



# Monkeypox: Review & Updates

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Educational Day Lecture

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# Objectives

- + Learn about the virology and epidemiology of monkeypox
- + Recognize monkeypox infection
- + Understand the use and administration of the monkeypox vaccines available in the US
- + Identify other prevention and treatment modalities
- + Understand stigma around monkeypox disease



# Monkeypox: Virology & Epidemiology

# Monkeypox (MPX) Virology

## + Viral structure

- + Enveloped
- + Double-stranded DNA

## + Classification

- + *Poxviridae* family
- + *Orthopoxvirus* genus
- + Related to smallpox, cowpox
- + NOT related to chicken pox (which is in herpesvirus family)
- + Is zoonotic (initially transmitted to humans from animals)

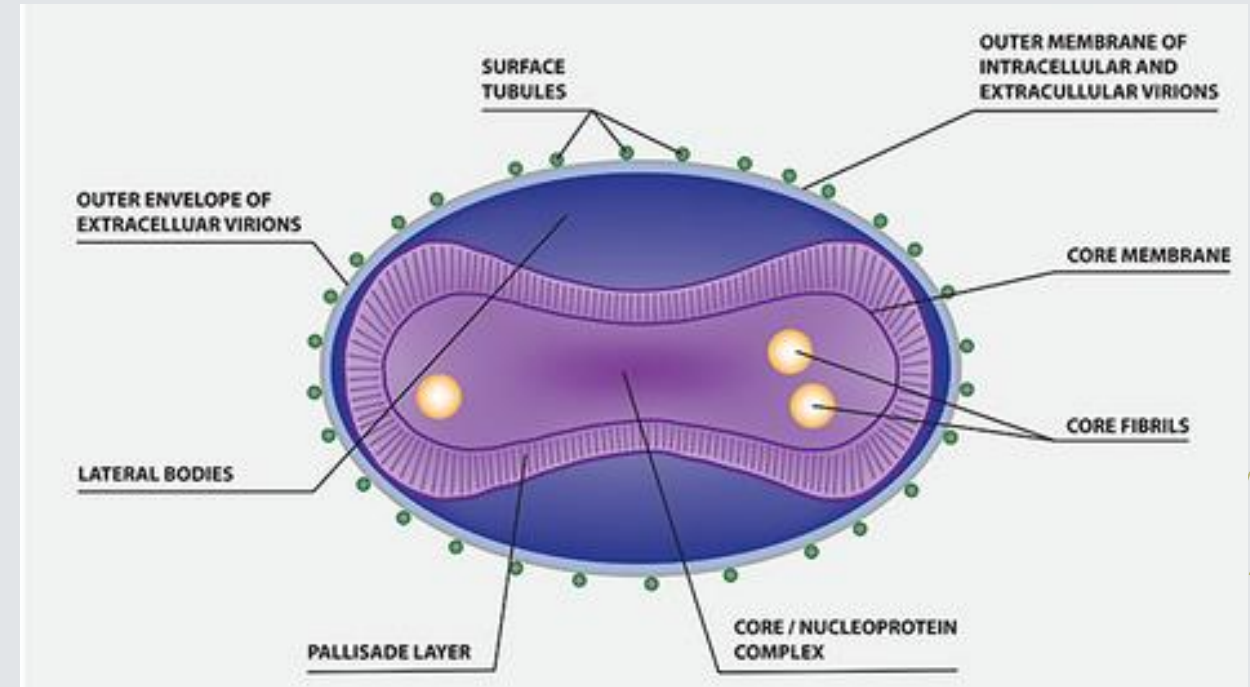


Image Credit: Shutterstock: Monkeypox Virus Structure Illustration, 2022

# MPX Natural History

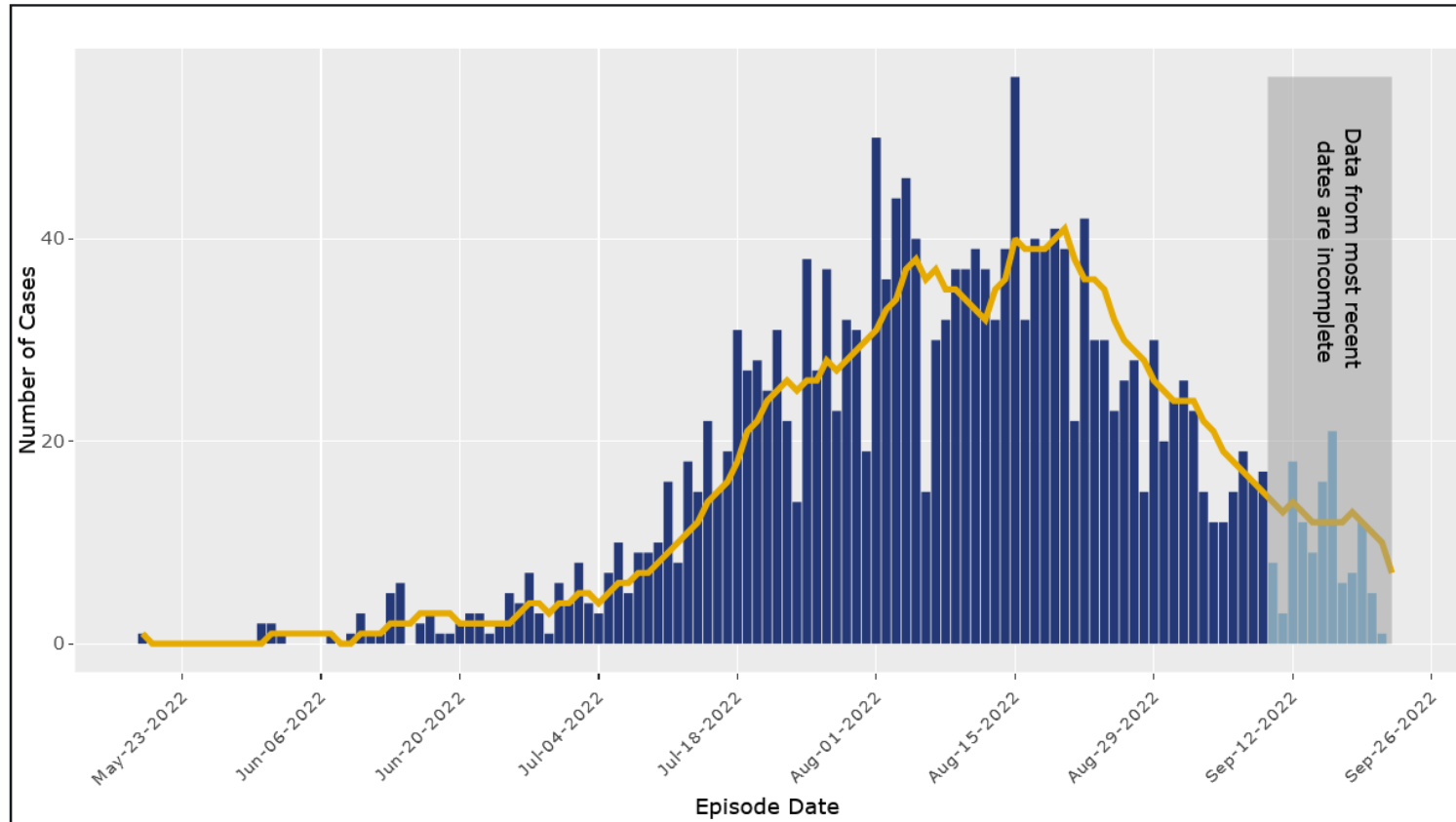
- + Exact reservoirs unknown (rodents suspected)
  - + Found to naturally circulate in squirrels, rats, non-human primates, and other species primarily in western and central Africa
  - + In US, initially found in prairie dogs
- + Human-to-animal transmission can occur via direct contact w/ body fluids or w/ mucous/cutaneous lesions

# MPX Natural History, cont'd

- + First discovered in humans in 1970 in the Democratic Republic of the Congo
  - + In an infant in an area smallpox recently eliminated
- + Since then, mostly only in western/southern Africa
  - + Nigeria w/ large outbreak in 2017 (500 cases, still having infections)
- + First case outside of Africa
  - + United States in 2003—from infected pet prairie dogs imported from Ghana

# MPX Outbreak: LA County, 2022

## CASE<sup>1</sup> COUNTS BY EPISODE DATE



Episode date is defined as the earliest existing value of: Date of Onset, Date of Diagnosis, Date of Death, Date Received, Specimen Collection Date.

