



Massachusetts General Hospital
Founding Member, Mass General Brigham

Monkeypox: *Epidemiology and Infection Prevention and Control*

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Road Map

- The Boston-Canada Connection
- Update on US Epidemiology
- Transmission and IPC Approaches
 - Identify-Isolate-Inform
 - Patient Placement and PPE
 - Waste Management
 - Environment of Care
 - Exposures in healthcare settings
 - *and more*



Boston-Canada Connection





May 2022

- 5/7/22- United Kingdom reported a case from returning traveler
- 5/14/22- 2 cases *not connected* to travel
- 5/17/22- review of cases from UK prompted consideration of MPX diagnosis in a patient admitted to MGH since 5/12/2022
- 5/18/22- MPX confirmed; first case recognized in the United States in this outbreak

Identify, Isolate and Inform. At

HEALTH

How Boston doctors diagnosed the first US case of monkeypox

It was an “aha moment.”



Dr. Nesli Basgoz, an infectious disease specialist at MGH, diagnosed the first case of monkeypox in the US. *John Tlumacki/Boston Globe*

By **Ross Cristantiello**

May 30, 2022



Basgoz N, Brown CM, Smole SC, Madoff LC, Biddinger PD, Baugh JJ, Shenoy ES. Case 24-2022: A 31-Year-Old Man with Perianal and Penile Ulcers, Rectal Pain, and Rash. *N Engl J Med.* 2022 Aug 11;387(6):547-556. doi: 10.1056/NEJMcpc2201244. Epub 2022 Jun 15. PMID: 35704401.



Massachusetts Monkeypox case linked to cluster of cases in Montreal, Canadian health officials say

Share



WCVB 5 abc

Updated: 10:01 PM EDT May 19, 2022

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MGH Exposure and Contact Tracing Investigation

- Identification of potentially exposed
- Risk stratification of exposure
- Counseling regarding post-exposure prophylaxis (PEP) with MVA vaccine



Monkeypox: By the Numbers



Current State of the Outbreak: Global Outlook

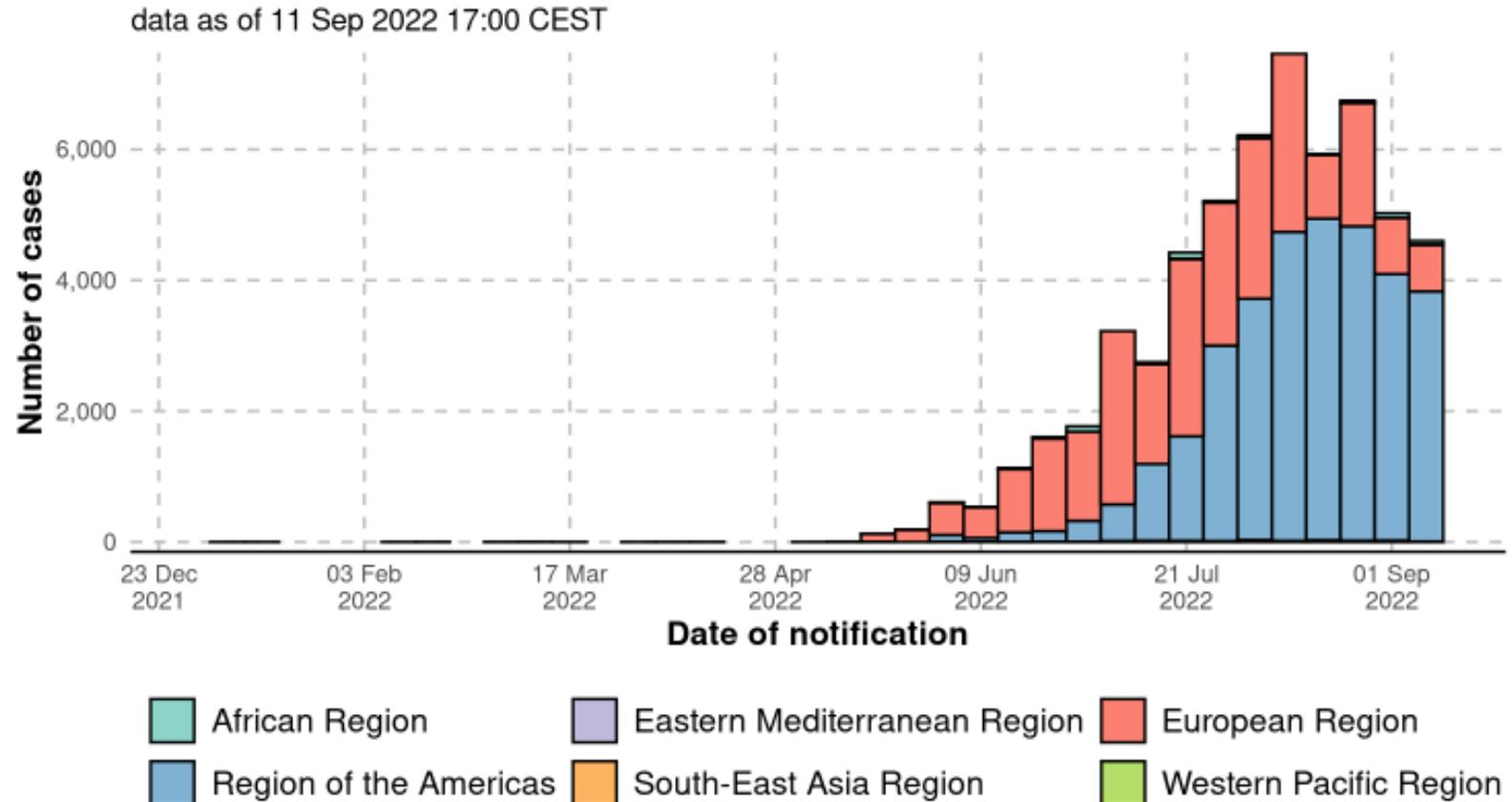
57,995 total cases

57,484 non-endemic

103 countries

96 non-endemic

22 deaths reported worldwide



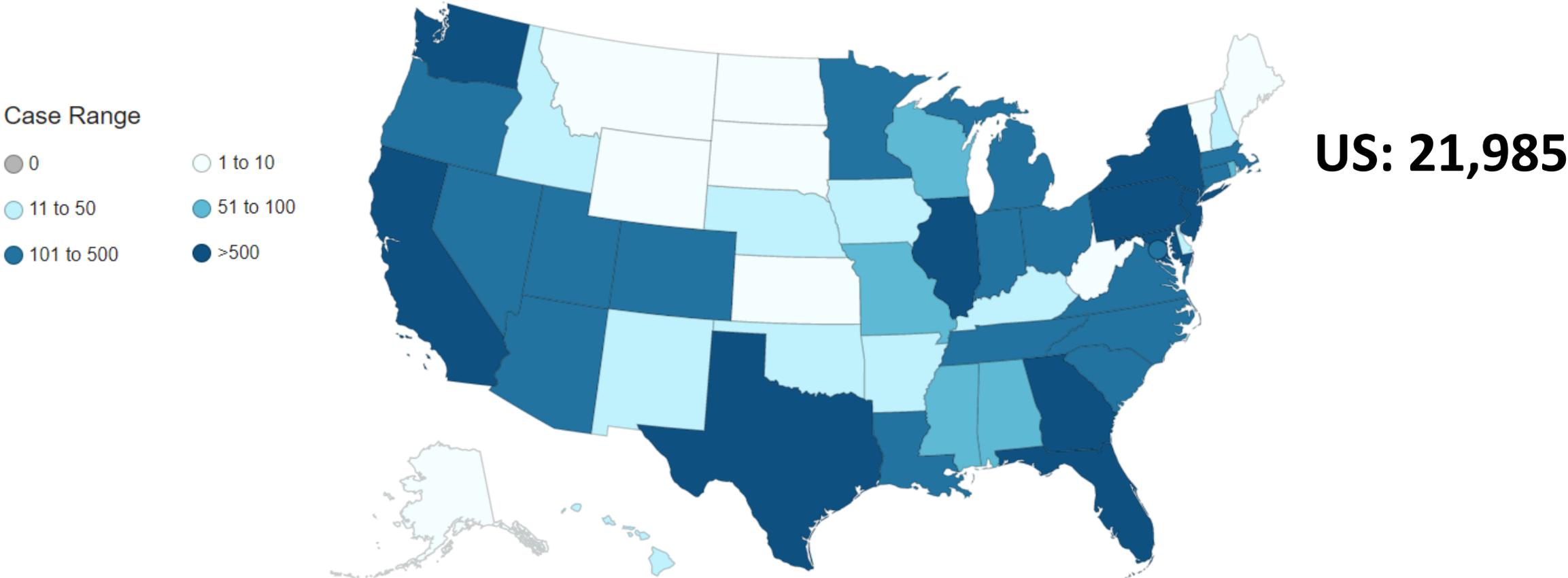
<https://www.cdc.gov/poxvirus/monkeypox/response/2022/world-map.html>, accessed 9/13/2022

