Centers for Disease Control and Prevention

Laboratory Procedures and Biosafety Guidelines

Updated August 22, 2022

Routine Chemistry, Hematology, and Urinalysis in Hospitals or Clinical Laboratories

If a patient is being tested for monkeypox virus infection, testing to evaluate other illnesses on the clinical differential may continue while awaiting orthopoxvirus test results. Specific biosafety precautions should be implemented depending on the specimen that is being tested:

- Non-lesion specimens (e.g., urine, blood, etc.): The quantity of pox virus likely to be in clinical specimens of blood and body fluids is low. Therefore, vaccination is not recommended for personnel who handle and process routine clinical specimens from monkeypox (e.g., urine for urinalysis, blood for complete blood count (CBC), chemistries, microbiology). Standard universal precautions to protect against potential infectious agents within any specimen received (using BSL-2 containment) are recommended. Consistent adherence to Standard Precautions and biosafety protocols for protection of laboratory workers will prevent exposure to monkeypox virus in clinical specimens. The number of staff who test specimens should be limited and any procedures that have the potential to generate infectious aerosols should be avoided. See Recommendations for Using Smallpox Vaccine in a Pre-Event Vaccination Program for further details.
- Lesion specimens from patients suspected to have monkeypox (being concurrently tested for orthopoxvirus and other differentials (e.g., herpes simplex virus (HSV) or varicella zoster virus (VZV)): Lesions are known to have the highest quantity of monkeypox virus. When possible, vaccinated (i.e., smallpox vaccination within the past 3 years) people should perform laboratory work that involves handling lesion specimens that are being processed for monkeypox virus testing. When only non-immunized people are available, additional personal protective equipment and practices should be used to further reduce the risk for exposures, including testing specimens in BSL-2 containment with BSL-3 practices* (see Manipulating Diagnostic Specimens Suspected to Contain Monkeypox Virus).
- Culture of lesion specimens from patients suspected to have monkeypox, for diagnostic purposes other than monkeypox virus (e.g., HSV or VZV), is recommended to occur in BSL-2 facilities, with smallpox vaccinated staff, using BSL-3 practices. If staff are not vaccinated, it is recommended to use BSL-3 containment.
- Once viral DNA is extracted utilizing a validated extraction protocol, the viral DNA is non-infectious and can be manipulated using BSL-2 containment facilities and procedures.
- Before using automated testing platforms (e.g., laboratory robotic platforms, etc.) it is recommended that laboratories perform site-specific and activity-specific risk assessments to identify and mitigate any risks associated with the use of these platforms. If testing a lesion specimen from a suspected monkeypox patient, it is recommended that complete viral inactivation of the specimen is performed before putting these specimens on any automated platform or, placing the platform within a BSC if possible.

The following is recommended guidance for handling suspected monkeypox specimens. As with all procedures, laboratories should perform site-specific and activity-specific risk assessment to identify and mitigate risks. Risk assessments and mitigation measures are dependent on:

- The procedures performed
- Identification of the hazards involved in the process and procedures
- The competency level of the personnel who perform the procedures
- The laboratory equipment and facility

- The resources available

For more information, see:

- Biological Risk Assessment: General Considerations for Laboratories
- Core Infection Prevention and Control Practices for Safe Healthcare Delivery in All Settings
- Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens Standard
- Biosafety in Microbiological and Biomedical Laboratories (BMBL) 6th Edition, Section II – Biological Risk Assessment, pages 9-20

Clinical Pathology, Molecular Testing, and Analysis of Bacterial or Mycotic Cultures

BSL-2 facilities with standard BSL-2 work practices may be used for the following activities:

- Pathologic examination and processing of formalin-fixed or otherwise inactivated tissues
- Molecular analysis of extracted nucleic acid preparations
- Electron microscopic studies with glutaraldehyde-fixed grids
- Routine examination of bacterial and mycotic cultures for diagnostic purposes other than monkeypox virus[1]
- Routine staining and microscopic analysis of fixed smears for diagnostic purposes other than monkeypox virus[1]

[1]Unless the cultures or smears are from lesion specimens. While awaiting results from an orthopoxvirus test, culture of lesion specimens for diagnostic purposes other than monkeypox virus from a suspect monkeypox virus case is recommended to occur in BSL-2 facilities, with smallpox vaccinated staff using BSL-3 practices* (see Manipulating Diagnostic Specimens Suspected to Contain Monkeypox Virus). If staff are not vaccinated, it is recommended to use BSL-3 facilities.

Manipulating Diagnostic Specimens Suspected to Contain Monkeypox Virus

It is recommended that processing and testing of monkeypox lesion material be performed in facilities that have recently vaccinated personnel, the necessary equipment, engineering controls, personal protective equipment, and appropriate diagnostic assays. Diagnostic testing for orthopoxviruses (which includes monkeypox virus) is available at Laboratory Response Network (LRN) laboratories located throughout the United States and abroad. There is currently no commercially available assay to detect monkeypox virus.