# MPX Outbreak 2022

## + Total confirmed cases

+ Global: 65,933 (as of 9/14/22)

+ United States: 25,162 (as of 9/14/22)

+ Los Angeles County: 2,136 (as of 9/26/22)

## + Total deaths

+ Global: 1

+ United States: 1

+ Los Angeles County: 1



# Who has been impacted by MPX?

- + Total cases in LA County (not Pasadena or Long Beach): 1,959
  - + Sex: 97% cisgender male
  - + Age: 88% 18-49y
    - + 23% 18-29y | 43% 30-39y | 22% 40-49y
  - + Race/Ethnicity: 13% Black/AA, 45% Latinx/Hispanic, 26% White
  - + Sexual Orientation: 67% Gay/Lesbian
    - + 6% Straight | 11% Bisexual | 2% Other | 15% Unknown/Prefer Not to State
  - + Service Provider Area: 43% Metro LA, 15% SF Valley



# Monkeypox Infection

# MPX Infection

- + Incubation period: 3-17 days
- + Duration of Illness: 2-4 weeks
- + Severity
  - + Varies by route of transmission and underlying health of infected person (worse in immunocompromised and young children)
- + Rash
  - + Goes through several stages before scabbing and falling off
  - + Often very painful and/or itchy
  - + Patterns: only rash, rash before other sx, rash after other sx

# Symptoms of MPX

## + Rash

- + Goes through several stages before scabbing and falling off
- + Often itchy and/or painful
- + Patterns: only rash, rash before other sx, rash after other sx

## + Other symptoms

- + Fevers
- + Chills
- + Lymphadenopathy
- + Myalgias
- + Exhaustion
- + Headaches
- + Flu-like prodrome
- + URI symptoms (sore throat, cold, etc)

# Stages of MPX Rash

| Stage    | Stage Duration | Characteristics   |
|----------|----------------|---|
| Enanthem |                | <ul style="list-style-type: none"><li>• Sometimes, lesions first form on the tongue and in the mouth.</li></ul>   |
| Macules  | 1–2 days       | <ul style="list-style-type: none"><li>• Macular lesions appear.</li></ul>   |
| Papules  | 1–2 days       | <ul style="list-style-type: none"><li>• Lesions typically progress from macular (flat) to papular (raised).</li></ul>   |
| Vesicles | 1–2 days       | <ul style="list-style-type: none"><li>• Lesions then typically become vesicular (raised and filled with clear fluid).</li></ul>   |
| Pustules | 5–7 days       | <ul style="list-style-type: none"><li>• Lesions then typically become pustular (filled with opaque fluid) – sharply raised, usually round, and firm to the touch (deep seated).</li><li>• Finally, lesions typically develop a depression in the center (umbilication).</li><li>• The pustules will remain for approximately 5 to 7 days before beginning to crust.</li></ul> |
| Scabs    | 7–14 days      | <ul style="list-style-type: none"><li>• By the end of the second week, pustules have crusted and scabbed over.</li><li>• Scabs will remain for about a week before beginning to fall off.</li></ul>   |

CDC, “Monkeypox,” 9/14/22

**Resolution:** Pitted scars and/or areas of lighter or darker skin may remain after scabs have fallen off. Once all scabs have fallen off and a fresh layer of skin has formed, a **person is no longer contagious.**

# Characteristics of Rash

- + Firm or rubbery
- + Well-circumscribed
- + Deep-seated
- + Often develop umbilication
- + During current pandemic:
  - + Typically found in genital, anorectal, oral areas
  - + May be single or very few lesions
  - + Less likely disseminated or on palms/soles (but possible)

