next slide.

I'd like now to mention a few considerations for healthcare providers and laboratory workers. Next slide.

So for a patient suspected to have poliovirus infection, please do isolate the patient in a room with a private bathroom if possible, while undergoing that diagnostic evaluation. Healthcare providers should use standard and contact precautions during interactions with suspected case patients and if respiratory distress develops, with a need for intervention, consider droplet precautions. Only healthcare providers and lab personnel with evidence of complete polio vaccination should work with patients confirmed to have poliovirus infection.

CDC does have booster recommendations for certain groups and a single lifetime booster is recommended for lab and healthcare providers who handle specimens that might contain polioviruses and for healthcare providers who are treating patients who could have polio. Next slide, please. Healthcare providers should discuss polio prevention methods with family members of the case patient who might have been exposed during the patient's illness. They should ensure that household contacts are up to date with polio vaccination, review hand hygiene guidance and that for polioviruses please wash with soap and water before eating or assisting with feeding and after toileting, changing diapers or assisting with toileting. And monitor household contacts for infection and shedding in stool, regardless of vaccination status. Next slide.

Alright, so we are ready for our third knowledge check of the presentation; which specimen type has the highest yield for detecting poliovirus in infected patients? Is it A, cerebrospinal fluid? B, serum? C, stool? Or D, an oropharyngeal swab? Next slide. And the answer is C, stool. Stool is the gold standard for detecting and isolating poliovirus because polio is enterovirus which sets up infection in the gut. Next slide.

So in summary, polio is characterized by lesions in the gray matter of the spinal cord, which show up as T2 hyperintense lesions on MRI. Consider polio and ask about vaccination status and travel history in patients presenting with acute flaccid limb weakness. Obtain stool specimens to test for poliovirus infection. And lastly, most importantly, please do report suspected cases to public health, there's no need to wait for laboratory confirmation before you reach out. Next slide.

And with that, thank you very much and next I'd like to turn it over to our final presenter, Dr. Georgina Peacock.

Thanks Janell and good afternoon. My name is Dr. Georgina Peacock and I'm the Director for the Immunization Services Division at CDC and it's a pleasure to join you for today's COCA Call. Today I'll be providing the history of polio in the United States, the polio vaccine, its recommended schedules for uptake, and safety precautions to be aware of. Next slide.

Inactivated poliovirus vaccine was licensed in 1955 and was used extensively until the early 1960s. In 1961, type 1 and type 2 monovalent oral poliovirus, or MOPV, vaccines were licensed, followed by type 3 OPV vaccine in 1962 and trivalent OPV, or TOPV, vaccine in 1963. When trivalent OPV was licensed, it for the most part replaced IPV use. Trivalent OPV became the vaccine of choice in the U.S. and most other countries after its introduction until the late 1990s. The nearly exclusive use of TOPV led to the elimination of wild poliovirus from the United States in less than 20 years.

However, with OPV, vaccine viruses are excreted in stool of the vaccinated person and be spread from the recipient to contacts. Persons in contact with the fecal material may be exposed and infected with the vaccine virus. One case of vaccine associated paralytic polio occurred for every two to three million doses of TOPV administered.

An enhanced potency inactivated poliovirus vaccine which we will refer to as simply, IPV, was licensed in November of 1987. In 1999 the ACIP recommended exclusive use of IPV, exclusive use of IPV vaccine eliminated the shedding of vaccine virus eliminated any indigenous vaccine associated paralytic polio. Outlined on this slide are the products that are currently available in the United States that contain polio vaccine. These differ in many aspects including components, age-- oh, next slide, sorry. And I'll start again.

Outlined in this slide are the products that are currently available in the United States that contain polio vaccine. These differ in many aspects including components, age indications, and the dose in the series for which it's approved for. I would like to take a few minutes to go through these.

The first one listed is Ipol, Ipol whose ACIP abbreviation is IPV, is a single component vaccine. That is, it only contains inactivated polio vaccine. It can be given to persons 6 weeks of age and older for any dose in the series.

Pentacel is the next on the list, it also contains DTaP and IPV and the additional component in this combination vaccine is Hib. It is approved for use for infants and young children, 6 weeks through 4 years of age for doses 1-4 of the polio vaccine series.

