

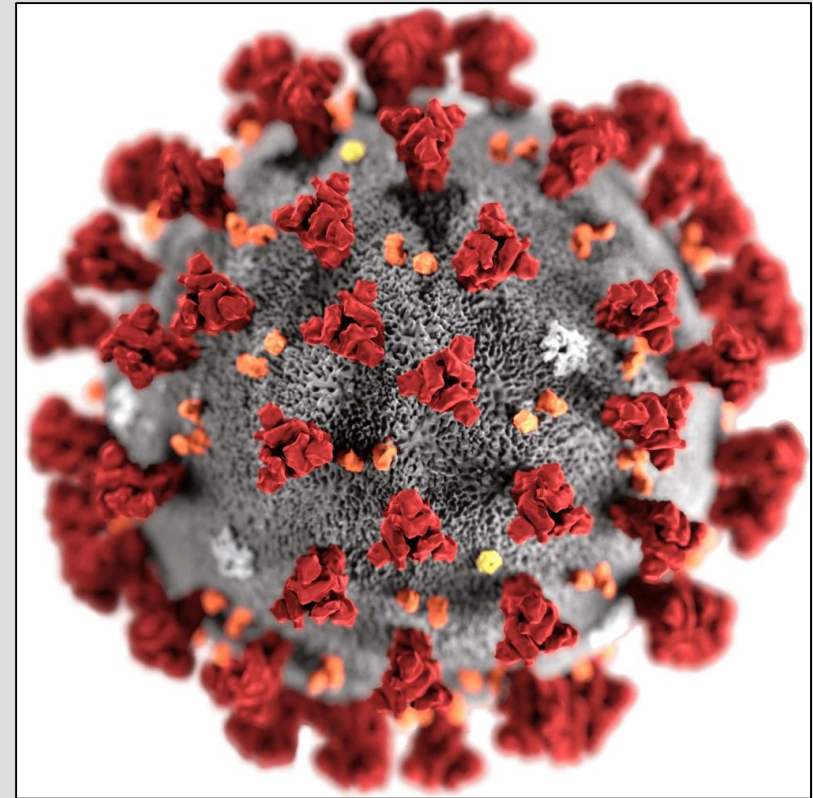


LAB BIOSAFETY GUIDELINES: HANDLING AND PROCESSING SPECIMENS ASSOCIATED WITH COVID-19

COVID-19 is an emerging, rapidly evolving situation. For latest information please visit CDC:
<https://www.coronavirus.gov> or <https://coronavirus.ucsf.edu/>

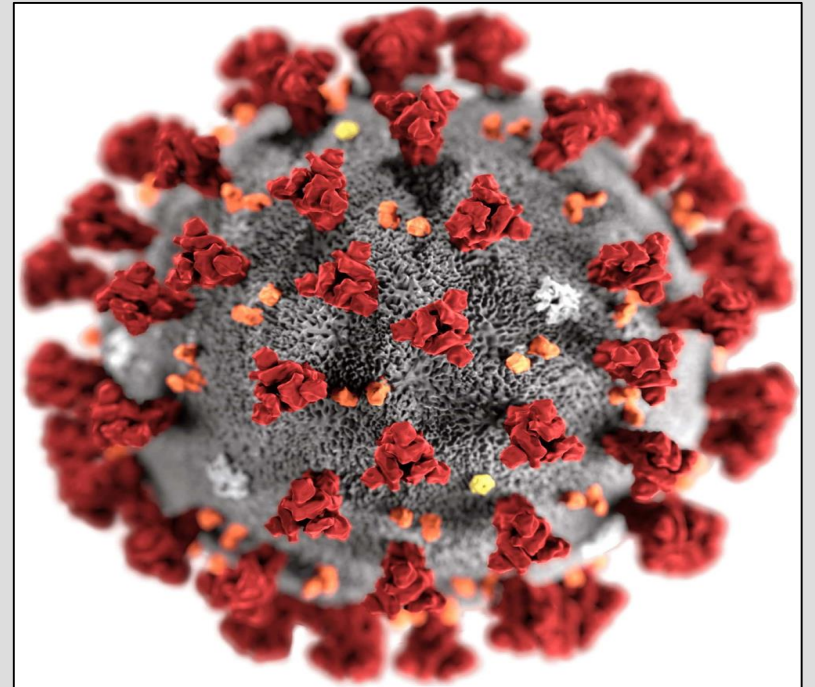
WHAT IS COVID-19?