# MPX Transmission

- + Close, intimate contact
  - + With person, secretions, or objects
- + Pregnancy
  - + From infected person through placenta to fetus, (ie vertical transmission)
- + Infected animals
  - + Bite or scratch of live animal
  - + Eating or preparing meat or other animal products

# MPX Transmission

## + Close, intimate contact

- + Direct contact with MPX lesions or body fluids of infected person
- + Touching objects, (e.g. fabrics, surfaces) that were used by infected person
- + Contact with respiratory secretions

## + Often intimate contact

- + Oral, anal, vaginal sex, including touching anogenital region/organs
- + Hugging, kissing
- + Prolonged face-to-face contact
- + Contact w/ used, non-disinfected sex toys and fabrics



# MPX Lesions



Photo credit: UK Health Security Agency via CDC, 2022



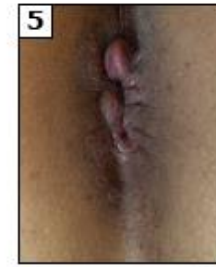
Photo Credit: NHS England High Consequence Infectious Diseases Network via CDC, 2022



Photo credit: CDC, 2022

# Progression of MPX Lesions

## A Anal lesions



## B Genital lesions



## C Skin lesions



5

6

7

9

11

Days from symptom onset

Antinori A, Mazzotta V, Vita S, et al. 5/2022 in UpToDate

# MPX Transmission

- + Infected person can spread to others from symptom onset until rash fully healed and new skin layer has formed (2-4 wks)
- + Still under study
  - + Does asymptomatic transmission occur
  - + How often does spread occur via respiratory secretions
  - + Spread through specific GU body fluids
    - + Semen, vaginal fluid, urine, feces

# When to suspect MPX infection

## + Suspected case

- + New onset of characteristic rash **OR**
- + High suspicion and meets epi criteria: reports contact w/ suspected or confirmed-infected person, MSM, high-risk sexual activity, traveled outside US to MPX-endemic area, or contact w/ dead or live MPX-endemic animal/product

## + Confirmed case

- + PCR of viral DNA or positive viral culture from clinical specimen
- + Note: can exclude MPX if no rash within 5 d of symptom onset

# Stigma of MPX Disease

- + ANYONE can get monkeypox
  - + Outbreak currently predominantly among younger MSM, gay, and bisexual men of color, though not limited to these groups
  - + HOWEVER, cases have been found in all age groups, including infants, in all genders, and via non-sexually transmitted routes
- + Risks of stigma
  - + Shaming affected people of marginalized communities and perpetuating systemic discrimination
  - + Prevent infected or exposed people from seeking treatment or vaccination
  - + Giving false sense of security to everyone else
  - + Prolonging a pandemic

# Strategies to Reduce Stigma

- + Emphasize that MPX is a public health issue relevant to everyone
- + Use language and imagery that is inclusive and non-alarmist
- + Provide education that is fact-based and straightforward
- + Emphasize that MPX can be recognized, managed, and prevented to help reduce fear and promote sense of agency

The background is a light gray color. In the top-left corner, there is a white circle partially cut off by the edge, with several wavy, dashed lines in a light brown color extending downwards and to the right. In the bottom-right corner, there is another white circle partially cut off by the edge, with several wavy, dashed lines in a light brown color extending upwards and to the left. A solid brown line also curves across the bottom right area.

