Centers for Disease Control and Prevention

Clinical Considerations for Monkeypox in Children and Adolescents

Updated November 17, 2022

Who this is for: Healthcare providers caring for children and adolescents less than ages 18 years in clinics, emergency departments, and hospitals in the United States.

What this is for: Considerations on clinical management of children and adolescents less than ages 18 years with exposure to monkeypox or concern for monkeypox virus infection.

How to use: These considerations are intended to help U.S. clinicians and health systems develop a plan for managing children and adolescents with exposure to monkeypox, suspected monkeypox, or confirmed monkeypox.

Clinicians who are caring for children and adolescents with possible monkeypox should consult their jurisdictional health department to ensure that a public health investigation is performed. Once test results are known, it is important to correctly interpret results and perform clinical management in collaboration with the jurisdictional health department. Health departments can facilitate consultation with CDC for additional guidance, if desired.

Key points

- In the current monkeypox outbreak, reported cases of monkeypox in children and adolescents are infrequent (<0.3% of total cases) and disease is generally not severe. Exposure to a household contact with monkeypox is the predominant route of exposure for children, while sexual contact is the predominant route of exposure for adolescents.
- Monkeypox should be considered when children or adolescents present with a rash that is consistent with the disease, especially if epidemiologic criteria are present.
- Young children, children with eczema and other skin conditions, and children with immunocompromising conditions may be at increased risk of severe disease.
- Treatment should be considered on a case-by-case basis for children and adolescents with suspected, probable, or confirmedmonkeypox who are at risk of severe disease or who develop complications of monkeypox. Tecovirimat is the first-line medication to treat monkeypox, including in children and adolescents.
- Children and adolescents with close contact to people with suspected, probable, or confirmed monkeypox may be eligible for post-exposure prophylaxis (PEP) with vaccination, immune globulin, or antiviral medication.
- Adolescents with certain risk factors and recent experiences that might make them more likely to have been recently exposed to monkeypox can be considered for vaccination [i.e., expanded post-exposure prophylaxis (PEP++)].
- Clinicians caring for adolescents who present with lesions consistent with monkeypox secondary to sexual transmission should consider testing for monkeypox, as well as for sexually transmitted infections and HIV, and offer appropriate care if tests are positive.

Children and adolescents can become infected with monkeypox virus through contact with people or animals with monkeypox or with contaminated materials. This includes close, skin-to-skin contact such as might occur during cuddling, caregiving, or bed-sharing; transmission across the placenta *in utero* or contact during the birthing process; contact with body fluids and respiratory secretions of patients with monkeypox or with contaminated fomites; and sexual contact. Historically, monkeypox has been documented in children and adolescents in many African countries and in periodic outbreaks linked to travel to these countries or imported animals from Africa, including a 2003 outbreak in the United States associated with pet prairie dogs.

In the current monkeypox outbreak in the U.S., cases of monkeypox among children and adolescents has been rare (0.3% of all reported cases as of September 24th, 2022). A report published on November 3rd, 2022 described the epidemiologic and clinical features of 83 cases of infection in children and adolescents. Among them, there were 16 cases among children <5 years, 12 cases in children 5-12 years and 55 cases among adolescents 13-17 years. Most adolescents (89%) were male. The most common mode of exposure for children <12 years was close physical contact with an adult household member with monkeypox, while for adolescents the most common exposure was through male-to-male sexual contact. The most common mode of exposure for children <12 years was close physical contact with an adult household member with monkeypox, while for adolescents the most common exposure was through male-to-male sexual contact.

Signs and symptoms

Similar to infections in adults, the most common sign of monkeypox in children and adolescents is a rash that progresses from maculopapular lesions to vesicles, pustules, and finally scabs. Historical reports of Clade I or II monkeypox infections in children and adolescents describe that the rash is often accompanied by fever, chills, sweats, lymphadenopathy, sore throat, headache, or myalgias. However, during the current outbreak, fever and lymphadenopathy have not always occurred. Other symptoms may include fatigue and headache. Difficulty swallowing or cough may occur when oropharyngeal lesions are present. Intraocular lesions, eyelid swelling, or eyelid crusting may occur when there are lesions near or in a patient's eye, which can occur when a patient touches these sites with their hand after touching a lesion. (See Clinical Recognition for key characteristics of monkeypox and pictures of lesions.)