- COVID-19 is the *disease* caused by infection with SARS-CoV-2
- Coronaviruses (CoV) = largest known RNA viruses
- Seven CoV have been found to infect humans and cause respiratory diseases:
 - Four cause common self-limited disease
 - Other three cause severe disease:
 - SARS-CoV = Severe Acute Respiratory Syndrome (2002-2003)
 - MERS-CoV = Middle East Respiratory Syndrome (2012)
 - SARS-CoV-2 = COVID-19 (Current outbreak)



VIRAL LOAD OF SARS-COV-2 IN CLINICAL SAMPLES

- **Respiratory samples** (nasopharyngeal swabs, throat swabs, sputum, bronchoalveolar lavage) have high viral loads
 - Maximum, 7.11×10^8 copies/swab by day 4/5 (per one study)
- A few studies have shown detectable viral RNA in **stool**
 - Although the viral loads were less than those of respiratory samples, precautionary measures should be considered when handling fecal samples
- Limited data have shown that viral RNA could be detected in **plasma or serum** from COVID-19 patients
 - Viremia in up to 15% patients, generally those with severe illness
 - Median PCR cycle threshold value was 35.1 (95% CI: 34.7-35.1), suggesting a very low RNA concentration
- **Urine** samples tested for viral RNA have shown 0% to 6.9% (in one study) samples with detectable viral RNA in COVID-19 patients