[2022 Monkeypox Outbreak: Global Trends \(shinyapps.io\)](https://shinyapps.io/2022-monkeypox-outbreak-global-trends/), accessed 9/13/2022

[WHO Health Emergency Dashboard](https://www.who.int/emergencies/diseases/nipw/monkeypox), accessed 9/13/2022



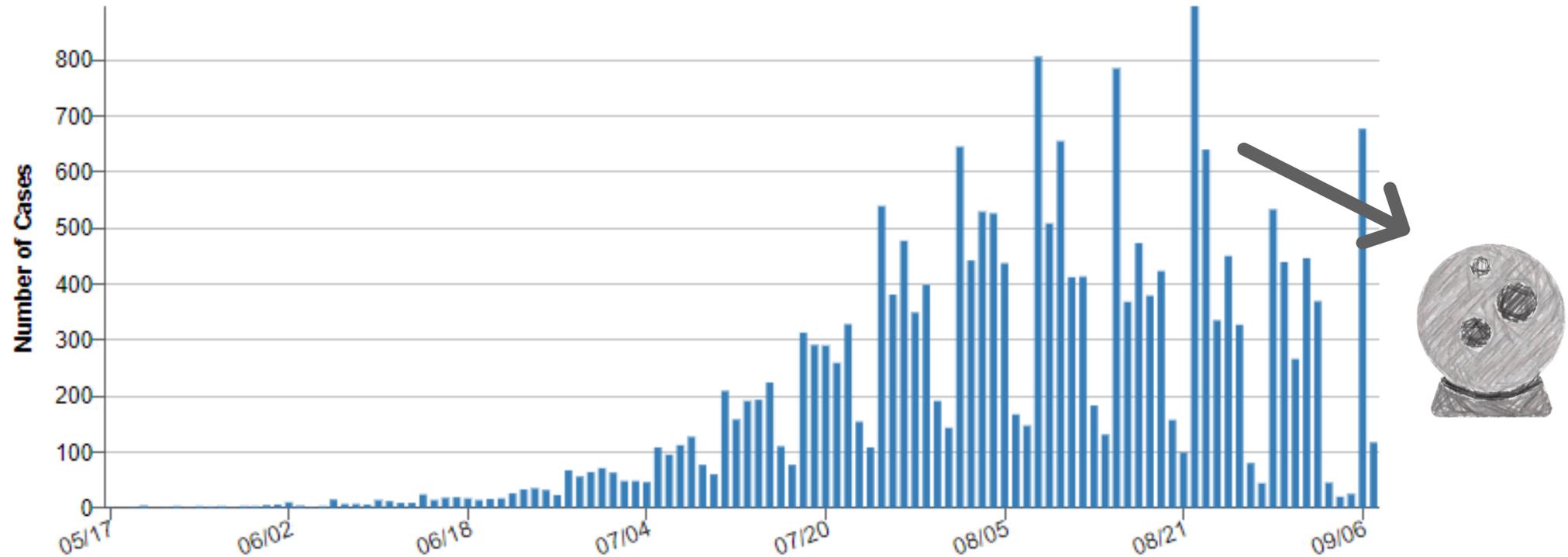
Current State of the US Outbreak: National Numbers



<https://www.cdc.gov/poxvirus/monkeypox/response/2022/us-map.html>, accessed 9/13/2022



Trends in Cases, United States, cases reported through 9/7



<https://www.cdc.gov/poxvirus/monkeypox/response/2022/mpx-trends.html> , accessed 9/13/2022



Testing

Non-variola orthopox/Monkeypox testing from public health and select commercial laboratories †

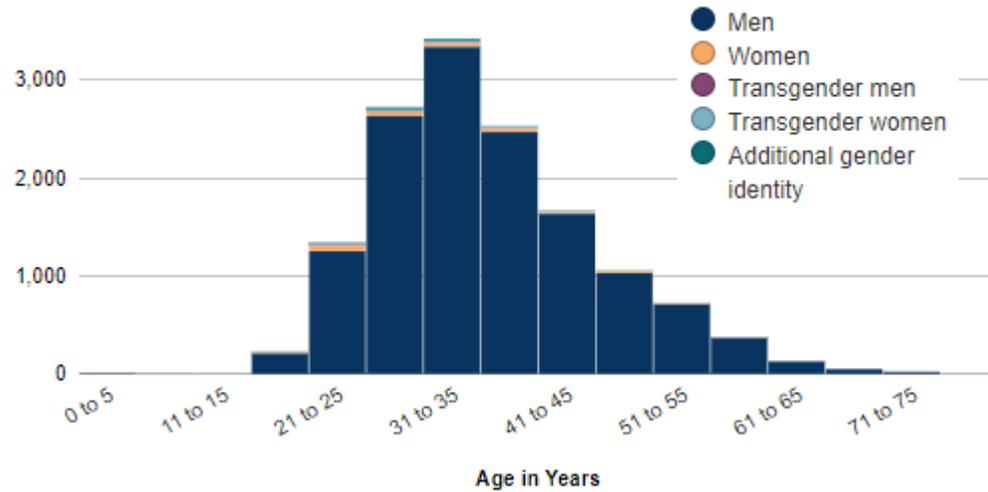


<https://www.cdc.gov/poxvirus/monkeypox/response/2022/2022-lab-test.html>, accessed 9/13/2022