The rash of monkeypox may be confused with other rash illnesses that are commonly considered in children, including classic varicella (chickenpox) and varicella zoster (shingles); hand, foot, and mouth disease; measles; scabies; molluscum contagiosum; herpes; syphilis; allergic skin rashes; drug eruptions; and a variety of congenital infections. Co-infections with monkeypox are possible. When indicated based on clinical presentation, evaluation for etiologies other than monkeypox should be done at the time of testing for monkeypox, particularly when no epidemiologic link to a person with monkeypox has been identified.

In the recent MMWR report, distribution of the rash in children was predominantly on the trunk and face; none of the children <12 years had anogenital lesions. In contrast, most adolescents presented with anogenital lesions. Over 11% of 83 children and adolescents were hospitalized with no patients requiring intensive care; 22% were treated with tecovirimat; all patients recovered without sequalae. There were 4 infants <1 year of age and no neonates < 4 weeks of age included in this series. An August 2022 publication describing a series of pediatric patients from Spain reported a similarly low rate of complications. Information about the disease course in neonates and young infants in the current outbreak is very limited. A recent report published in October 2022 described the case of a neonate who developed monkeypox lesions on day 9 of life, as a result of perinatal transmission within a family cluster. The infant required hospitalization and mechanical ventilation. Both monkeypox virus (clade IIb) and adenovirus were identified in the infant. The infant received a 2-week course of enteral tecovirimat and intravenous cidofovir and recovered. In this case, it is not possible to attribute the clinical illness to either pathogen (monkeypox virus or adenovirus) directly, nor is it possible to attribute the improvement to the use of tecovirimat or cidofovir.

Testing

The recommendations for testing for monkeypox are similar for children and adults. Tests should be performed on people for whom monkeypox is suspected based on clinical presentation and epidemiologic criteria. If testing is indicated, lesions should be vigorously swabbed and sent for testing according to the guidance on Preparation and Collection of Specimens. Unroofing, opening or aspirating monkeypox lesions because of the risk for sharps injury and related monkeypox transmission.

Positive diagnostic results from testing of lesion material for *Orthopoxvirus* or *Monkeypox virus* DNA in people without epidemiologic criteria or known risk factors, or with atypical presentations, should be verified. Molecular tests (e.g., real-time PCR tests) are highly specific and sensitive; however, when epidemiologic criteria are absent or unknown and the Cycle threshold (Ct) value is high (generally ≥34), CDC recommends re-extraction and retesting of the specimen. CDC can be consulted for complex cases, including those that appear atypical or questionable, and can perform additional viral specific- and clade-specific PCR testing and anti-orthopoxvirus serologic testing. For more information, see HAN Archive – 00471 | Health Alert Network (HAN) (cdc.gov) and Orthopoxvirus Testing Challenges for Persons in Populations at Low Risk or Without Known Epidemiologic Link to Monkeypox — United States, 2022 | MMWR (cdc.gov).

Patients with suspected monkeypox should be assessed for contact with people or animals having a rash or diagnosed with monkeypox. Clinicians should contact their jurisdictional health department (Jurisdictional Contacts) as soon as monkeypox is suspected.

Management of monkeypox

As with adults, children and adolescents with monkeypox should be closely monitored throughout their illness and likely will benefit from supportive care and pain control. Decisions about treatment for children closely align with treatment plans for adults (see Interim Clinical Guidance for the Treatment of Monkeypox). For the pediatric population, particular attention should be paid to keeping skin lesions covered and preventing children from scratching lesions or touching their eyes after touching lesions, which may result in auto-inoculation and more severe illness. For information about skin care for individuals with monkeypox lesions, please see . an ophthalmologist should be consulted and a careful ocular exam performed. Optimal fluid intake should be encouraged, particularly in persons with extensive skin involvement who may have additional fluid losses.

While most cases of monkeypox resolve without treatment, treatment should be considered, based on interim guidance for clinical treatment, for children and adolescents who have the following clinical manifestations:

- Severe disease, including disseminated rash, a large number of lesions that are confluent, hemorrhagic or necrotic lesions, severe lymphadenopathy that can cause airway obstruction, involvement of multiple organ systems and associated comorbidities (for example, pulmonary involvement with nodular lesions, encephalitis, ocular disease, myocarditis, neurologic involvement), sepsis, or if the disease requires hospitalization.
- Involvement of anatomic areas which might result in serious sequelae that include scarring or strictures.