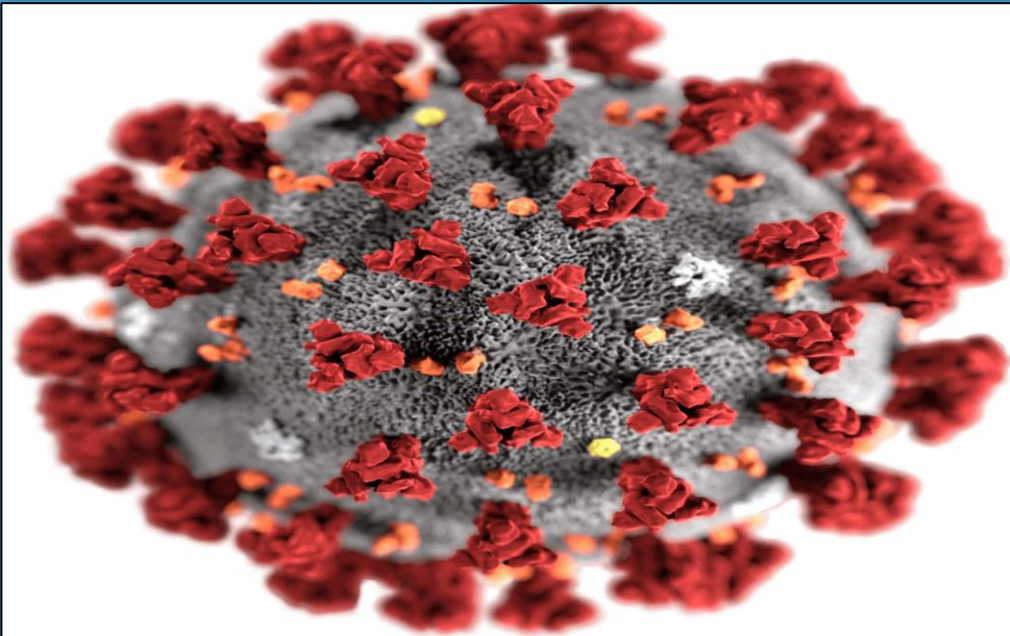


To date, laboratory-acquired infection has not been reported for SARS-CoV-2

SARS-COV-2 IN CLINICAL SAMPLES

Study patients	BLOOD/ SERUM	STOOL/ ANAL SWAB	URINE
Beijing; N=2 followed daily after hospitalization	N/A	0/2	0/2
Beijing; N=17	N/A	9/17 (53%) pos (viral load lower Vs resp samples)	N/A
Wuhan; N=41	6/41 (15%) patients; low viral load (Median PCR value 35.1)	N/A	N/A
Sichuan; N=19 suspected clinically with 9 confirmed	0/19	8/9 (89%) pos	0/9
Guangzhou; N=57 in-patients	6/57 (10.5%); all 6 with severe illness	11/28 (39%) anal swab pos (stool not tested)	N/A
Shanghai; N=62 convalescent patients	0/14 (0%) positive during convalescence	54/66 (81.8%) stool positive for viral RNA	4/58 (6.9%) positive for viral RNA

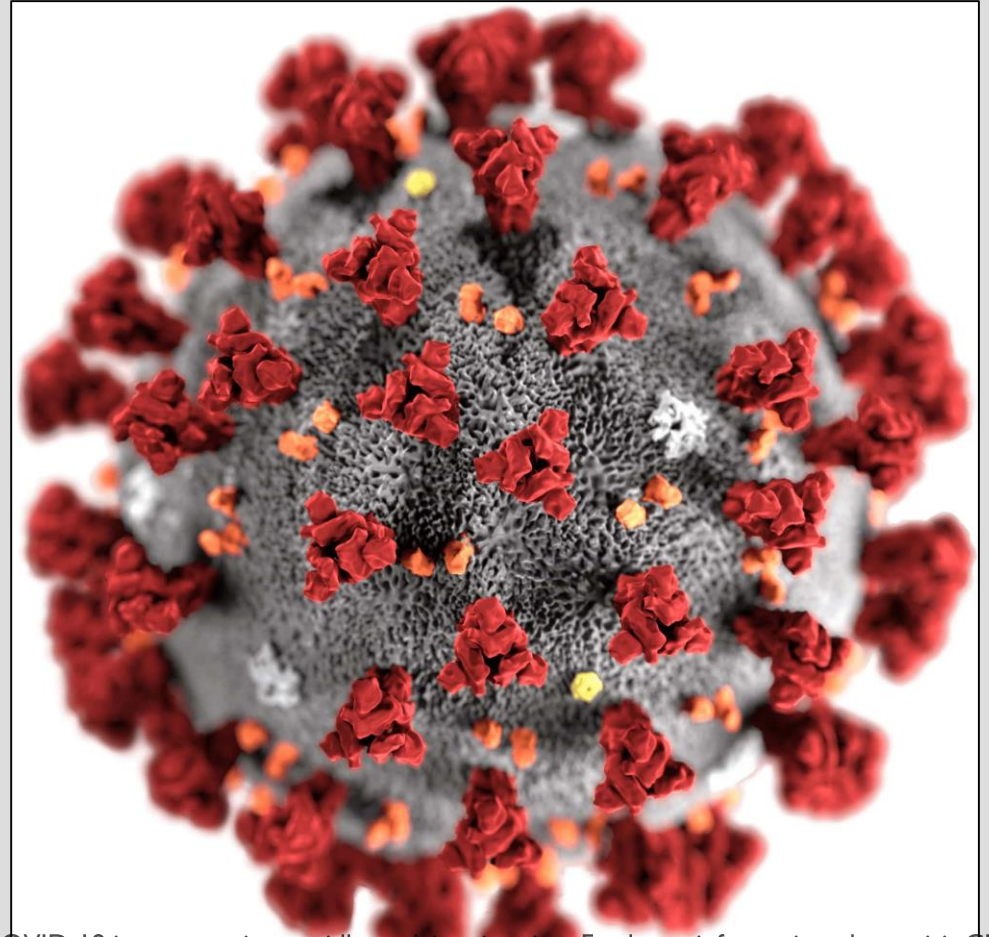
QUICK GUIDE TO BIOSAFETY LEVELS (BSL)