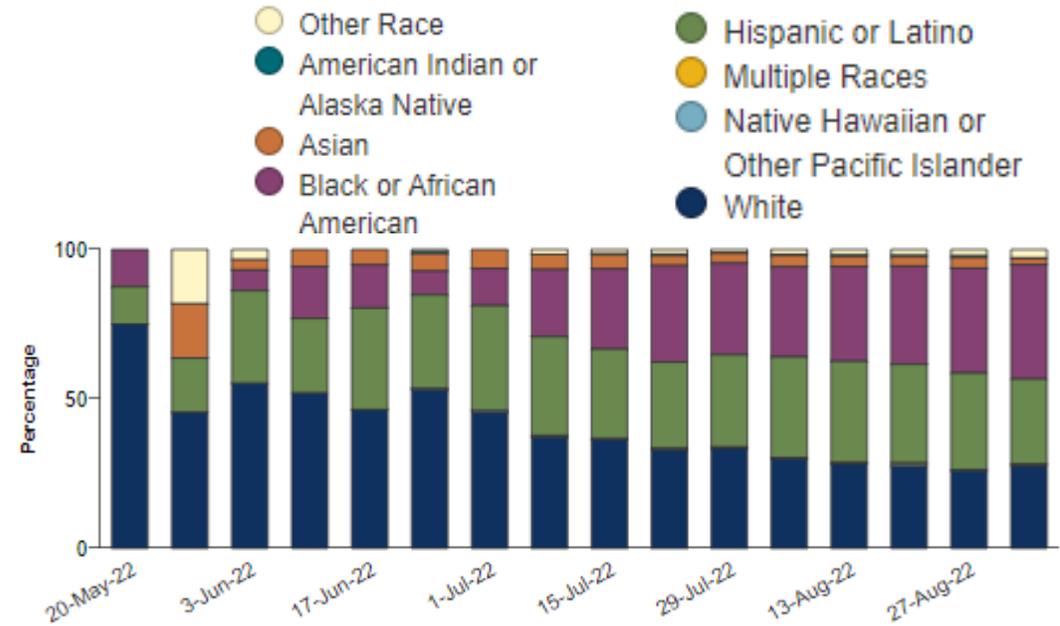


Case Demographics

Age and Gender



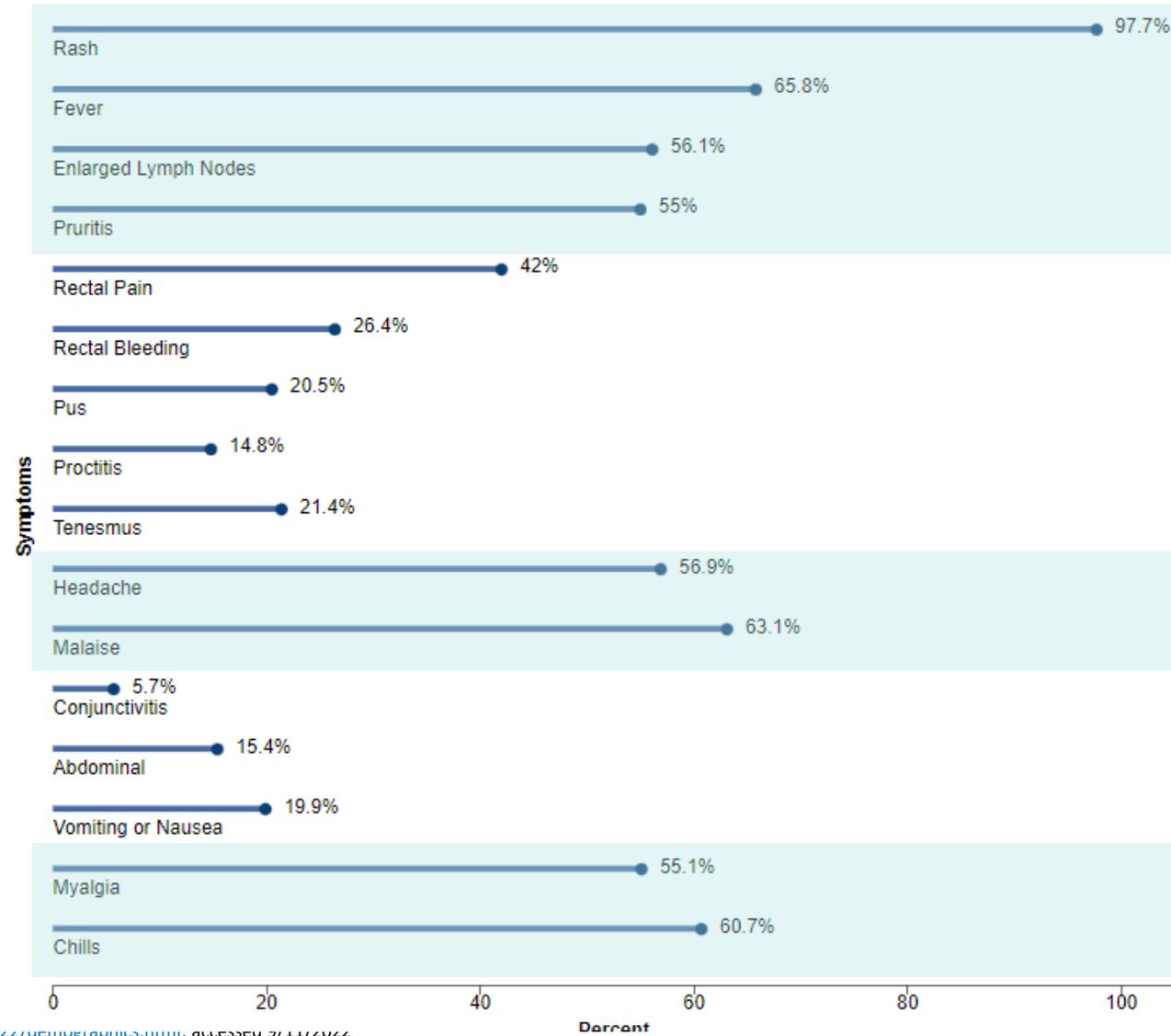
Race/Ethnicity



<https://www.cdc.gov/poxvirus/monkeypox/response/2022/demographics.html>, accessed 9/13/2022



Symptoms



<https://www.cdc.gov/poxvirus/monkeypox/response/2022/seroprevalence.html>, accessed 07/11/2022



Reported changes in activities associated with increased risk of exposure, surveyed 8/5-8/15/2022

TABLE 1. Strategies for monkeypox prevention adopted by men who have sex with men since they learned about the monkeypox outbreak (N = 797) — American Men’s Internet Survey, United States, August 2022

Characteristic (no. who answered not applicable)	No. (%)*		
	Decreased/Less	No change	Increased/More
No. of sex partners (108)	329 (47.8)	358 (52.0)	1 (0.1)
One-time sexual encounters (176)	309 (49.8)	305 (49.2)	6 (1.0)
Sex with a partner met on a dating app or at a sex venue (199)	294 (49.6)	294 (49.6)	5 (0.8)
Having group sex (331)	234 (50.4)	229 (49.4)	1 (0.2)
Going to sex venues or events (407)	162 (41.9)	222 (57.4)	3 (0.8)
Going to social events with close contact, such as dance parties or raves (347)	156 (34.9)	288 (64.4)	3 (0.7)
Use of condoms (275)	6 (1.2)	471 (90.8)	42 (8.1)

* Row percentages calculated after subtracting the number of respondents who reported that the individual behavior was not applicable to them, which is included in parentheses. Row totals including those who felt the item was not applicable might not sum to 797 because of missing data for individual items.



Monkeypox Transmission



Transmission

- Close, personal, skin-to-skin contact
 - with the rash, scabs, or body fluids from a person with monkeypox
- Contact with objects, fabrics (clothing, bedding, towels), and surfaces that have been contaminated with fluid from lesions, scabs, body fluids from a person with monkeypox
- Contact with respiratory secretions during prolonged face to face encounters
- During pregnancy, via placenta to fetus
- From infected animals via scratch or bite, or by preparing or eating meat or using products from an infected animal

- The infectious period is from the onset of symptoms until the rash has fully healed and fresh layer of skin has formed; this can take 2-4 weeks.



