Proudly a CDC and NIH-DRM compliant BSL-3 facilty commissioned by Merrick Mexico since August 2023.
Un instalación BSL-3 orgullosamente CDC y NIH-DRM certificada por Merrick México desde agosto 2023.

Laboratory biosafety guidance related to SARS-CoV-2 (COVID-19)

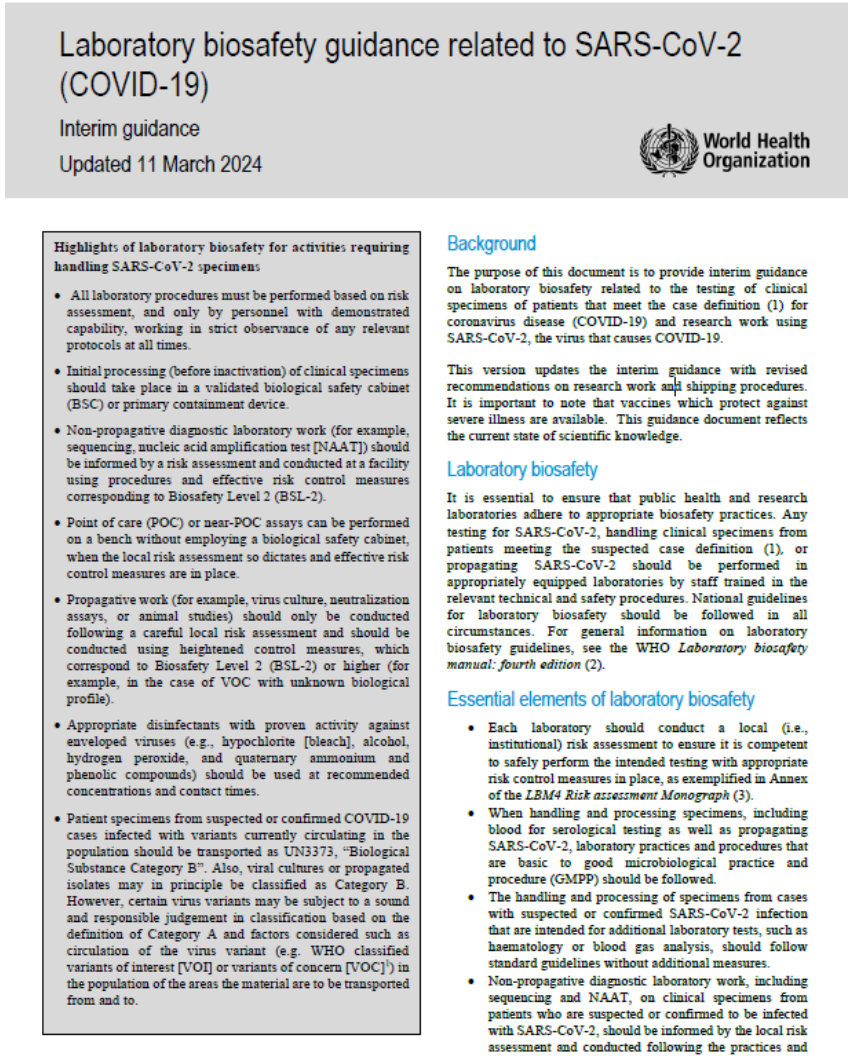
Interim guidance
Updated 11 March 2024

Dr. Christian A. García-Sepúlveda
Laboratorio de Genómica Viral y Humana BSL-3
Facultad de Medicina
Universidad Autónoma de San Luis Potosí

Document

This presentation summarizes the World Health Organization's (WHO) "*Laboratory biosafety guidance related to SARS-CoV-2 (COVID-19): Interim guidance*" report.

This report was prepared by WHO's Epidemic and Pandemic Preparedness and Prevention (EPP) team as of March 11, 2024 (WHO/WHE/EPP/2024.3.)



