Treating and Preventing Monkeypox

People who contract monkeypox usually recover over the course of two to four weeks without any medical intervention. If people come into close contact with someone with monkeypox, or if they are at risk for severe symptoms, vaccines and antiviral medications are available to help.

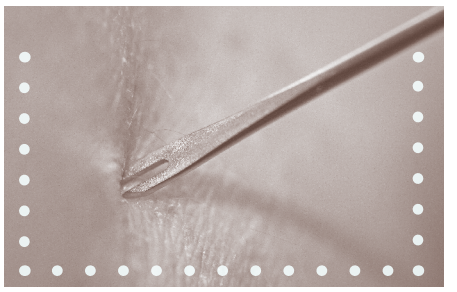
VACCINES

ACAM2000 - The Smallpox Vaccine

While scientists originally developed the ACAM2000 vaccine for smallpox, it is about 85% effective against monkeypox because of the similarity among *orthopoxviruses* (17). Similar to the smallpox vaccine used in the mass vaccination effort to rid the world of smallpox, ACAM2000 uses a bifurcated needle to scratch a person's skin and deliver a dose of live vaccinia virus. Vaccinia virus is related to smallpox, but it causes a much milder disease. After vaccination, a localized infection occurs at the vaccination site, and within 3-4 days, an itchy spot forms there (18). This sore blisters and eventually leaves a small scar. People vaccinated with ACAM2000 only need one dose, and they have full protection 28 days after vaccination (19).

Because ACAM2000 is a live virus vaccine, it can spread to other sites of the body or to another person. This is dangerous because if that person is pregnant, immunocompromised, or has a skin condition like atopic dermatitis, the virus can cause serious and sometimes life-threatening health problems (18). In some cases, people vaccinated with ACAM2000 experienced severe side effects including pericarditis and myocarditis.

Multiple countries around the world keep a stockpile of this vaccine (20); the United States has more than 100 million doses in its Strategic National Stockpile.



JYNNEOS - A Monkeypox and Smallpox Vaccine

Scientists at Bavarian Nordic developed the JYNNEOS vaccine for both monkeypox and smallpox as an alternative to ACAM2000 (21). Unlike the bifurcated needle administration used for the ACAM2000 vaccine, the JYNNEOS vaccine is a standard injection. It contains a live, replication-deficient modified vaccinia Ankara virus (19). Because this virus cannot replicate within the human body, it cannot spread to other parts of the body or to other people. It causes fewer side effects than ACAM2000 and can be safely administered to those who cannot receive the ACAM2000 vaccine. JYNNEOS requires two doses to be effective, and people are protected against infection two weeks after their last dose (19). Clinicians can also use both ACAM2000 and JYNNEOS to prevent monkeypox or lessen its symptoms by vaccinating people soon after they are exposed (19). Receiving a vaccine within four days of exposure can often prevent monkeypox altogether, and if a person gets the vaccine within 14 days, it can lessen the severity of monkeypox symptoms.

ANTIVIRALS

Tecovirimat

Tecovirimat is an antiviral made by Siga Technologies that targets the *orthopoxvirus* protein p37 (23). Smallpox, monkeypox, and other *orthopoxviruses* need p37 to form enveloped virions, which help the virus to release from an infected cell and infect new ones (24). Tecovirimat is FDA-approved for smallpox treatment in adults and children, but the CDC has a non-research expanded access Investigational New Drug (EA-IND) protocol for it (25), which allows its use to treat monkeypox infections in adults and children weighing over 6.6 pounds. Animal studies and a human case report indicate that tecovirimat can shorten the duration of the monkeypox infection (26). Tecovirimat is available in both an oral and intravenous form.

Cross protection

People who previously received the smallpox vaccine were well-protected against monkeypox infection during the 1981-1986 surveillance period in the DRC (17). Data from a 2005 monkeypox outbreak in the DRC, however, demonstrated that many people who had been vaccinated against smallpox contracted monkeypox (22), suggesting that smallpox vaccine-induced immunity wanes over time. Scientists at the CDC hypothesized that prior smallpox vaccination may have some protection against monkeypox but that it won't be completely protective now.

Brincidofovir

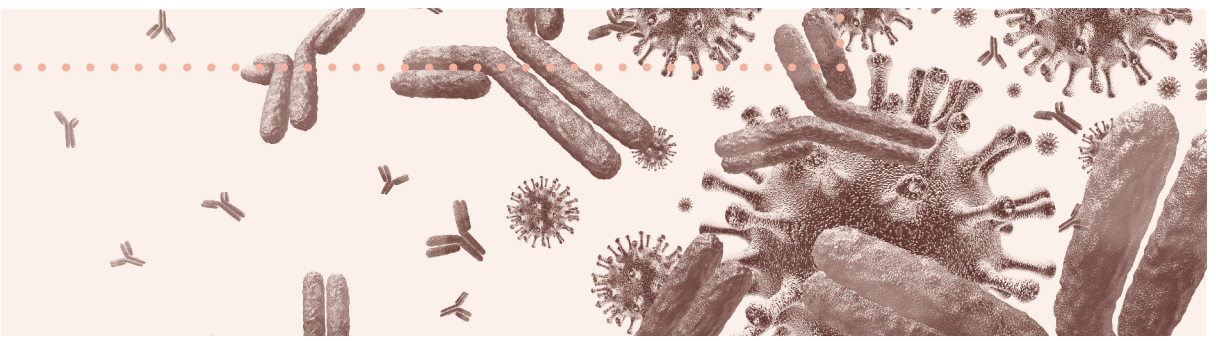
Like tecovirimat, brincidofovir is an oral antiviral that is FDA approved to treat smallpox in adults and children. Made by Chimerix, brincidofovir is a lipid-conjugated form of the antiviral cidofovir. When a virus takes up brincidofovir, the lipid gets cleaved and releases cidofovir to inhibit viral DNA polymerase function, halting viral replication (27). Brincidofovir is effective against monkeypox and other *orthopoxviruses* in animal models, but its efficacy against monkeypox in humans has not been tested yet (28).

Vaccinia Immune Globulin Intravenous

Vaccinia immune globulin intravenous (VIGIV) consists of antibodies against the vaccinia virus used in the ACAM2000 vaccine (28). Clinicians currently use it to treat people with severe adverse reactions to the ACAM2000 vaccine. While its effectiveness at treating monkeypox is unknown, the CDC has an expanded access protocol for its use in the case of a monkeypox outbreak. VIGIV can also be given prophylactically to immunocompromised people who were exposed to monkeypox.

On the Horizon

In May of 2022, Moderna, which produced one of the now FDA-approved COVID-19 vaccines at lightning speed, announced that they are testing monkeypox vaccines at the preclinical level. Researchers from the United Kingdom analyzed the symptoms of 54 people with monkeypox and saw differences in the location and appearance of lesions from cases in previous pandemics (29). New treatments and vaccines may be needed as our understanding of the disease evolves.



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