The components in Kinrix are DTaP and IPV and it's approved for children 4-6 years of age for the fourth dose in the polio vaccine series. And then we come to Quadracel, it also contains DTaP and IPV and is approved for dose 4 or 5 in the polio series.

Another combination vaccine containing IPV that is licensed but will not be available until 2021, is a four component combination vaccine for the prevention of six diseases containing DTaP, IPV, Hib, and Hep B, called Vaxelis. It is approved for infants and children 6 weeks through 6 years of age for doses 1-3 of the polio vaccine series.

Finally, Pediarix is a combination vaccine containing IPV, as well as DTaP and Hepatitis B vaccines. It is approved for infants and children 6 weeks through 6 years of age for doses 1-3 of the polio vaccine series. Next slide.

IPV is highly effective in producing immunity to the three types of polioviruses it contains. Like many other inactivated vaccines, most recipients do not become immune after a single dose, but 90 percent of recipients are immune to all three poliovirus types after two doses and at least 99 percent are immune after three doses. The duration of immunity with IPV is not known although it probably provides lifelong immunity after complete series. Next slide.

And next I'll go over the clinical considerations for the ACIP polio vaccine immunization recommendations. Next slide.

A primary series of IPV consists of three doses. In infancy these primary doses are integrated with the administration of other routinely administered vaccines. Dose 1 should be given at 2 months of age, dose 2 at 4 months of age, dose 3 should be given at 6-18 months of age, and the recommended interval between the first three doses is two months. The final dose in the IPV series should be administered at 4-6 years of age. Next slide.

A dose of IPV on or after age 4 years is recommended, regardless of the number of previous doses. Of note when DTaP, IPV, and Hib or Pentacel is used, four doses of IPV are given at ages 2, 4, 6, and 15-18 months. Essentially following the schedule for the DTaP component. This results in four doses of IPV by the age of 18 months.

However, it is important to remember the minimum age for the last dose in the series is 4 years. An additional booster dose of age appropriate IPV containing vaccine should be administered at 4-6 years. This will result in a 5 dose IPV vaccine series which is considered acceptable by ACIP. Next slide. In the first 6 months of life, ACIP, or the Advisory Committee on Immunization Practices, recommends the following routine schedule; minimum age and minimal intervals are only recommended in certain situations.

If the person is at risk of imminent exposure to circulating poliovirus, for example, travel to a polio endemic region or during an outbreak, if accelerated protection is needed, the minimum ages for the first three doses are 6, 10, and 14 weeks respectively. The interval between each of the first three doses of IPV is 4 weeks. The minimum age for dose 4 is 4 years. There should be at least six months between the last and the next to last dose. Minimum intervals may also be used to catch up a child who is missing doses or who is delayed; however, once the child is caught up and back on schedule, routine intervals between doses should be followed. Next slide.

Some nuances on the catch up schedule, and I think we may be, our spikes may be off a little bit.

So I'll keep going, so the fourth dose in the series may not be necessary if the third dose is given on or after the fourth birthday and at least 6 months after the previous dose. One catch up scenario we are frequently asked about is if the child who received more than four doses before his fourth birthday and if four or more doses are administered before age 4, an additional dose should be administered at 4-6 years of age. Just make sure that there is a 6 month interval between the next to last and last dose.

ACIP recommends that the minimum interval from the last dose to the next to last dose should be at least 6 months to provide an optimum booster response. If a child has received the second dose in your office today and will turn 4 years in less than 4 weeks, you should not need to have them come back in 4 weeks for the third dose. Have them come back in 6 months for the third and final dose because they will be 4 years old by that time. Next slide.

Because only trivalent doses count as valid for the U.S. Polio Vaccination Schedule, a frequently asked question we receive here at CDC is how can I determine if a dose of OPV given in another country is trivalent OPV? The simplest way is to use the date of administration to make a presumptive determination of what type of OPV was received. Trivalent OPV was used throughout the world prior to April of 2016. In April 2016, all countries using OPVs switched to bivalent OPV or BOPV. In addition, some countries also used monovalent OPV or MOPV during special vaccination campaigns.