Laboratory biosafety guidance related to SARS-CoV-2 (COVID-19)

Interim guidance

Updated 11 March 2024

World Health Organization

Highlights of laboratory biosafety for activities requiring handling SARS-CoV-2 specimens

- All laboratory procedures must be performed based on risk assessment, and only by personnel with demonstrated capability, working in strict observance of any relevant protocols at all times.
- Initial processing (before inactivation) of clinical specimens should take place in a validated biological safety cabinet (BSC) or primary containment device.
- Non-propagative diagnostic laboratory work (for example, sequencing, nucleic acid amplification test [NAAT]) should be informed by a risk assessment and conducted at a facility using procedures and effective risk control measures corresponding to Biosafety Level 2 (BSL-2).
- Point of care (POC) or near-POC assays can be performed on a bench without employing a biological safety cabinet, when the local risk assessment so dictates and effective risk control measures are in place.
- Propagative work (for example, virus culture, neutralization assays, or animal studies) should only be conducted following a careful local risk assessment and should be conducted using heightened control measures, which correspond to Biosafety Level 2 (BSL-2) or higher (for example, in the case of VOC with unknown biological profile).
- Appropriate disinfectants with proven activity against enveloped viruses (e.g., hypochlorite [bleach], alcohol, hydrogen peroxide, and quaternary ammonium and phenolic compounds) should be used at recommended concentrations and contact times.
- Patient specimens from suspected or confirmed COVID-19 cases infected with variants currently circulating in the population should be transported as UN3373, "Biological Substance Category B". Also, viral cultures or propagated isolates may in principle be classified as Category B. However, certain virus variants may be subject to a sound and responsible judgement in classification based on the definition of Category A and factors considered such as circulation of the virus variant (e.g. WHO classified variants of interest [VOI] or variants of concern [VOC][1]) in the population of the areas the material are to be transported from and to.

Background

The purpose of this document is to provide interim guidance on laboratory biosafety related to the testing of clinical specimens of patients that meet the case definition (1) for coronavirus disease (COVID-19) and research work using SARS-CoV-2, the virus that causes COVID-19.

This version updates the interim guidance with revised recommendations on research work and shipping procedures. It is important to note that vaccines which protect against severe illness are available. This guidance document reflects the current state of scientific knowledge.

Laboratory biosafety

It is essential to ensure that public health and research laboratories adhere to appropriate biosafety practices. Any testing for SARS-CoV-2, handling clinical specimens from patients meeting the suspected case definition (1), or propagating SARS-CoV-2 should be performed in appropriately equipped laboratories by staff trained in the relevant technical and safety procedures. National guidelines for laboratory biosafety should be followed in all circumstances. For general information on laboratory biosafety guidelines, see the WHO *Laboratory biosafety manual: fourth edition* (2).

Essential elements of laboratory biosafety

- Each laboratory should conduct a local (i.e., institutional) risk assessment to ensure it is competent to safely perform the intended testing with appropriate risk control measures in place, as exemplified in Annex of the *LBM4 Risk assessment Monograph* (3).
- When handling and processing specimens, including blood for serological testing as well as propagating SARS-CoV-2, laboratory practices and procedures that are basic to good microbiological practice and procedure (GMPP) should be followed.
- The handling and processing of specimens from cases with suspected or confirmed SARS-CoV-2 infection that are intended for additional laboratory tests, such as haematology or blood gas analysis, should follow standard guidelines without additional measures.
- Non-propagative diagnostic laboratory work, including sequencing and NAAT, on clinical specimens from patients who are suspected or confirmed to be infected with SARS-CoV-2, should be informed by the local risk assessment and conducted following the practices and

Click on image for link to original document.

Gist

Laboratory risk assessment is a prerequisite to all work involving SARS-CoV-2.

Only personnel with demonstrated capability & strict observance of protocols.

Initial processing (before inactivation) of clinical specimens always within BSC.

Non-propagative diagnostic laboratory work (NAT) conducted in BSL-2.

Point of care (Rapid tests) on a bench outside of BSC if effective risk control in place.

Propagative work (virus culture, neutralization assays, animals) in ≥ BSL-2.

Handlinng of high concentrations or large volumes of either variants of interes (VOI) or variants of concern (VOC), emerging strains, and strains of unknown bioprofile in ≥ BSL-3.