Treatment should also be considered for children and adolescents who may be at high risk for severe disease:

- Children under 1 year of age
- Children and adolescents experiencing severe immunodeficiency or immunocompromise
- Adolescents who are pregnant or breastfeeding
- Children and adolescents with a condition affecting skin integrity

While disease caused by clade I monkeypox virus may be more severe in children younger than 8 years of age, compared with adults, the limited available evidence from the current outbreak of clade II suggests that, in general, the clinical presentation in children is not more severe than that of adults. There are very limited data for neonates and for young infants. Clinicians caring for young infants with monkeypox may consider antiviral treatment.

When considering treatment for a child or adolescent with monkeypox, clinicians should consult their jurisdictional health department. Jurisdictional health departments can facilitate consultation with CDC for additional guidance, as needed.

CDC offers a clinical consultation service (email eocevent482@cdc.gov), or healthcare providers may contact the CDC Emergency Operations Center [EOC] at (770) 488-7100) where CDC can provide additional guidance to clinicians with patient management questions.

Treatment

Tecovirimat

Tecovirimat is currently the first-line treatment for monkeypox virus infection in people with severe disease or who are at risk for severe disease, including for children and adolescents.

Patients should be informed about the clinical trial for tecovirimat (, and encouraged to consider enrollment. For patients who are not eligible for STOMP or who decline to participate, tecovirimat can be provided under an expanded access protocol.

For more specific information about tecovirimat use for adult and pediatric patients, see Guidance for Tecovirimat Use Under

Expanded Access Investigational New Drug Protocol during 2022 U.S. Monkeypox Outbreak.
Oral tecovirimat dosing is most practical for children who weigh at least 13 kilograms (approximately 28 pounds), can take capsules or the contents of a capsule mixed with soft food, and are able to eat a fatty meal to ensure optimal drug absorption. In the absence of an oral tecovirimat suspension formulation, IV tecovirimat may be considered for children weighing less than 13 kilograms based on clinical assessment of risk/benefit and if determined appropriate by the treating clinician. For information on weight-based dosing of tecovirimat, see the EA-IND protocol [1 MB, 22 pages]. The protocol includes instructions for opening capsules and mixing with food [295 KB, 2 pages] or liquid for infants and children who require less than a 200 mg dose, which differs from the FDA-approved TPOXX (tecovirimat) labeling.

Monitoring of renal function is recommended in pediatric patients < 2 years of age, given theoretical concerns that renal immaturity in young pediatric patients may result in higher exposure of hydroxypropyl-β-cyclodextrin, an ingredient in IV tecovirimat. Animal studies have shown potential for nephrotoxicity at very high exposure levels of hydroxypropyl-β-cyclodextrin. For more information, see Expanded Access IND Protocol: Use of Tecovirimat (TPOXX®) for Treatment of Human Non-Variola Orthopoxvirus Infections in Adults and Children (cdc.gov) [1 MB, 22 pages].

Other treatments

Other treatments might be considered in addition to tecovirimat or as an alternative for children and adolescents who are ineligible or have a contraindication for oral or intravenous tecovirimat. These treatments should be reserved for unusual circumstances, such as very severe infections, disease progression or recrudescence (initial improvement followed by worsening) despite tecovirimat treatment, or when tecovirimat is unavailable. Use of these treatments should be in consultation with infectious disease specialists, pharmacists, state and local health departments, and CDC.

Vaccinia immune globulin , licensed by the FDA for the treatment of vaccinia virus vaccine complications, may be used for treatment of severe monkeypox infection, though it is unknown whether children will benefit from treatment. Vaccinia immune globulin is available from the US Strategic National Stockpile and can be requested by clinicians through an existing expanded access Investigational New Drug (EA-IND) protocol.

The use of the antiviral medications brincidofovir [670KB, 21 Pages] and cidofovir [828KB, 6 Pages] may also be considered, but these should be used with caution due to potential toxicity. Data are not available on the effectiveness of brincidofovir or cidofovir in treating monkeypox virus infection in people. However, they have been shown to be effective against orthopoxviruses in *in vitro* and animal studies. Brincidofovir may have a more favorable safety profile than cidofovir. Cidofovir and brincidofovir should not be used simultaneously. Cidofovir is commercially available. Brincidofovir is made available from the Strategic National Stockpile for treatment of monkeypox to clinicians who request and obtain an FDA-authorized single-patient emergency use IND (e-IND). Clinicians with monkeypox patients necessitating brincidofovir treatment need to submit an e-IND request to FDA by email (DDI.EIND@fda.hhs.gov) or phone 301-796-3400 or 1-855-543-3784 during normal business hours (8 am-4:30 pm ET M-F). During after hours, call the FDA Emergency Coordinator at 1-866-300-4374 or 301-796-8240 or email CDER-EIND@fda.hhs.gov and call the CDER Emergency Coordinator at 301-796-9900.