- **Biosafety:** application of safety precautions that reduce a laboratorian's risk of exposure to a potentially infectious microbe and limit contamination of the work environment and, ultimately, the community
- There are **4 biosafety levels;** each has specific controls for containment of microbes and biological agents

STANDARD MICROBIOLOGICAL PRECAUTIONS

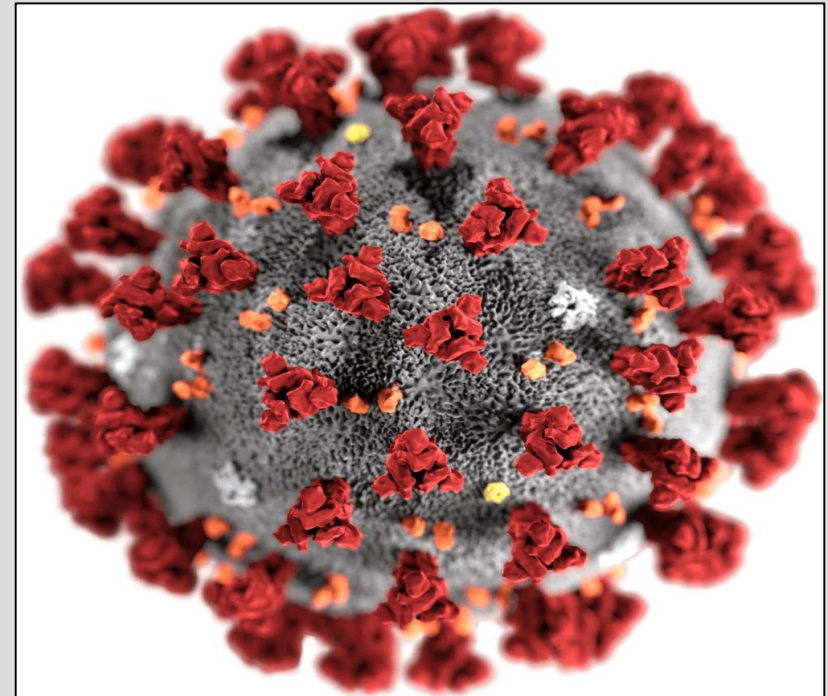
- Common to all labs, REGARDLESS OF BSL
- Based on the principle that all blood, body fluids, secretions, nonintact skin, mucous membranes, and excretions (except sweat) may contain transmissible infectious agents
- Includes:
 - Not eating, drinking, or applying cosmetics in the lab
 - No shorts, short skirts, or open-toed shoes
 - Washing hands frequently (e.g. after working with biological materials and before leaving the lab)
 - Use of PPE (gloves, lab coats, etc.) depending on the anticipated exposure
 - Routinely decontaminating work surfaces



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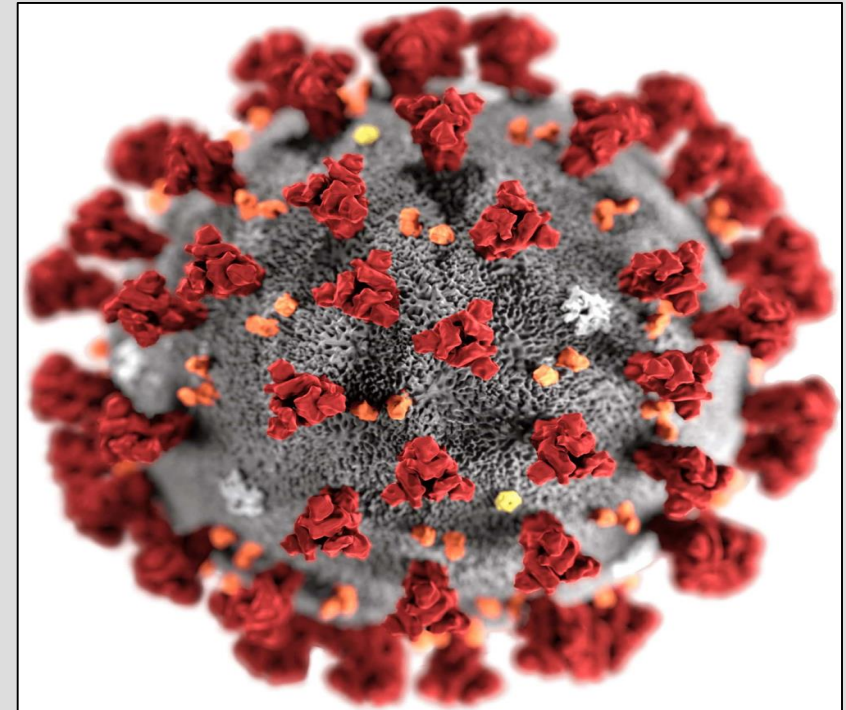
BSL-I