Disinfectants with proven activity against enveloped viruses.

Most COVID-19 samples shipped as UN3373 Biological Substance Category B, but dangerous COVID-19 samples should be shipped as UN2814 Category A.

Purpose of the document

To provide guidance on laboratory biosafety related to the testing of clinical specimens of COVID-19 patients and to research work with SARS-CoV-2.

Revised and updated recommendations on research work and shipping procedures.

Recommendations address the minimal/essential working conditions for laboratory work with SARS-CoV-2 specimens.

This document reflects current state of scientific knowledge.

It is essential to ensure that handling of COVID-19 clinical specimes be carried out in properly equipped public health and research laboratories following strict adherence to biosafety practices and having trained staff.

Minimal / essential working conditions

The following slides describe the minimal/ essential working conditions associated with specific manipulations in laboratory settings.

1.- Risk assessment.

2.- Routine laboratory procedures (non-propagative and PCR based diagnostics). → Conventional clinical lab

3.- Point of care (POC) assays. → Bedside

4.- Use of disinfectants.

5.- Viral isolation and propagation. → BSL-2 and BSL-3 labs

6.- Waste management.

7.- Additional risks associated with virus isolation studies.

8.- Work with animals infected with SARS-CoV-2 → Preferably ABSL-3 lab

9.- Referral of laboratory specimens.

Risk assessment

Systematic process of gathering information.

Evaluating the likelihood and impact (consequences) of exposure

Workplace hazard(s) - Biohazards

Risk control measures to reduce the risk to an acceptable level.

Types of equipment used and the procedures performed.

Revised:

- Regularly
- When new information becomes available
- New procedures
- New equipment

Risk assessment

Assess risk of each processing step (i.e., sample collection, sample reception, clinical testing, polymerase chain reaction (PCR), or virus isolation, if required).

Identify hazards of each processing step (leaking sample containers).

Each step has its own level of risk.

Risk = Consider the likelihood as well as the consequences of an exposure or release.

Develop appropriate risk control measures for each step to leave us with an acceptable level of residual risk.

The likelihood of errors and incidents rises when staff is not well trained and subjected to the Pressure of producing rapid results.

Conventional clinical microbiology labs

Examples of routine laboratory procedures that can be carried out in conventional clinical microbiology laboratories include:

- Diagnostic testing of serum / blood (including haematology and clinical chemistry).
- Diagnostic testing of respiratory specimens
  - Nasopharyngeal swabs
  - Oropharyngeal swabs
  - Sputum
  - Endotracheal aspirate or
  - Bronchoalveolar lavage).
- Stools and urine.
- Examination of mycotic / bacterial cultures grown from respiratory tract specimens.
- Laboratories must follow “WHO Lab manual core requirements”.
- Excellent biosafety video series prepared by the WHO.

Activities requiring work in BSL-2

Adhere to good microbiological practice and procedure (GMPP).

Non-propagative diagnostic laboratory work (sequencing & NAT) on clinical specimens from SARS-CoV-2 suspected / confirmed patients.

All manipulations of potentially infectious materials and all procedures having the potential to generate splashes or aerosols always conducted within a BSC.

Propagating SARS-CoV-2 only in appropriately equipped laboratories by staff trained in the relevant technical and safety procedures (though still BSL-2).

Well-characterized variants pose negligible risks to public health and may necessitate only some increased control measures for virus isolation and propagation if aerosol generation outside the BSC is not anticipated.

Initial processing (before inactivation) of specimens, conducted in validated BSC.

Lysis buffer of common RNA extraction inactivates SARS-CoV-2.

Unless a country states otherwise, follow WHO recommendations.

Point of care (POC) or near-POC

Bedside rapid tests based on portable, cartridge based NAT platforms (GeneXpert).

Must produce little aerosols if any.

Spills and splashes uncommon unless badly trained staff.

Ok as long as:

- Work is performed on a large paper towel in a well-ventilated clutterless area, with no documents, computers, or personal items.
- PPE (lab coat, safety goggles, and gloves, respiratory protection).
- Validated infectious waste management process.