Topical trifluridine eye drops can be considered if there is involvement near or in the eye, in consultation with ophthalmology. For additional information on current therapeutic recommendations, see Treatment Information for Healthcare Professionals.

Post-exposure prophylaxis (PEP)

Data on PEP to prevent monkeypox in children are limited. The only vaccine that is authorized and recommended for use in children or adolescents for PEP is the JYNNEOS vaccine. PEP should not be withheld from children or adolescents who are otherwise eligible. Decisions about whether to offer PEP should take into account the level of risk from the patient's exposure and the individual patient's risk of severe disease. Vaccination, immune globulin, and antiviral medication can be used as monkeypox PEP. For most people, vaccination is preferred. Immune globulin may also be considered for infants under 6 months of age, given their immature immune systems and possible decreased responses to vaccination.

When considering prophylactic modalities for a child or adolescent, clinicians should first consult their jurisdictional health department (Jurisdictional Contacts). Jurisdictional health departments can facilitate consultation with CDC for guidance regarding PEP modalities, when needed, and for assistance with the associated EA IND processes, if applicable.

Vaccines and other options for monkeypox PEP in children and adolescents are reviewed below. For detailed information on vaccines for monkeypox, see Considerations for Monkeypox Vaccination.

Vaccines

JYNNEOS

JYNNEOS contains a non-replicating *Vaccinia virus*. While JYNNEOS has not been studied specifically for children or adolescents, the same non-replicating V*accinia virus* in the JYNNEOS vaccine has been used in studies against other diseases including tuberculosis, measles, and Ebola. These studies included children as young as 5 months old, and no serious safety concerns were reported. In the United Kingdom in 2018–2019, JYNNEOS was administered to a few young children, including infants, following exposures to monkeypox, with no known adverse events. JYNNEOS has also been administered to children in the United States during the current outbreak without any adverse events to date.

YNNEOS is available for use as post exposure prophylaxis (PEP) for children and adolescents under 18 years determined to be at high risk for monkeypox infection under the Emergency Use Authorization (EUA) issued by the US Food and Drug Administration on August 9, 2022. In the current outbreak, children as young as 4 months have been vaccinated with JYNNEOS as PEP after a known exposure. Prior to administration in people younger than age 6 months, clinicians should first contact their jurisdictional health department.

Vaccination with JYNNEOS for children and adolescents aged <18 years should be administered via subcutaneous injection as two doses (0.5mL each) given four weeks apart, ideally with the first dose given within four days of exposure. The intradermal route of administration is not recommended for persons <18 years, as there are no data with this route of administration in people <18 years. For more information, review EUA Fact Sheet for Healthcare Providers Administering Jynneos Vaccine .

ACAM2000

ACAM2000 contains a replicating *Vaccinia virus* and is associated with adverse events caused by uncontrolled viral replication, such as progressive vaccinia and eczema vaccinatum.

Up until the early 1970s, a precursor to ACAM2000 was administered to children in the United States to prevent smallpox, an infection caused by another orthopoxvirus. That vaccine and ACAM2000 contain a replicating *Vaccinia virus* and are associated with adverse events caused by uncontrolled viral replication, such as progressive vaccinia and eczema vaccinatum. Many adverse events were more common in young children, particularly post-vaccinial encephalitis in those under age 12 months, and immunocompromised individuals.

ACAM2000 is contraindicated in children under 12 months of age and in children and adolescents with the following conditions:

- Congenital or acquired immune deficiency disorders, including those taking immunosuppressive medications and people living with HIV (regardless of immune status)
- Atopic dermatitis/eczema or a history of atopic dermatitis/eczema or other acute or exfoliative skin conditions
- Pregnancy
- Cardiac disease
- Eye disease treated with topical steroids

ACAM2000 is allowed for use against monkeypox under an EA-IND. However, it is not the preferred vaccine and its use should be considered only in cases that the JYNNEOS vaccine is unavailable or if there is a contraindication to its use (e.g., allergy to a component of JYNNEOS).