Rashes

Examples of Monkeypox Rashes

Photo credit: UK Health Security Agency



Key Characteristics of Monkeypox Rash



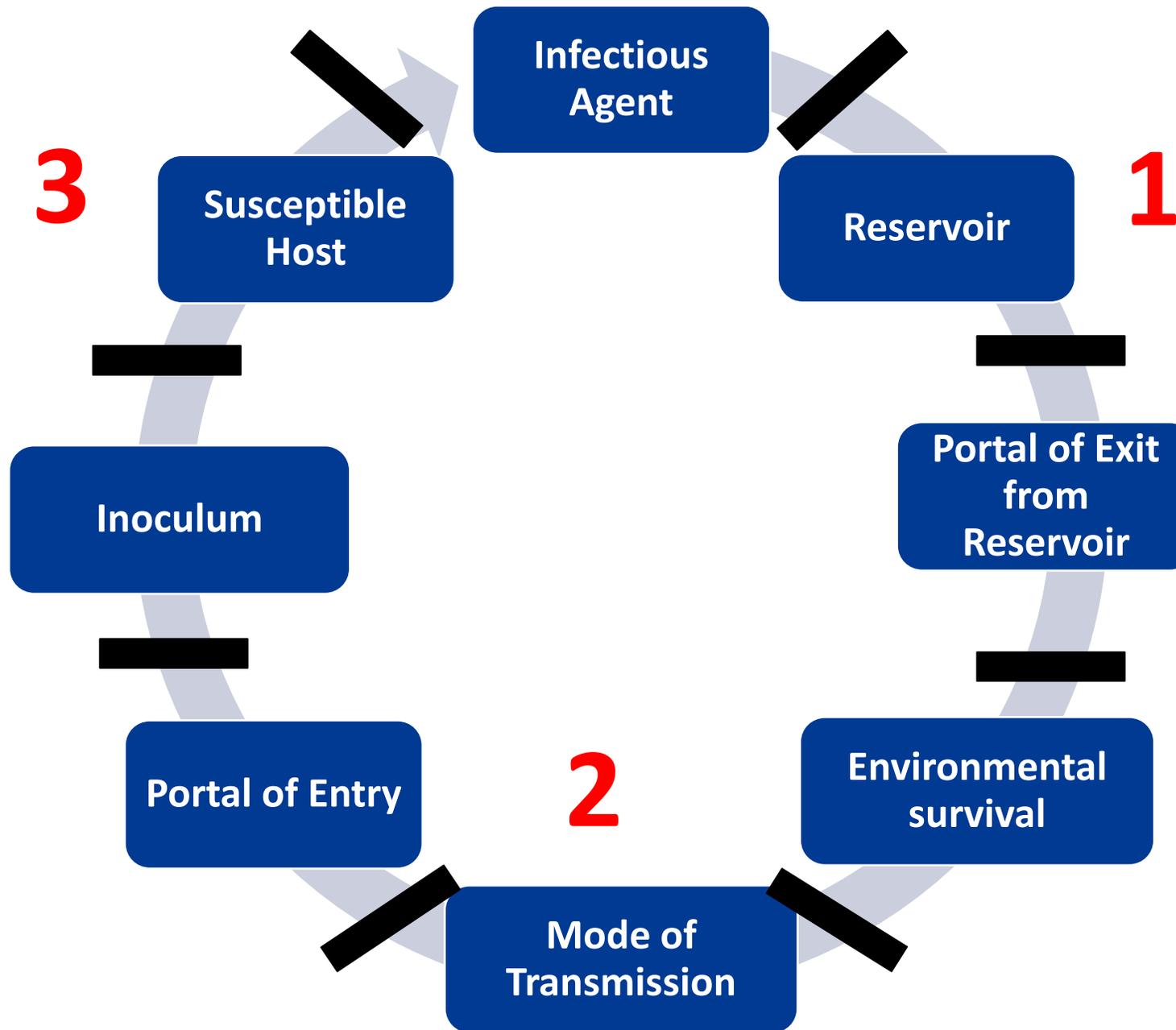
More Monkeypox Rash Photos

Photo Credit: NHS England High Consequence Infectious Diseases Network



<https://www.cdc.gov/poxvirus/monkeypox/clinicians/clinical-recognition.html>





IPC Approaches



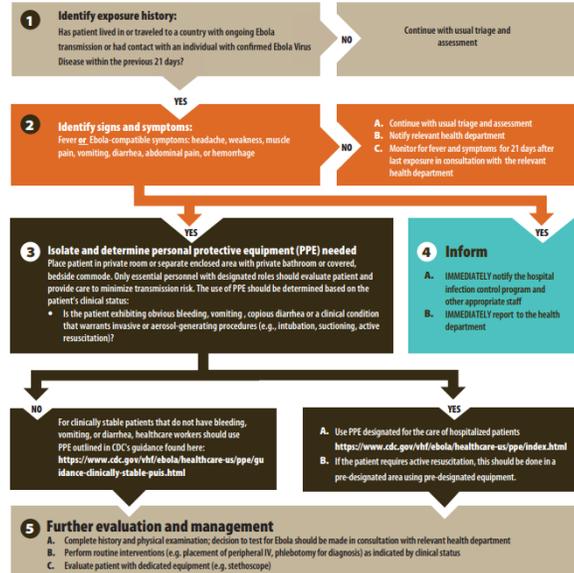
Identify, Isolate, and Inform

- Identify: the potential for infection
 - travel, symptoms, other relevant epidemiology
 - may be based on official person under investigation (PUI) definition
 - *clinical suspicion even if the epi doesn't quite fit; awareness of a spectrum of presenting signs and symptoms*
- Isolate: apply appropriate isolation immediately
- Inform: inform the right people



Identify, Isolate, Inform

Identify, Isolate, Inform: Emergency Department Evaluation and Management of Patients Under Investigation for Ebola Virus Disease

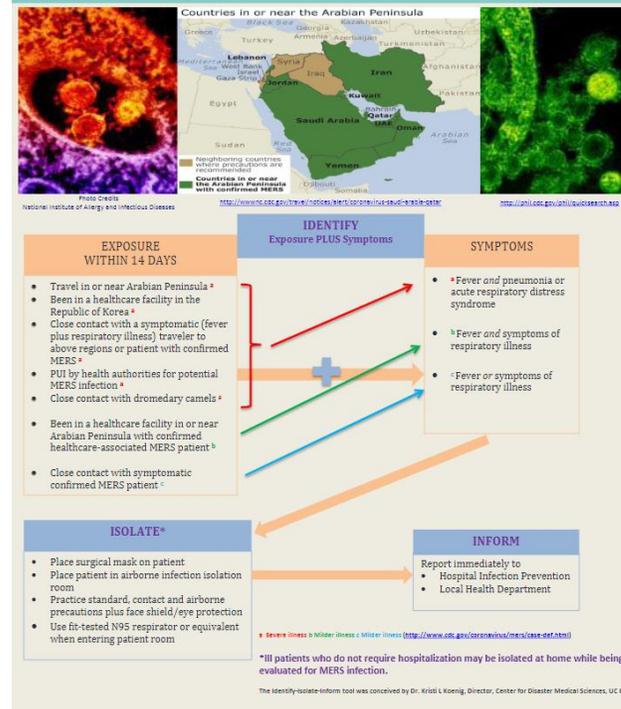


U.S. Department of Health and Human Services Centers for Disease Control and Prevention
For 508 compliance, please visit: <https://www.cdc.gov/vhf/ebola/clinicians/evaluating-patients/think-ebola.html>
January 13, 2015 | 01_20252-4