# Monkeypox Treatment

# Treatment of Monkeypox

- + No specifically approved monkeypox medications/treatment
- + Antiviral therapy—TPOXX
  - + FDA-approved for treatment of smallpox
  - + Investigational for treatment of monkeypox (studies underway)
  - + Can help reduce viral load
  - + For treatment of severe disease (and at high risk for developing severe disease)
  - + Can develop resistance if prescribed inappropriately



# Treatment of Monkeypox

- + Treatment is mostly supportive
  - + Tylenol, NSAIDs
    - + Sometimes stronger pain meds needed
  - + Fluids
  - + Topical lidocaine
  - + Oral or topical antihistamines
  - + Occlusives (ie petroleum jelly)
  - + Oatmeal-containing products
  - + Sitz baths

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# Monkeypox Prevention

# Vaccines Available in US

## + JYNNEOS

- + PRIMARY vaccine being used in the current US outbreak, approved to prevent monkeypox and smallpox

## + ACAM2000

- + Alternative vaccine; approved to treat smallpox; being used under “investigational new drug” (IND) application through CDC

## + Efficacy of both currently under study

- + More data needed → expect in coming months
- + No prior similar outbreaks in the past to compare

## + Long-term protection under investigation

# JYNNEOS Vaccine

- + Primary vaccine, most widely available during outbreak
- + FDA-approved to prevent monkeypox and smallpox
- + Two doses, given 28 days apart
- + Should get both doses; protection after single dose unknown
- + Considered fully vaccinated 14 days after second dose
- + Can give simultaneously w/ other vaccines
  - + Exception: delay covid 4 wks after JYNNEOS dose

# JYNNEOS: Mechanism of Action

- + Is a “modified vaccinia Ankara” or “MVA” vaccine
  - + JYNNEOS is brand name in US
- + Live, highly-attenuated vaccine
  - + Weakened version of live vaccinia virus (cowpox)
  - + Vaccinia virus in same genus as smallpox (variola) and MPX, but does not cause either disease
  - + Excellent safety profile in immunocompromised and those with certain skin conditions
  - + Not approved for pregnancy, but evidence so far suggests it likely is safe
- + Considered safe in patients w/ HIV, immunocompromise (talk to ID specialist)

# Vaccine Mechanism of Action

- + Typically given intradermal (smaller dose) or subcutaneous
- + Attenuated vaccinia virus enters a patient's cell and carries out replication process in cytoplasm
  - + Certain immune cells present viral particles to B-cells and T-cells to produce antibodies and also memory cells
  - + These are weakened viral particles—they replicate and spread in the body but do NOT cause infection