Vaccinia immune globulin

Vaccinia immune globulin is approved for treatment of smallpox vaccine complications. Its effectiveness as monkeypox PEP is unknown. However, vaccinia immune globulin is available through an EA-IND for potential prevention of monkeypox. Particularly for infants under 6 months of age with high risk exposures, vaccinia immune globulin can be offered as a PEP modality.

Antivirals as PEP

Antiviral medications, primarily tecovirimat, can be considered for monkeypox PEP in unusual circumstances, such as when vaccine is contraindicated due to an allergy to vaccine components. The effectiveness of antiviral medications as monkeypox PEP is unknown.

Infection control

Pediatric inpatient care

For children hospitalized with suspected or confirmed monkeypox or for hospitalized children with monkeypox exposure, isolation and infection control procedures should take into consideration the child's age and caregiving needs, family and caregiver preferences, and individual patient and caregiver factors, including the patient's course of illness, the extent and location of lesions, the ability to cover lesions, and the risk to caregivers (e.g., pregnant or immunocompromised persons). The presence of caregivers in the hospital provides immeasurable benefit to children.

For detailed recommendations on isolation and infection control in healthcare settings, see Infection Control: Healthcare Settings.

In homes

Isolation and infection control measures can prevent the spread of *Monkeypox virus* to others. Extra care should be taken to ensure all children avoid close contact with people who have monkeypox. If unavoidable, then children over 2 years of age should wear a well-fitting mask or respirator when interacting with members of the household who have monkeypox, and they should avoid any contact with rash lesions or sharing of bedding, towels, cups or utensils with household members with monkeypox. Household members with monkeypox should keep all their lesions covered. Children who have a household member who has monkeypox should be considered for PEP.

If a child or adolescent develops monkeypox, they should avoid contact with uninfected people and pets until the rash has resolved, the scabs have fallen off, and a fresh layer of intact skin has formed. When possible, whether in the hospital or at home, limit the number of caregivers to one person. Caregivers of children with monkeypox should avoid direct skin-to-skin contact with the child's rash. During interactions with caregivers, children over 2 years of age with monkeypox should wear well-fitting source control (e.g., a medical mask) when possible. Caregivers assisting with changing bandages or clothes covering the child's rash should wear gloves to avoid infection. Gloves should be disposed of after each use, followed by handwashing. If any clothing (whether on the caregiver or the child) comes into contact with the rash, it should be immediately laundered. Caregivers and household members of children with monkeypox should be considered for PEP.

Sexually-active adolescents

PEP vaccine should be offered to sexually active adolescents who were exposed to monkeypox. Additionally, people with certain risk factors and recent experiences that might make them more likely to have been recently exposed to monkeypox; or put them at increased risk to be exposed in the future, can be considered for vaccination [i.e., expanded post-exposure prophylaxis (PEP++); or PrEP, respectively]. Jurisdictional vaccination programs should reflect national priorities to employ PEP and PEP++ approaches, and should prioritize delivering PEP first, before other vaccination approaches.

Additional considerations

Breastfeeding a child who has monkeypox

Decisions about whether an infant or child with monkeypox may directly breastfeed from an uninfected caregiver should be considered on a case-by-case basis through weighing the benefits of breast milk with any uncertain risks of the child transmitting infection to the caregiver, particularly to a caregiver who is immunocompromised or at risk for severe infection. PEP with the JYNNEOS vaccine should be considered for the uninfected caregiver.

Neonates born to individuals with suspected or confirmed monkeypox

Early bathing is recommended for neonates born to individuals with suspected or confirmed monkeypox. Bathing can be performed using soap and water and should occur prior to the neonate receiving procedures, vaccines, and medications (e.g., Vitamin K).

PEP should be considered for neonates born to individuals with suspected or confirmed monkeypox. The specific therapeutic that is administered should be determined after consultation with public health authorities.

Caregivers or family members who do not have suspected or confirmed monkeypox can provide routine care to an uninfected neonate who is born to a person with monkeypox.

Neonates born to individuals with suspected or confirmed monkeypox should be closely monitored for the development of signs consistent with monkeypox, including fever, lymphadenopathy, rash, or any new signs or symptoms of illness, for 21 days following birth or the last close contact with a person with monkeypox during their infectious period. Monitoring should include at least daily temperature checks and full skin exams, which can be performed by a caregiver or healthcare provider.

For detailed recommendations, see Clinical Considerations for Monkeypox in People Who are Pregnant or Breastfeeding.

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