Ebola Virus Disease

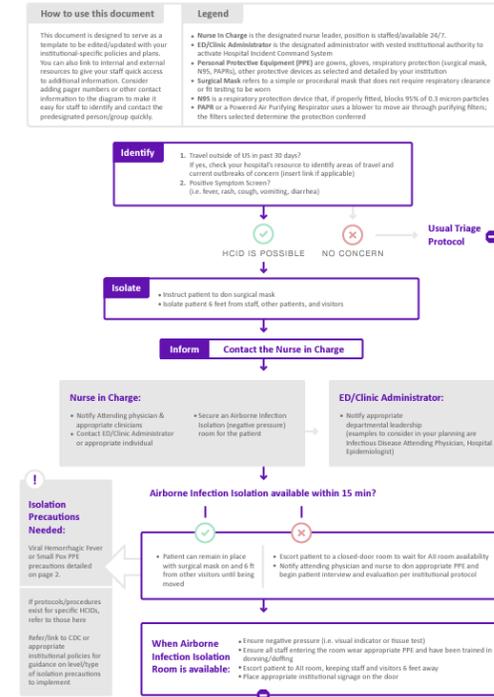
CDC: <https://www.cdc.gov/vhf/ebola/clinicians/emergency-services/emergency-departments.html>; RDHRS: <https://www.rdhhs.org/>; Koenig KL. Identify-Isolate-Inform: A Modified Tool for Initial Detection and Management of Middle East Respiratory Syndrome Patients in the Emergency Department. West J Emerg Med. 2015 Sep;16(5):619-24. doi: 10.5811/westjem.2015.7.27915. Epub 2015 Oct 20. PMID: 26587081; PMCID: PMC4644025.

Identify, Isolate, Inform: Emergency Department Evaluation and Management of Patients Under Investigation (PUIs) for MERS Coronavirus



Middle East Respiratory Syndrome (MERS)

High Consequence Infectious Disease (HCID): Emergency Department (ED) Identify - Isolate - Inform Algorithm



Generic High Consequence Infectious Disease (HCID)



Low-Tech/High-Tech: Either Way, Embedding in Workflow is Essential

- Educating clinicians on clinical recognition
- Embedded clinical decision support in the electronic health record has been demonstrated to improve guideline adherence
 - In setting of shifting PUI definitions, IC guidelines, testing strategies, clinical decision support may be even more important
 - Design tools with clinician workflow at the center
 - Assist in communication between HCPs about patient evaluation and status

Monkeypox PUI Evaluation/Infecti...

MPX, MPX-Risk, and MPX-Exp Infection Status and Resolution Criteria

Link to MGB Pulse: [MPX Infection Status and Resolution](#)

NOTE: .monkeypox is a real-time decision support tool. If you need to make a correction, create a NEW note and run .monkeypox again. DO NOT addend or delete the note. If you have resolved an MPX infection status in error, please contact infection control.

Monkeypox Virus Person Under Investigation (PUI) Evaluation

CDC guidance (including images) that can assist with clinical recognition

In the last 21 days, has the patient had a new and otherwise unexplained rash, ulcer, vesicle, pustule, or anogenital lesion? Yes No

Epidemiological Risk Factors

Contact with person(s) with a similar appearing rash.

Contact with person(s) with suspected or confirmed MPX.

Close/intimate in-person contact with individuals in a social network experiencing MPX activity (e.g., men who have sex with men).

Travel to a country where MPX is endemic (Cameroon, Central African Republic, Cote d'Ivoire, Democratic Republic of the Congo, Gabon, Liberia, Nigeria, Republic of the Congo, and Sierra Leone)

Contact with a dead/live animal/pet that is an African endemic species or used a product derived from such animals (e.g., game meat, creams, lotions, powders, etc.).

No epidemiological risk factors.

What was the nature of the contact? spouse

When did the contact occur? 8/9/2022

Where did the contact occur? home

Did the contact have a rash or other symptoms during the period of contact? Yes No

MPX Symptoms

Fever/chills

Myalgias

Lymphadenopathy

Fatigue/malaise

Headache

Recent genital ulcer/lesion or concern for STD

Other

Date of first onset of symptoms (if known) 8/7/2022

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Kawamoto K, Lobach DF. Clinical decision support provided within physician order entry systems: a systematic review of features effective for changing clinician behavior. AMIA Annu Symp Proc. 2003;2003:361-5. PMID: 14728195; PMCID: PMC1480005; Albin JS, Lazarus JE, Hysell KM, Rubins DM, Germaine L, Dugdale CM, Heller HM, Hohmann EL, Baugh JJ, Shenoy ES. Development and implementation of a clinical decision support system tool for the evaluation of suspected monkeypox infection. J Am Med Inform Assoc. 2022 Aug 29;ocac151. doi: 10.1093/jamia/ocac151. Epub ahead of print. PMID: 36036367.



Clinicians must keep an open mind when evaluating patients

- Male in 20s with 7 days of vesicular rash after travel to UK; **no** sexual contact
- Attended crowded outdoor event with close contact, including dancing
- Shared an e-cigarette with a woman
- Multiple non draining skin lesions, umbilicated lesion on palm positive for MPX; nasopharyngeal swab, saliva, and rectal swab positive for MPX

EMERGING INFECTIOUS DISEASES®

EID Journal > Volume 28 > Early Release > Main Article

Disclaimer: Early release articles are not considered as final versions. Any changes will be reflected in the online version in the month the article is officially released.

Volume 28, Number 10—October 2022

Research Letter

Human Monkeypox without Viral Prodrome or Sexual Exposure, California, USA, 2022

Abraar Karan¹, Ashley R. Styczynski, ChunHong Huang, Malaya K. Sahoo, Krithika Srinivasan, Benjamin A. Pinsky, and Jorge L. Salinas

Author affiliation: Stanford University School of Medicine, Stanford, California, USA

[Suggested citation for this article](#)

Abstract

We report human monkeypox in a man who returned to the United States from the United Kingdom and reported no sexual contact. He had vesicular and pustular skin lesions but no anogenital involvement. The potential modes of transmission may have implications for the risk of spread and for epidemic control.



But testing low probability individuals also has downsides

- Case series of three patients with low pre-test probability who had false positive MPX PCR results
- All three patients had
 - Atypical rashes
 - Uncharacteristic risk factors, no epi link to confirmed monkeypox
- Impact
 - Patient A: pregnant → delivered newborn; infection control precautions in hospital, including no skin-to-skin contact with mother and newborn; delayed breastfeeding; disposal of expressed milk; newborn received vaccinia immune globulin intravenous (dx bed bugs)
 - Patient B: child treated with tecovirimat; isolation of child at home; PEP for all family members and other children (dx enterovirus)
 - Patient C: infant treated with tecovirimat; 12 adults and 7 children received PEP; multiple families travel plans affected for weeks (dx pending)