# JYNNEOS Vaccine, cont'd

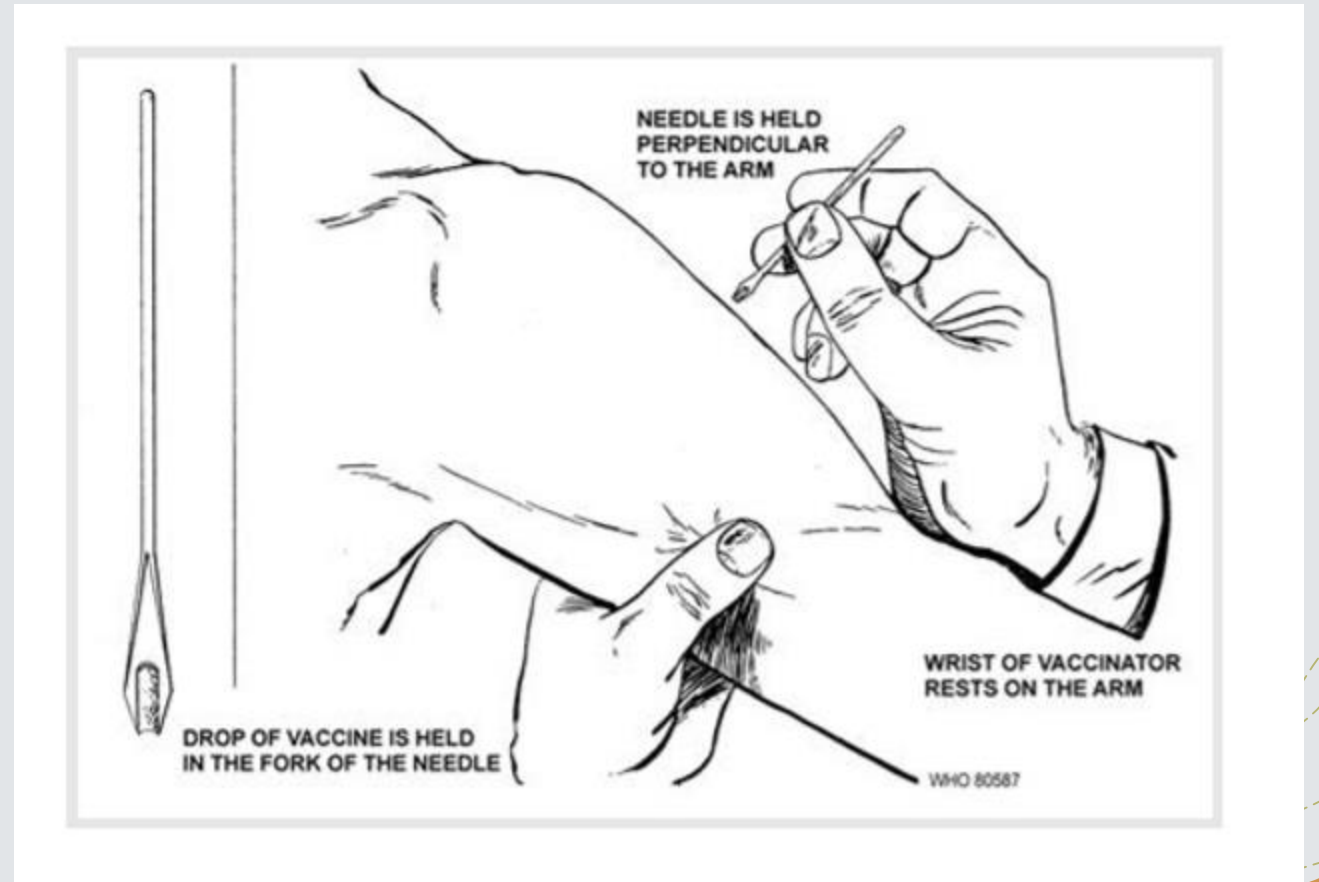
- + Contraindication: allergy to prior dose, pregnancy\*
- + Precaution if allergies to gentamicin, ciprofloxacin, chicken, egg
- + Most common side effects
  - + Swelling/itching/redness at injection site
  - + Fatigue, ha, myalgias, chills
- + \*Pregnancy
  - + Not approved in pregnancy, but data so far suggests it is likely safe
  - + Ok to administer to breastfeeding patients

# ACAM2000 Vaccine

- + Approved to prevent smallpox, but made available during outbreak to prevent monkeypox, under IND license by CDC
- + Single dose, given as multiple skin pricks w/ special needle
- + Considered fully vaccinated 28 days after dose
- + Lesion called a “take” appears at vaccination site
  - + Can last several weeks or more
  - + Have to closely care of lesion to avoid spreading vaccinia virus (NOT smallpox or MPX) to other areas of body or to other people



# ACAM2000 Administration



# ACAM2000: Mechanism of Action

- + Live, replication-component vaccine
  - + Uses modified *vaccinia* virus as vector (ie cowpox)
  - + Can spread vaccinia by contact w/ “take” lesion that occurs after vaccination → mild disease, not smallpox or MPX
- + More severe side effect risk compared to other vaccines
  - + Especially if given to immunocompromised