Doses recorded as BOPV or MOPV or doses given during a vaccination campaign, which may be included on the record, do not count as valid doses for the U. S. Polio Vaccination Schedule. If the record indicates OPV and the dose was given prior to April 1, 2016, it can be counted as a

valid TOPV dose, unless the record says campaign. If the dose was administered on or after April 1, 2016, it should not be counted as a valid dose for the U.S. Polio Vaccination Schedule because it was bivalent or monovalent vaccine instead of trivalent. Persons younger than 18 years of age, with doses of OPV that do not count towards the U. S. vaccination requirements should receive IPV to complete the schedule according to the U.S. Polio Administration Schedule. Next slide.

Polio vaccination has been a routine childhood vaccine for decades, since the 1950s. Those who received any vaccines as a child, almost certainly received polio vaccination. Routine vaccination of U. S. residents 18 years of age or older is not necessary or recommended because most are already immune and have a very small risk of exposure to wild poliovirus in the United States. Some adults, however, are at increased risk for infection from poliovirus. These include laboratory workers handling specimens that may contain polioviruses, healthcare personnel treating patients who could have had polio or have close contact with a person who could be infected with poliovirus, and travelers to areas where polio myelitis is endemic or epidemic. Currently there is no adult IPV shortage. Next slide.

Recommendations for poliovirus vaccination of adults at increased risk depends upon the previous vaccination history and the time available before protection is required. For unvaccinated adults, including those adults without a written record of prior polio vaccination, at increased risk for exposure to polio myelitis, primary immunization with IPV is recommended. The recommended schedule is two doses, separated by one to two months and a third dose given 6-12 months after the second dose.

The minimum interval between the second and third doses is 6 months. In some circumstances time will not allow completion of this schedule. If 8 weeks or more available before protection is needed, three doses of IPV vaccine should be given at least 4 weeks apart. If 4-8 weeks are available before protection is needed, two doses of IPV vaccine should be given at least 4 weeks apart. If less than 4 weeks are available before protection is needed, a single dose of IPV vaccine is recommended.

In all instances, the remaining doses of vaccine should be given later at the recommended intervals if the person remains at risk. Next slide.

Now we have arrived at our last of the self-knowledge check questions. What is the recommended interval between the first three doses of the polio vaccine for children? A, 3 months, B, 2 months, C, 6 months, D, 1 year. Next slide.

The answer is B, 2 months. And now I'll share something, next slide. And now I'll share some things about vaccine safety. Next slide.

Contraindications; severe allergic reactions such as anaphylaxis to a vaccine component or following a prior dose of vaccine is a contraindication for further doses of that vaccine. Since IPV contains trace amounts of Streptomycin, Neomycin, Polymyxin B, there is a possibility of allergic reactions in persons sensitive to these antibiotics. Persons with allergies that are not anaphylactic, so just skin contact sensitivity, may be unvaccinated. As far as precautions,

pregnancy is a precaution to IPV vaccination. Although no adverse effects of IPV vaccine have been documented among pregnant women or their fetuses, vaccination of pregnant women should be avoided on theoretical grounds. However, if a pregnant woman is at increased risk for infection or requires immediate protection against polio, IPV vaccine can be administered in accordance with the recommended schedule for adults.

Persons with a moderate or severe acute illness normally should not be vaccinated until their symptoms have improved. And finally, IPV adverse reactions in pre-licensure trials, minor local reactions such as pain and redness most commonly occurred following IPV. Severe reactions are rare. Next slide. Adults who have previously completed a primary series of three or more doses and who are at increased risk of exposure to polio myelitis should receive one dose of IPV.

The need for further supplementary doses has not been established. Only one supplemental dose of polio vaccine is recommended for adults who have received a complete series. It is not necessary to administer adult additional doses for subsequent travel to a polio endemic country. Adults who have previously received less than a full primary course of OPV or IPV, and who are at increased risk of exposure to polio myelitis, should be given the remaining doses of IPV regardless of the interval since the last dose and type of vaccine previously received. It is not necessary to restart the series of either vaccine if the schedule has been interrupted. Next slide.

Thank you so much for your time, and now I'll hand it off to the next presenter.

Presenters, thank you so much for providing our audience with this timely information. We will now go into our Q and A session. Please remember that to ask a question using Zoom, click the Q and A button at the bottom of your screen, then type your question. And please note that we receive many more questions than we can answer during our webinars.

For our first question for our presenters, it's quite a theme that we have seen in our Q and A box where this question can be kind of summed up as either A, older people and communities, folks that may be in their 80s or 90s that may have never got the vaccine, what are the options for such community members that are of older age, or B, folks that came to the U.S. at an older age from another country that may have not been vaccinated as children. So can you please share what options we have for such folks?