Patient Placement and Personal Protective Equipment

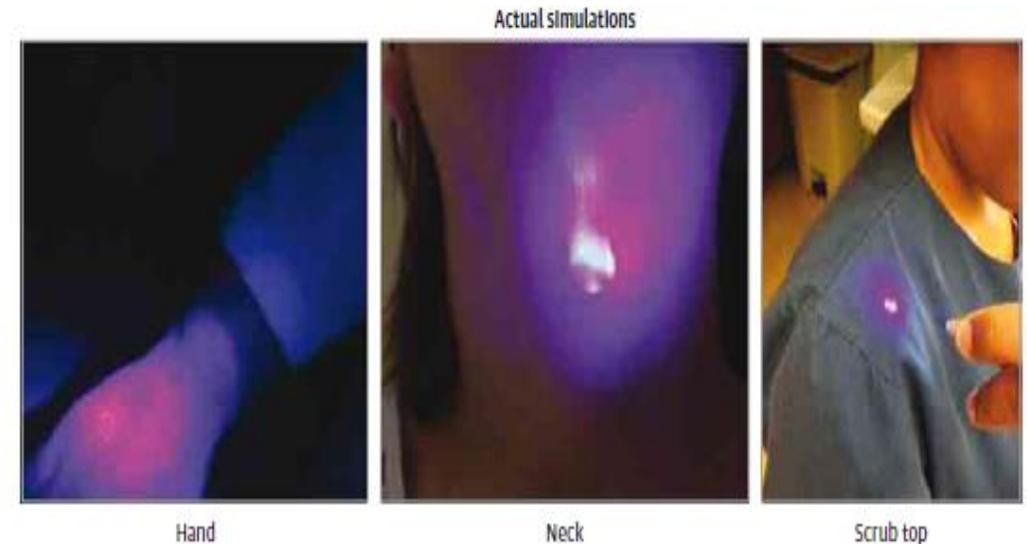
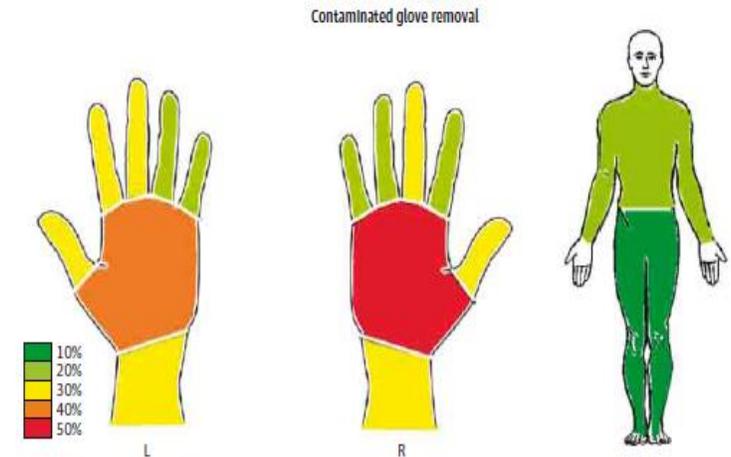
- **Patient Placement**
 - Single, private standard room
 - Use Airborne Infection Isolation Rooms (AIIRs, “negative pressure”) if aerosol generating procedures are planned or anticipated
- **Personal Protective Equipment**
 - Patient PPE: surgical/medical mask
 - HCP PPE:
 - gown, gloves, N95 respirator, eye protection
 - Some jurisdictions recommend N95 respirator only in setting of Aerosol-Generating Procedures

<https://www.cdc.gov/niosh/topics/hierarchy/default.html>



PPE must be worn correctly; failures can result in self- and cross-contamination

- Study to assess frequency of HCP self-contamination when using PPE using simulations involving donning/doffing with gowns and gloves contaminated with fluorescent lotion
 - At baseline, 46% of simulations resulted in self-contamination of skin or clothing
- Intervention to teach correct technique:
 - Reduction in skin and clothing contamination during glove and gown removal (60.0% before the intervention vs. 18.9% after, $P < .001$)
 - Sustained after 1 and 3 months (12.0% at both time points, $P < .001$ compared with before the intervention)
- Probability of self-contamination higher for those using incorrect technique (70.3% vs 30.0%)



Waste Management & Cleaning and Disinfection

- During the current global outbreak, all cases are expected to be Clade II (West African); this means that waste management is per routine. For Clade I (Central African), waste generated is considered Category A.
- Standard cleaning and disinfection should be approved using hospital-approved disinfectants following directions for concentration, contact time, and care and handling
 - Portable medical equipment
 - Built environment
- Soiled laundry should be handled according to standard practices; never shake or handle laundry in a manner that may disperse infectious material
 - Laundering of exam room curtains and other linens, if present

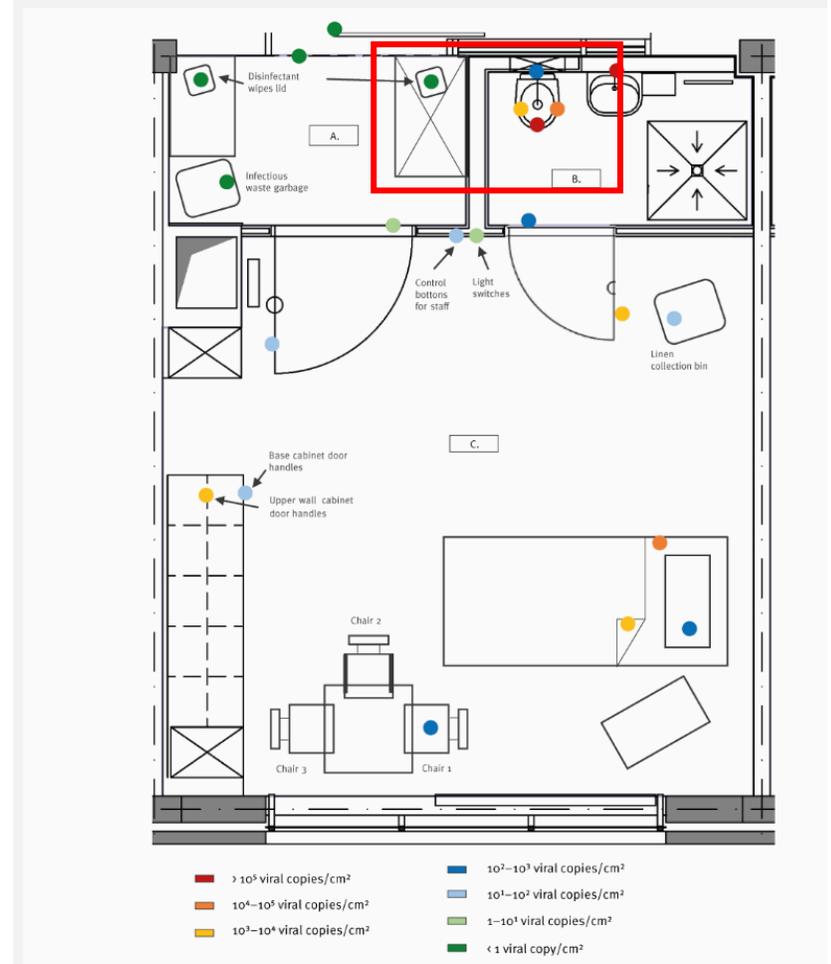


Contamination of the care environment

- Sampling of various surfaces in rooms occupied by patients with MPX; viral load quantification
- All surfaces directly touched by the patients' hands showed viral contamination with the highest loads detected in both bathrooms.
- Surfaces presumably touched by HCP also with detectable virus
- Fabrics that were extensively used by the patients showed viral contamination; gloved hand contaminated after touching fabric