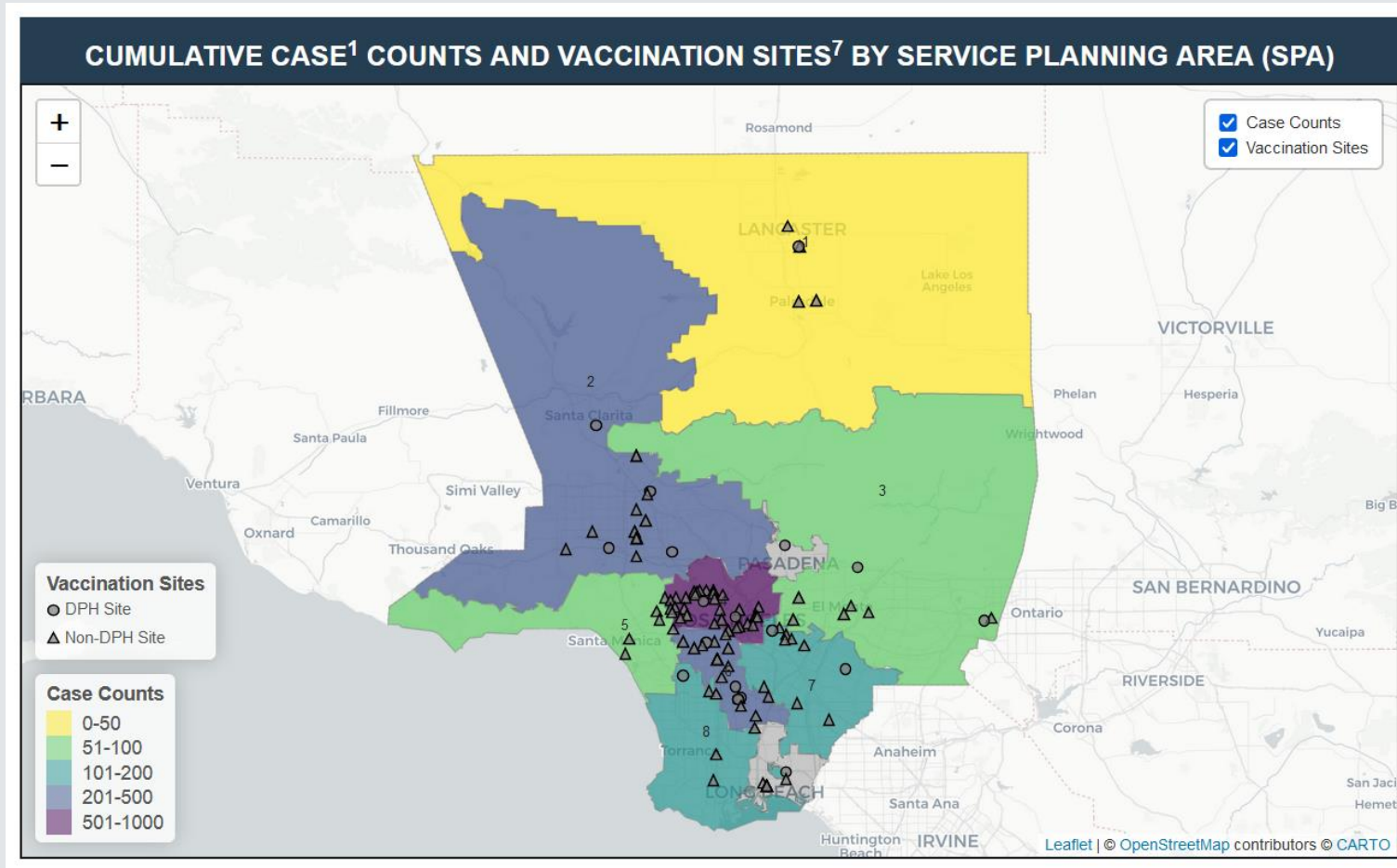
# ACAM2000 Vaccine: Contraindications

- + Severe allergic reaction to previous vaccination
- + Immunosuppression from any cause
- + Pregnant or breastfeeding
- + Heart disease, or 3+ CAD risk factors
- + Skin conditions: eczema, psoriasis, dermatitis
- + Eye disease requiring treatment w/ topical steroids
- + Unable to isolate safely from others at home w/ above conditions
- + Children under 12 months
- + Should delay most other vaccines after receiving ACAM2000

# Who should get vaccinated?

- + Those identified as close contact of confirmed case
- + Had a sex partner in the past 2 weeks who is a confirmed case
- + MSM, transgender person, or gender-diverse person who had:
  - + Sex w/ multiple partners or group sex
  - + Sex at commercial sex venue
  - + Sex at event/place w/ known MPX transmission