Dr. Routh, I know we were talking about this a little bit more and you have some good insight into this.

Dr. Peacock, thanks, I'm happy to take that. So we do recommend that adults who are un- or undervaccinated in the United States get caught up with their IPV schedule. So for those who lived outside the country and came to the United States without being vaccinated against poliovirus, we do recommend they catch up with a complete series, using inactivated polio vaccine, or IPV. I know there are lots of questions about older citizens, particularly those maybe in nursing homes that did not receive initial polio vaccine when it first came out in the 1950s, I will say this, we know that polio vaccine has been part of routine childhood immunization schedule for decades and it is still, as Dr. Peacock mentioned, included in routine childhood immunizations. Unlike smallpox, which we have discontinued, polio still continues to be given

routinely. The Salk vaccine, licensed in 1955 and childhood immunization campaigns started shortly afterwards. Persons who received any childhood immunizations, especially those who attended public school and many private schools, where they're generally vaccination requirements for school entry, almost certainly received polio vaccination back in those decades and we do know that adults were vaccinated as well during those campaigns. We will say for adults who believe that they were not vaccinated or do not have proof of vaccination, that full series, which is a three-dose series for adults, is recommended.

Great, thank you so much. And Captain Routh, a question that we received based on your portion of the presentation, can you elaborate or share a little bit more about those international locations that should be red flags to look for?

Certainly, so I can actually direct our viewers to the Global Polio Eradication Initiative website. They routinely post lists of countries with circulating vaccine derived polioviruses and wild poliovirus detections, and so those would be the countries we would be concerned about for travelers going to, traveling there. And those would be countries we would recommend a single IPV booster before travel.

Thank you very much. Our next question asks how long after vaccination is a person considered protected? Is there a period after their last dose that they're considered protected?

This is Captain Routh, I can take that question as well, and so again, we generally say that antibody levels rise about 14 days after a dose of, after that initial dose of vaccination, after that initial dose of vaccine. So for example, when somebody is receiving an initial dose of IPV, we can expect antibody development about 14 days after that. We do know with each subsequent dose there is an anamnestic response so those B cells that have already been primed in your immune system to respond, actually act very quickly once they see a repeat of that antigen, and so you're almost certainly to see an antibody rise within a couple of days. But I think for the sake of certainly our COVID discussions about when is a person considered fully vaccinated, it usually is 14 days after that dose.

Thank you for that clarification. And we have time for one last question; and the question asks, can you please share with our audience how they can differentiate between polio and AFM?

That is a great question, and this is Dr. Routh, I'm happy to take that one again since this is part of my day job as well. It's a great question and I would say to our audience, a case of acute flaccid weakness coming to your office is polio until proven otherwise, and so it is incredibly important for you to collect those stool specimens in order for us to be able to differentiate whether this is AFM or this is polio. A couple, a few things about acute flaccid myelitis, so again, we think that these increases in cases that we've seen in a biannual period pattern up until 2018 are caused by a different enterovirus, enterovirus D68, that is a respiratory virus and usually infects the nasopharynx as opposed to the gut, so we have seen differences in the clinical presentation of acute flaccid myelitis where children more often have upper extremity weakness as opposed to the lower extremity weakness that we see when acute flaccid weakness is due to poliovirus. But really, one of the critical things to distinguish between AFM and polio is to

collect those stool specimens and actually look for the enterovirus that is causing acute flaccid weakness.

The MRI images will look very similar and so we are recommending everybody, all clinicians who see a child with acute flaccid weakness and whom they suspect either AFM or polio, please get those stool specimens, two, stool specimens collected 24 hours apart, within 14 days of weakness onset and do send them forward for testing. Thank you.

Thank you, Captain Routh.

Again, thank you to our presenters for answering these questions and for sharing your expertise with us today.

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A transcript and closed caption video will be available on-demand on the COCA Call's webpage later this week. Please plan to join us this next Thursday, September 8, at 2:00pm Eastern, for our next COCA Call. The topic will be 2022-2023 influenza vaccination recommendations and guidance on coadministration with COVID-19 vaccines.

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Again, thank you for joining us for today's COCA Call and have a great day.