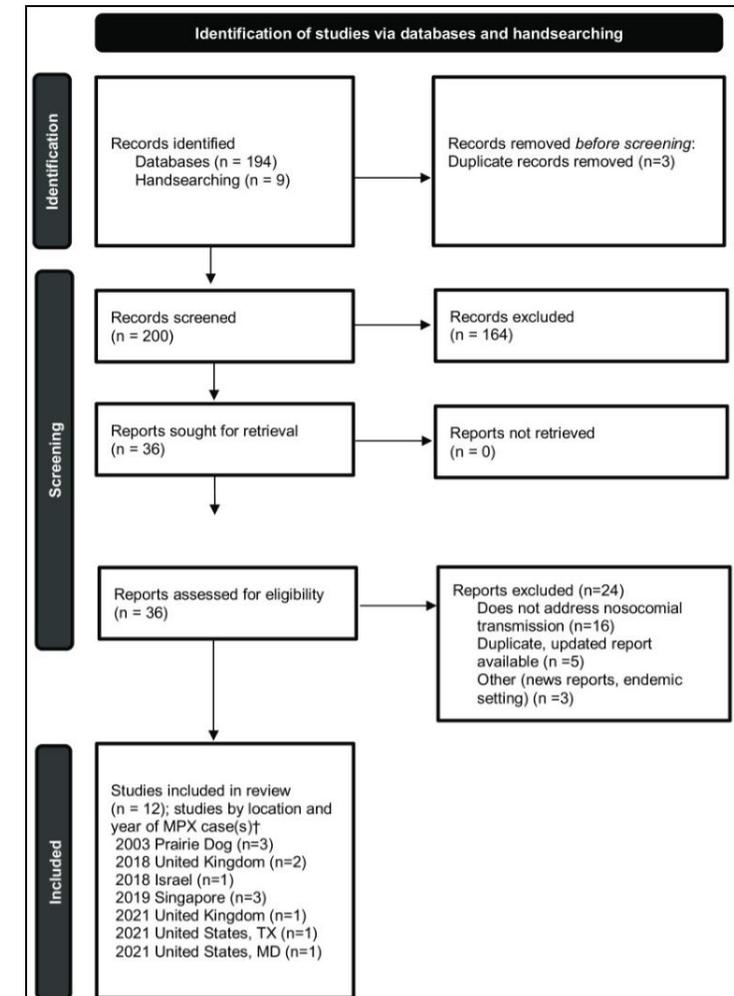
Nörz D, Pfefferle S, Brehm TT, Franke G, Grewe I, Knobling B, Aepfelbacher M, Huber S, Klupp EM, Jordan S, Addo MM, Schulze Zur Wiesch J, Schmiedel S, Lütgehetmann M, Knobloch JK. Evidence of surface contamination in hospital rooms occupied by patients infected with monkeypox, Germany, June 2022. Euro Surveill. 2022 Jun;27(26). doi: 10.2807/1560-7917.ES.2022.27.26.2200477. PMID: 35775427.

FIGURE. Outline map of the (A) anteroom (B) bathroom and (C) room of a hospitalised patient^a infected with monkeypox virus, with various sampled-surface locations and measured monkeypox virus contamination level Germany, June 2022



MPX Exposures in Healthcare Settings

- Imperative to follow identify/isolate/inform: our infection control protocols are protective
- Exposures can occur when there is a delay to identification of a patient as an MPX suspect
- A review of the literature from 2000 through the current outbreak identified a single case of transmission from patient to healthcare personnel, in the setting of not utilizing appropriate PPE and changing patient linens
- During the current 2022 outbreak, 2 HCP infections have been reported; 1 described as needlestick exposure



Zachary KC, Shenoy ES. Monkeypox transmission following exposure in healthcare facilities in nonendemic settings: Low risk but limited literature. Infect Control Hosp Epidemiol. 2022 Jul;43(7):920-924. doi: 10.1017/ice.2022.152. Epub 2022 Jun 9. PMID: 35676244; PMCID: PMC9272466; Thy M et al, Breakthrough infections after post-exposure vaccination against Monkeypox, medRxiv, August 4, 2022, doi: <https://doi.org/10.1101/2022.08.03.22278233> (preprint).



CDC Recommendations for Prophylaxis for Healthcare Personnel

- Currently, **pre-exposure** prophylaxis **is not** recommended for healthcare personnel (HCP) with the exception of:
 - Clinical laboratory personnel who perform testing to diagnose orthopoxviruses, including those who use polymerase chain reaction (PCR) assays for diagnosis of orthopoxviruses, including Monkeypox virus
 - Research laboratory workers who directly handle cultures or animals contaminated or infected with orthopoxviruses that infect humans, including Monkeypox virus, replication-competent Vaccinia virus, or recombinant Vaccinia viruses derived from replication-competent Vaccinia virus strains
 - Certain healthcare and public health response team members designated by public health authorities to be vaccinated for preparedness purposes
- **Post-exposure** prophylaxis indicated for specific high risk exposures and on a case-by-case basis for intermediate risk exposures
 - Ideally administered 0-4 days after exposure; up until 14 days



Exposure Risk Assessment and Stratification

Current CDC Healthcare Exposure Risk Assessment

Risk level of exposure	Exposure characteristics	Recommendations	
		Monitoring	PEP*
Higher	Unprotected contact between an exposed individual's broken skin or mucous membranes and the skin lesions or bodily fluids from a patient with monkeypox (e.g., inadvertent splashes of patient saliva to the eyes or mouth of a person), or soiled materials (e.g., linens, clothing) -OR-	Yes	Recommended
	Being inside the patient's room or within 6 feet of a patient with monkeypox during any medical procedures that may create aerosols from oral secretions (e.g., cardiopulmonary resuscitation, intubation), or activities that may resuspend dried exudates (e.g., shaking of soiled linens), without wearing a NIOSH-approved particulate respirator with N95 filters or higher and eye protection		
Intermediate	Being within 6 feet for a total of 3 hours or more (cumulative) of an unmasked patient with monkeypox without wearing a facemask or respirator -OR-	Yes	Informed clinical decision making recommended on an individual basis to determine whether benefits of PEP outweigh risks of transmission or severe disease.**
	Unprotected contact between an exposed individual's intact skin and the skin lesions or bodily fluids from a patient with monkeypox, or soiled materials (e.g., linens, clothing) -OR- Activities resulting in contact between an exposed individual's clothing and the patient with monkeypox's skin lesions or bodily fluids, or their soiled materials (e.g., during turning, bathing, or assisting with transfer) while not wearing a gown		
Lower	Entry into the contaminated room or patient care area of a patient with monkeypox without wearing all recommended PPE, and in the absence of any exposures above	Yes	None
No Risk	No contact with the patient with monkeypox, their contaminated materials, nor entry into the contaminated patient room or care area	No	None

Implementation challenges

- Scheme has to be able to classify a wide range of interactions between source and exposed, accounting for patient-HCP, patient-patient, patient-visitor, as well as types of interactions (direct, indirect, close contact) with modification by PPE worn at the time by both source and exposed
- Challenging to implement in real life (understatement)
- Can be additionally challenged when HCP is the source

<https://www.cdc.gov/poxvirus/monkeypox/clinicians/infection-control-healthcare.html>, accessed 9/13/2022



Risk Assessment and Stratification: High

Description of Exposure

H1. The exposed individual has direct contact with their skin (intact or non-intact) or their mucous membranes to the lesions, body fluids, or mucous membranes of an individual infected with MPX. ¹

H2. The exposed individual with non-intact skin has direct contact to potentially contaminated materials, including linens, equipment, and clothing.²

H3a. The exposed individual is in a room or within 6 feet of an individual infected with MPX, while not wearing an N95 respirator (or equivalent/higher level) and eye protection, during aerosol generating procedures of oral or respiratory secretions, including the room air period after.

H3b. The exposed individual is in a room or within 6 feet of an individual infected with MPX, while not wearing an N95 respirator (or equivalent/higher level) and eye protection, during actions that could aerosolize or resuspend dried exudates (i.e., vigorous shaking linens or clothing)

H4. The exposed individual (patient) was housed in the same room with an individual infected with MPX

H5. The exposed individual was known to have shared toileting facilities with an individual infected with MPX (i.e., skin contact with a toilet seat)

Risk Assessment and Stratification: Intermediate

Description of Exposure

INT1. The exposed individual's intact skin has direct contact to the intact skin (without visible lesions) of individual infected with MPX (e.g., shaking hands) or with the potentially contaminated linens, equipment, and clothing

INT2. The exposed individual's clothing, due to lack of use of gown, has direct contact with the lesions, body fluids, mucous membranes, and potentially contaminated materials (e.g., including linens, equipment, and clothing) of the individual with MPX. This can include, but is not limited to, activities such as bathing, turning, or transferring, with or without gloves.

INT3. The exposed individual is wearing a surgical or procedural mask, but no eye protection, within 6 feet of an individual infected with MPX, who is not wearing a surgical or procedural mask.