As with all procedures, laboratories should perform a site-specific and activity-specific risk assessment to identify and mitigate risks. See Routine Chemistry, Hematology, and Urinalysis in Hospitals or Clinical Laboratories for more details.

When possible, vaccinated (i.e., smallpox vaccination within the past 3 years) people should perform laboratory work that involves handling lesion specimens that are being processed for monkeypox virus testing. The Biosafety in Microbiological and Biomedical Laboratories (BMBL), 6th edition and the Advisory Committee on Immunization Practices (ACIP) recommends booster doses of smallpox vaccine every 3 years for persons at occupational risk for virulent replicating orthopoxviruses (e.g., monkeypox) and at least every 10 years for those at occupational risk for less virulent orthopoxviruses (e.g., cowpox and vaccinia virus).

When only non-immunized individuals are available, additional personal protection equipment and practices should be used to further reduce the risk for exposures.

Use of a certified Class II Biological Safety Cabinet (BSC) or other containment device that provides a barrier between the specimen and personnel is recommended for manipulations of monkeypox specimens.

- Sealed centrifuge rotors or sample cups for centrifugation are recommended for use. Ideally, these rotors or cups are loaded and unloaded in a BSC.

- If a BSC or other containment device cannot be used, the risk of exposure to an inadvertent sample release should be reduced by the appropriate combinations of personal protective equipment (e.g., respirators, face shields) and physical containment devices (e.g., centrifuge safety cups or sealed rotors).

For laboratories with personnel vaccinated within the past 3 years—

- Diagnostic specimens may be handled in Biosafety Level 2 (BSL-2) facilities, using BSL-2 practices.
- Diagnostic specimen manipulations should be carried out in a certified Class II BSC or other containment device, especially if there is a potential to generate aerosols (e.g., vortexing or sonication of specimens in an open tube).
- Directional air flow (negative air pressure with respect to the surrounding area) is recommended, but not required for BSL-2 laboratory facilities.

For laboratories without vaccinated personnel—

- Routine specimen processing may be handled in BSL-2 facilities, but with more stringent BSL-3 work practices*.

*BSL-3 practices include conducting procedures that involve the manipulation of infectious materials within a Class II BSC. Work with open vessels should not be conducted on the bench top. If a procedure cannot be performed within a BSC, use a combination of personal protective equipment and other containment devices (glove box, centrifuge safety cups or sealed rotor) designed to create a barrier between the specimen and the laboratorian.

Additional examples of BSL-3 practices include, but are not limited to:

- a solid-front gown with cuffed sleeves,
- double gloves,
- eye protection (safety glasses, snugly fitting goggles) or face protection (face-shield),
- N-95 respirator,
- limiting the number of laboratory personnel who work during specimen manipulation,
- including the correct biohazard warning signage outside of the laboratory, and
- using a laboratory with directional air flow

Protective clothing should not be worn outside of the laboratory.

If procedures that generate aerosols cannot be contained within a BSC, acceptable methods of respiratory protection include particulate respirators; these respirators provide the minimum level of respiratory protection. Facilities may consider using higher levels of respiratory protection, particularly if the vaccination status of staff is not confirmed or personnel cannot be correctly fitted to disposable models. These higher levels may include the use of powered air purifying respirators.

Standard cleaning and disinfection procedures should be performed using an EPA-registered hospital-grade disinfectant with emerging viral pathogens claim. Products with Emerging Viral Pathogens claims may be found on EPA's List Q. Follow the manufacturer's directions for concentration, contact time, and care and handling.

If the appropriate safety equipment and/or protocols are unavailable, referring specimens to a suitably equipped reference laboratory should be considered.

Culturing Specimens for Monkeypox Virus

Culture-based testing for monkeypox virus should not be performed as a routine diagnostic procedure at clinical or diagnostic laboratories. These methods should only be performed by staff who are vaccinated against smallpox and in laboratories with validated protocols and BSL-3 containment facilities.

Disposal of Waste

All cultures, stocks, residual specimens, and other monkeypox virus waste should be decontaminated before on-site disposal by using an approved method, such as autoclaving. Materials to be decontaminated outside of the immediate laboratory should be placed in a durable, leak-proof container and closed for transport from the laboratory. All waste disposal must comply with local, regional, state, national, and international regulations. Waste disposal regulations vary at the state and local levels; see Environmental Protection Agency Regulations, State Universal Waste Programs in the United States, and U.S. Department of Transportation's Planning Guidance for Handling Category A Solid Waste for more information.

Select Agent Regulations

Laboratory testing has indicated that the current outbreak is associated with the Clade IIb of monkeypox virus. The Clade IIb of the monkeypox virus is not subject to select agent regulations (42 CFR § 73).

Monitoring Healthcare Workers Exposed to Monkeypox Virus

Guidelines for monitoring healthcare workers who have unprotected exposures to patients with monkeypox or laboratory specimens from these patients.

Post-exposure vaccination may be appropriate in cases of direct exposure to monkeypox specimens. Guidelines for the use of smallpox vaccine.

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