- Risk Group I (RGI) microbes not known to consistently cause disease in healthy adults and present minimal potential hazard (e.g. nonpathogenic strain of *E. coli*)
- Use BSL-I containment which requires:
 - Laboratory practices:
 - Standard microbiological practices are followed
 - Work can be performed on an open lab bench or table
 - Safety equipment:
 - PPE worn as needed
 - Facility construction:
 - Sink must be available for hand washing
 - Lab should have doors to separate the working space with the rest of the facility



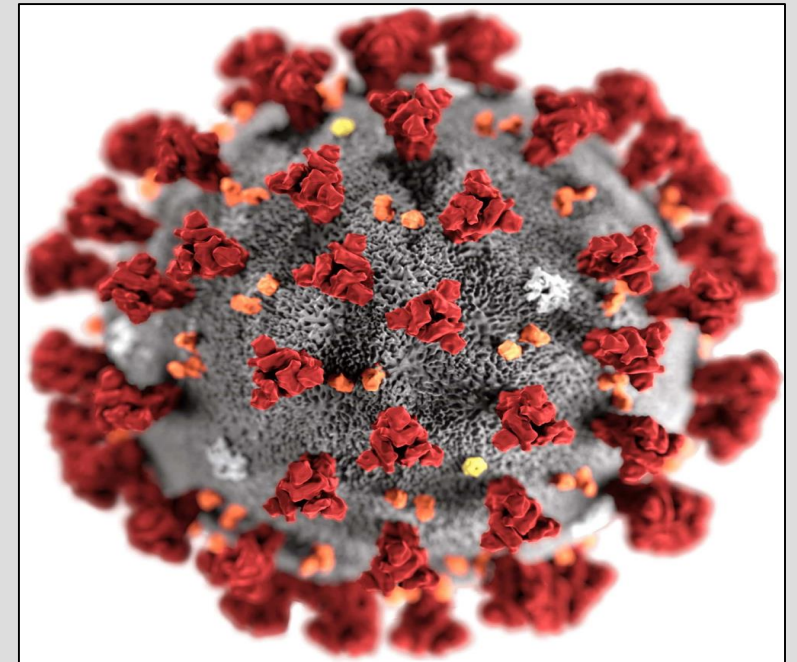
BSL-2

- Risk Group 2 (RG2) microbes pose moderate hazards to laboratorians and the environment (e.g. *Staphylococcus aureus*)
- Use BSL-2 containment which requires BSL-1 PLUS:
 - Laboratory practices
 - Restricted access (to approved users only)
 - Keep doors closed during active procedures
 - Safety equipment:
 - Eye protection and face shields worn, as needed
 - All procedures that can cause aerosols or splashes are performed within a biological safety cabinet (BSC)
 - An autoclave or an alternative method of decontamination is used for waste treatment
 - Facility construction:
 - Lab has self-closing doors
 - Sink and eyewash readily available