Risk Assessment and Stratification: Low

Description of Exposure

L1. The exposed individual, wearing gown, gloves, eye protection and a surgical or procedural mask or N95 respirator, entering the room of an individual with MPX when the patient is present, or when the patient has left, prior to terminal clean.

L2. The exposed individual is wearing a surgical or procedural mask, but no eye protection, within 6 feet of an individual infected with MPX, who is wearing a surgical or procedural mask.

L3. The exposed individual is wearing a surgical or procedural mask within 6 feet of an individual infected with MPX, who is wearing a surgical or procedural mask.



Approach– 5/2022

- Pending the finalization of the risk assessment, we sent all individuals on our list a survey to identify individuals who had no possible exposure (i.e., chart review only).
 - All those remaining were instructed to continue symptom monitoring using our **REDCap MPX Symptom Check**; information sessions held to explain process and plan for risk stratification
- Once risk assessment approach finalized, the list was divided into
 - RN, MD, other clinicians to risk stratify based on a **REDCap MPX Risk Assessment Survey**, with follow up verification of categorization
 - Other staff were contacted by a team of nurses to review the risk stratification and classify their categorization
- For individuals in High Risk and Intermediate Risk with interest in vaccines, follow up calls by team of physicians to verify risk categorization and provide counseling

Simpson LA, Macdonald K, Searle EF, Shearer JA, Dimitrov D, Foley D, Morales E, Shenoy ES. Development and deployment of tools for rapid response notification of Monkeypox exposure, exposure risk assessment and stratification, and symptom monitoring. *Infect Control Hosp Epidemiol.* 2022 Aug;43(8):963-967. doi: 10.1017/ice.2022.167. Epub 2022 Jul 11. PMID: 35815416.



Experience *since* that time

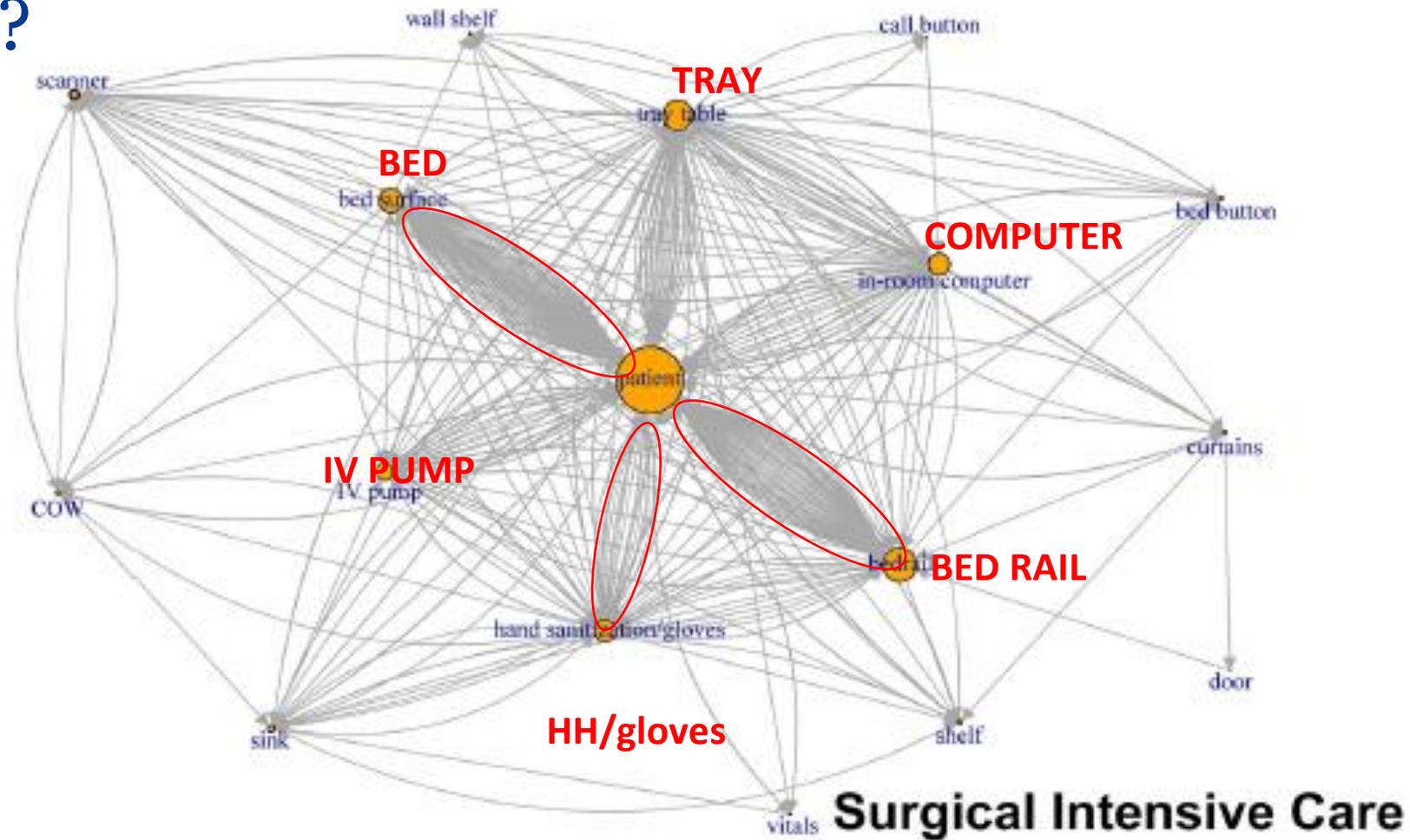
- Modifications to the “grid” to aide in ease of application
- Based on experience in working up a series of exposures with slightly different scenarios
- Supported through build in REDCap with simplified approach combining eligibility and risk assessment survey into one



Pause: Importance of
Hand Hygiene, and
Standard Precautions



Hand Hygiene, Hand Hygiene... wait...did I mention Hand Hygiene?



Jinadatha C, Villamaria FC, Coppin JD, Dale CR, Williams MD, Whitworth R, Stibich M. Interaction of healthcare worker hands and portable medical equipment: a sequence analysis to show potential transmission opportunities. BMC Infect Dis. 2017 Dec 28;17(1):800. doi: 10.1186/s12879-017-2895-6. PMID: 29281998; PMCID: PMC5745722.



When Standard Precautions are *not* Standard

July 2020: Florida DPH alerted to 4 *Candida auris* infections in patients cared for in a COVID-19 unit at a single hospital (3 bloodstream infections, 1 urinary tract)

August 2020: in response, point-prevalence survey of all patients admitted to the unit was conducted; among 67 patients screened, 35 (52%) were positive; 6 of the 35 developed clinical infections



Investigation: serious lapses in PPE use and basic infection prevention/standard precautions

- HCP wearing multiple layers of gowns and gloves caring for COVID-19 patients
- HCP donned eye protection, N95, gown, gloves, bouffant, shoe covers upon entry to the unit, then put a second gown and pair of gloves upon entry to each patient room
- HCP used hand sanitizer on the gloved hands
- Mobile equipment and reusable medical equipment was not cleaned and disinfected between patients
- Clean supplies stored in hallway bins accessed by HCP in contaminated PPE



Summary



Summary points

- Cases and Trends
 - Epidemiological curve in the US has plateaued/started to decline
 - As cases decline, consideration of what this means for access to testing, treatment, and possible shifts in vaccination strategies
- Transmission
 - Correct consistent implementation of Standard Precautions is essential
 - Transmission-based precautions as indicated
- IPC
 - Be on the look out: I-I-I
 - PPE works, attention to doffing essential
 - Risk in healthcare appears to be low; exposure investigations are resource intensive