Activities requiring work in BSL-3

Handling high concentrations or lagre volumes of of live SARS-CoV-2 variants of interest (VOI).

Handling variants of concern (VOC).

Handling emerging strains of SARS-CoV-2 of unknown biological profile.

Neutralization assays.

Experimantal animal infection.

Strains no longer circulating.

Emerging, no longer circulating strains or those with unknown biological profile may require both increased and additional control measures.

Virus propagation in BSL-3

Newly emerging viruses that meet the definition of a VOI or VOC.

1) Personal protective equipment (minimum/essential):
    a) Gloves, solid-front or wrap-around gowns, scrubs, coveralls with sleeves that fully cover forearms, head covering, shoe covers (or dedicated shoes) and eye protection (goggles or face shield).

2) Sealed centrifuge rotors for centrifugation of specimens.
    a) NOTE: Rotors or cups should be loaded and unloaded in a BSC.

3) Risk-assessment based respiratory protection.
    a) Fit-tested EU FFP2 or US 6 NIOSH-certified N95 respirator.
    b) Powered Air Purifying Respirator (PAPR) competency.

Other risks associated to viral manipulations

Experimental procedures may carry risk of inducing viral mutations, reassortments and recombinations.

Risk of increased pathogenicity and/or transmissibility, altered antigenicity or drug susceptibility.

Specific risk assessments should be conducted, and specific risk-reduction measures adopted before any of the following procedures are conducted:

- Coinfection of cell cultures with different coronaviruses or any procedures that may result in a coinfection and, in turn, recombination.
- Culture of viruses in the presence of antiviral drugs.
- Deliberate genetic modification of viruses.

All of the above worthy of DURC (Dual-Use Research of Concern) assessment & audits.

Risk of experimental animal infections

This activity poses additional risks of injury (e.g., bites, scratches).

Specific training in animal handling and experimental procedures on animals.

All handling of infectious material carried out within BSC.

Follow WHO's Laboratory Biosafety Manual Risk Assessment Monograph.

Examples of animal work needing risk assessment:

- Inoculation of animals for potential recovery of SARS-CoV-2;
- Animal inoculation for confirmation and/or characterization of SARS-CoV-2.
- Infection of animals for preclinical vaccine/anti-viral drug testing.
- Host-pathogen interaction studies.

All lab activites (either BSL-2 or BSL-3)

All technical procedures should be performed in a way that minimizes the generation of aerosols and droplets.

Wear appropriate personal protective equipment (PPE), based on risk assessment.

All proesses that may cause splashes, droplets, or aerosols of infectious materials should be performed in validated BSCs by personnel with demonstrated capability.

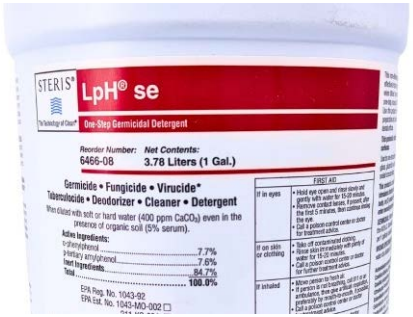
- loading and unloading of sealed centrifuge cups
- grinding, blending
- vigorous shaking or mixing
- sonic disruption
- opening of containers with pressure differential (where was sample taken).

Disinfectants

Disinfectants with proven activity against enveloped viruses:

- Hypochlorite (bleach) at 0.1% for general surface disinfection 1% for spills.
  - 0.1% = 20 ml 5% bleach + 980 ml water (1 + 49) = 1,000 mg/litre or 1,000 ppm
  - 1% = 200 ml 5% bleach + 800 ml water (1+4) = 10,000 mg/litre or 10,000 ppm.
- Ethanol (62–71%)
- Hydrogen peroxide 0.5%

- Quaternary ammonium (according to manufacturers instructions).



- Phenolic compounds (according to manufacturers instructions).

Use at recommended concentrations and contact times.

SARS-CoV-2 sample transportation

Includes:

- Transport within laboratory.
- Transportation from one laboratory to another laboratory of same facility.
- Transportation from one facility to another facility.
- Transprtation from one city, state or country to another city, state or country.