BSL-3

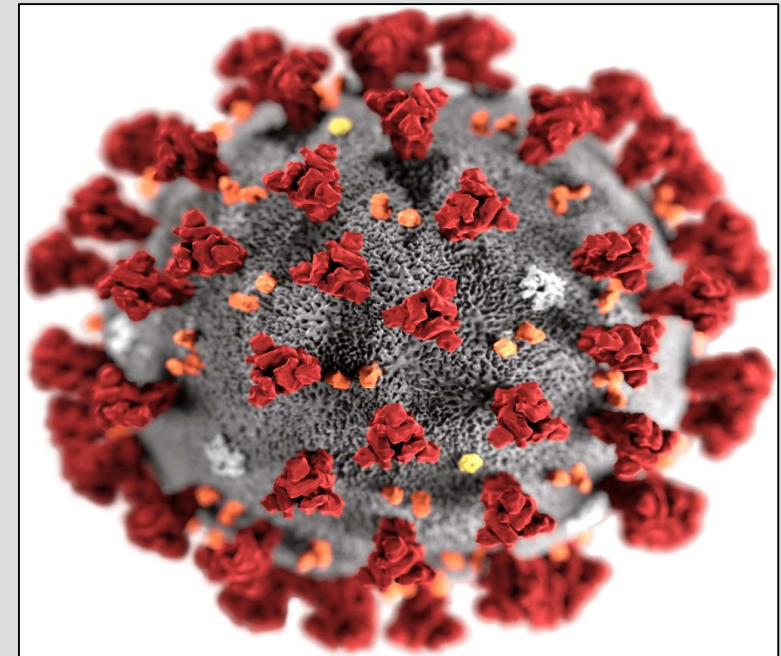
- Risk Group 3 (RG3) microbes there can be either indigenous or exotic, and they can cause serious or potentially lethal disease through respiratory transmission (e.g. *Mycobacterium tuberculosis*)
- Use BSL-3 containment which requires BSL-2 PLUS:
 - Laboratory practices:
 - Laboratorians are under medical surveillance and might receive immunizations for microbes they work with
 - Access to the laboratory is restricted and controlled at all times
 - Safety equipment
 - All work with microbes must be performed within a certified BSC
 - Appropriate PPE must be worn which may require the use of respirators
 - Facility construction
 - Hands-free sink and eyewash are available near the exit
 - Entrance to the lab is through an antechamber and self-closing, interlocked doors
 - Exhausted air is via a dedicated system and is not recirculated to any other location
 - Laboratory maintains sustained directional inward airflow by drawing air into the laboratory from clean areas towards potentially contaminated areas



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BSL-4

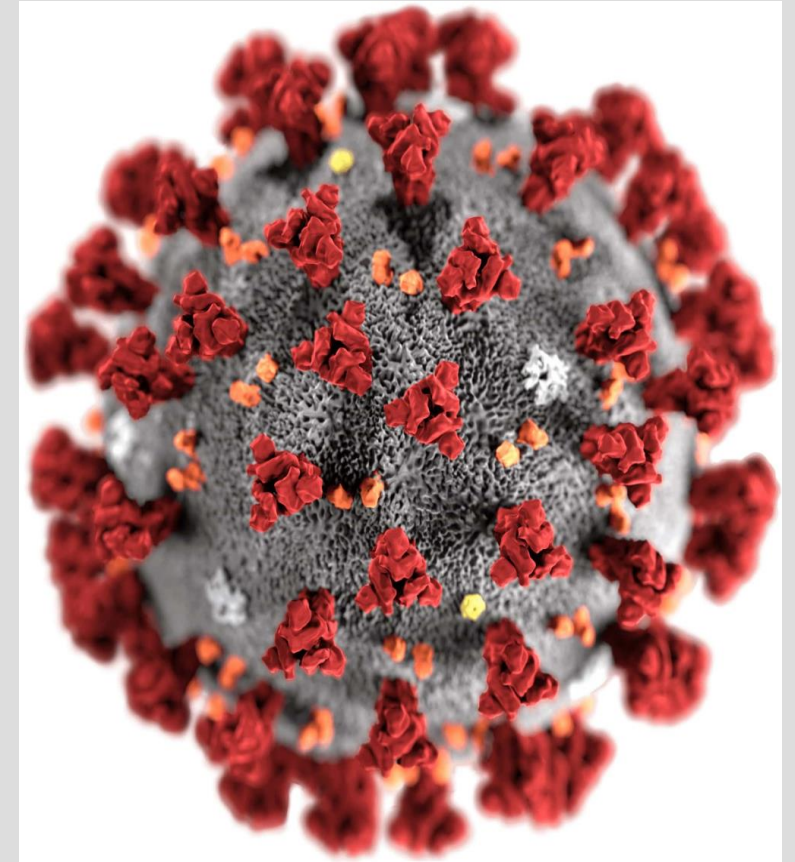
- Risk Group 4 (RG4) microbes are dangerous and exotic, posing a high risk of aerosol-transmitted infections and are frequently fatal without treatment or vaccines (e.g. Ebola virus)
- BSL-4 containment includes BSL-3 PLUS:
 - Laboratory practices
 - Change clothing before entering
 - Shower upon exiting
 - Decontaminate all materials before exiting
 - Safety equipment
 - Perform all work with microbe within appropriate Class III BSC
 - Users wear a full body, air-supplied, positive pressure suit
 - Facility construction
 - Lab located in a separate building or in an isolated and restricted zone of the building
 - Lab has dedicated supply and exhaust air, as well as vacuum lines and decontamination systems