# LA County Vaccination Sites



# Further MPX Vaccine Info

- + Vaccine is free, though sometimes there are admin fees
  - + May NOT be denied vaccine due to inability to pay fees
- + Get vaccinated as soon as possible after exposure (ideally within 4 days)
- + Currently, CDC recommends against vaccination of general public or everyone who is sexually active

# Vaccination Special Considerations

- + What if you were previously infected with MPX?
  - + Post-exposure prophylaxis (PEP) with vaccines depends on exposure risk
  - + Ideally, administer within 4 days of exposure, but can give up to 14 days after exposure
- + Exposure risk (detailed table available on UpToDate)
  - + High: vaccination indicated, monitor for 21 days
  - + Intermediate: vaccination case-by-case basis, monitor for 21 days
  - + Low: no vaccination, monitor for 21 days

# Vaccination Special Considerations

## + Pregnant patients

- + Need maternal fetal medicine (MFM) consult
- + Depending on timing and severity of infection, the timing and type of delivery may be adjusted, but data on effectiveness in preventing vertical transmission unclear
- + No vaccines approved during pregnancy
- + JYNNEOS ok while breastfeeding




# Other Ways to Reduce Infection Risk

- + Use of safer sex practices
  - + Limiting number of sex partners and use of venues
  - + Condoms (will not fully prevent)
  - + Temporary abstinence
  - + Clean sex toys, fetish gear
  - + Sex/masturbation without physical contact
- + Disinfecting of exposed surfaces
- + Limiting handling of pets
  - + Ask someone else to care for pet until symptoms resolved
  - + Talk to your veterinarian if exposure or symptom concerns



# The End

Thank you for your attention!



# Sources

- + <https://www.cdc.gov/poxvirus/monkeypox/index.html>
- + “Monkeypox Data”  
<http://publichealth.lacounty.gov/media/monkeypox/data/index.htm>
- + <https://www.cdc.gov/poxvirus/monkeypox/clinicians/clinical-recognition.html>
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- + <https://www.cdc.gov/poxvirus/monkeypox/resources/reducing-stigma.html>

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- + <https://www.cdc.gov/poxvirus/monkeypox/if-sick/what-to-do.html>
- + <https://www.cdc.gov/poxvirus/monkeypox/if-sick/treatment.html>

# Image Credits

- + Monkeypox Virus Structure Illustration: [https://www.shutterstock.com/image-vector/monkeypox-virus-structure-illustration-vector-2171743639?utm\\_campaign=image&utm\\_medium=googleimages&utm\\_source=iptc](https://www.shutterstock.com/image-vector/monkeypox-virus-structure-illustration-vector-2171743639?utm_campaign=image&utm_medium=googleimages&utm_source=iptc)
- + Progression of MPX lesions: From: Antinori A, Mazzotta V, Vita S, et al. Epidemiological, clinical and virological characteristics of four cases of monkeypox support transmission through sexual contact, Italy, May 2022. Euro Surveill 2022; 27(22). Available at: <https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2022.27.22.2200421> (Accessed on June 14, 2022). Reproduced under the terms of the [Creative Commons Attribution 4.0 International License](#).
- + [https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.vdh.virginia.gov%2Fcontent%2Fuploads%2Fsites%2F8%2F2022%2F06%2FSmallpox-Vaccine-Administration-Job-Aid\\_06.01.2022.pdf&psig=AOvVaw3LEYy7XBvK5UTLiM2Nx3OG&ust=1664445210932000&source=images&cd=vfe&ved=0CA0QjhxqFwoTCJDRxu-bt\\_oCFQAAAAAdAAAAABAI](https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.vdh.virginia.gov%2Fcontent%2Fuploads%2Fsites%2F8%2F2022%2F06%2FSmallpox-Vaccine-Administration-Job-Aid_06.01.2022.pdf&psig=AOvVaw3LEYy7XBvK5UTLiM2Nx3OG&ust=1664445210932000&source=images&cd=vfe&ved=0CA0QjhxqFwoTCJDRxu-bt_oCFQAAAAAdAAAAABAI)