COVID-19 clinical specimens, viral cultures, isolates and propagated material classified as UN 3373 Biological Substance Category B.

Some BSL-3 specimens classified as Infectious substance affecting humans Category A

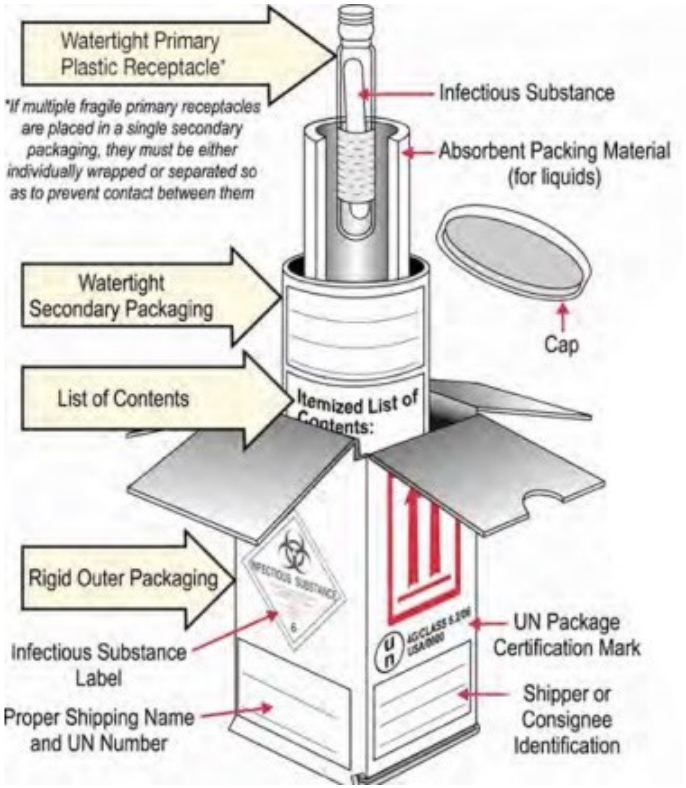
“infectious substances, i.e., capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals.”

- High concentrations of VOI.
- Large volumes of VOI.
- Emerging strains.
- Unknown bioprofile strains.
- Etc.

Triple packaging system

International Civil Aviations Organization (ICAO) recommended by the WHO.

International Air Transport Association (IATA) recommended by the CDC.



RVPVE

Red de Vigilancia de Patógenos Virales Emergentes

Christian García-Sepúlveda — Laboratorio de Genómica Viral & Humana BSL-3, Medicina UASLP
Sandra Guerra-Palomares — Laboratorio de Genómica Viral & Humana BSL-3, Medicina UASLP
Ignacio Amezcua Osorio — Comité Estatal para el Fomento y Protección Pecuaria de San Luis Potosí.
Fernando Díaz-Barriga Martínez — Centro de Investigacion Aplicada en Ambiente y Salud) (CIAAS), Medicina UASLP
Guillermo Espinosa Reyes — Centro de Investigacion Aplicada en Ambiente y Salud) (CIAAS), Medicina UASLP
Andreu Comas Garcia — Departamento de Microbiología, Medicina UASLP
Mauricio Comas Garcia — Laboratorio de Microscopía de Alta Resolución, CICSAB Ciencias UASLP
Juan Carlos Cuevas Tello — Grupo de Bioinformática, Ingeniería UASLP
Dulce Ma. Hernández Piña — Lab manager, LGVH UASLP
J. Manuel Mendoza Méndez — Laboratorio de Genómica Viral & Humana BSL-3, Medicina UASLP
Nidya Jurado Sánchez — Laboratorio de Genómica Viral & Humana BSL-3, Medicina UASLP
Claudio S. Ferrer Pérez — Laboratorio de Genómica Viral & Humana BSL-3, Medicina UASLP
Estefania Jurado Sánchez — Laboratorio de Genómica Viral & Humana BSL-3, Medicina UASLP
Andrea Salinas Gómez — Laboratorio de Genómica Viral & Humana BSL-3, Medicina UASLP