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COVID-19 AND BSL STATUS

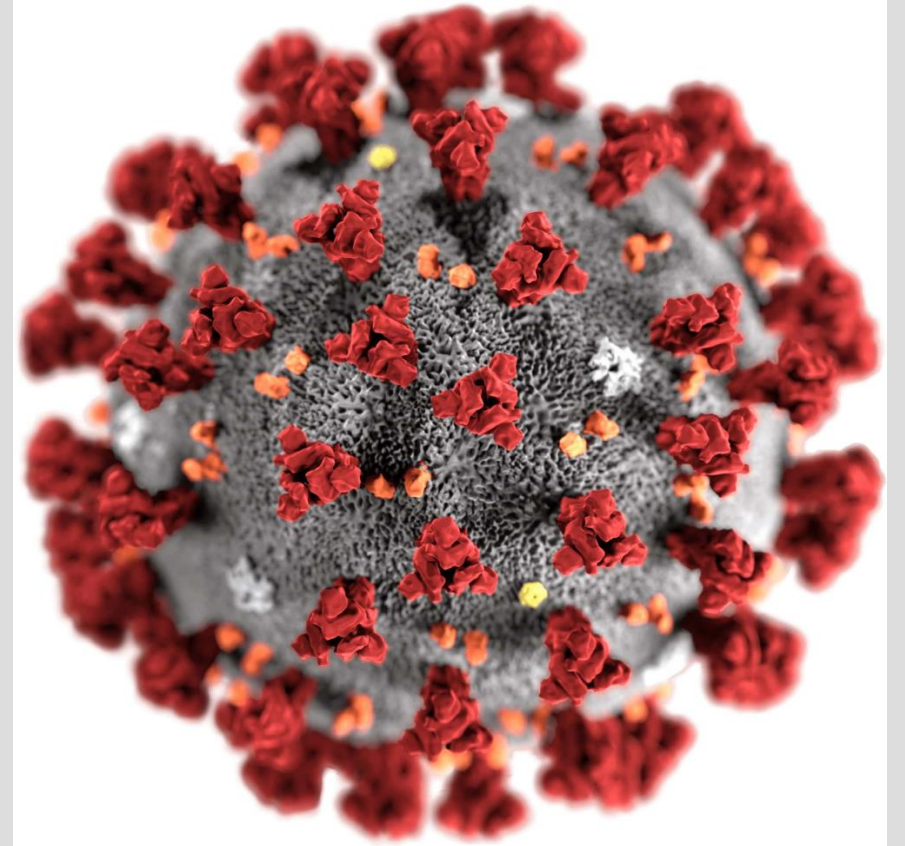
- **Routine diagnostic testing of specimens can be handled using Standard Precautions**
- For procedures with a high likelihood to generate aerosols or droplets, use either a certified Class II Biological Safety Cabinet (BSC) or additional precautions to provide a barrier between the specimen and personnel
- Virus isolation in cell culture and initial characterization of viral agents recovered in cultures of SARS-CoV-2 specimens must be done in a BSL-3 lab



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DECENTRALIZED AND POINT OF CARE TESTING

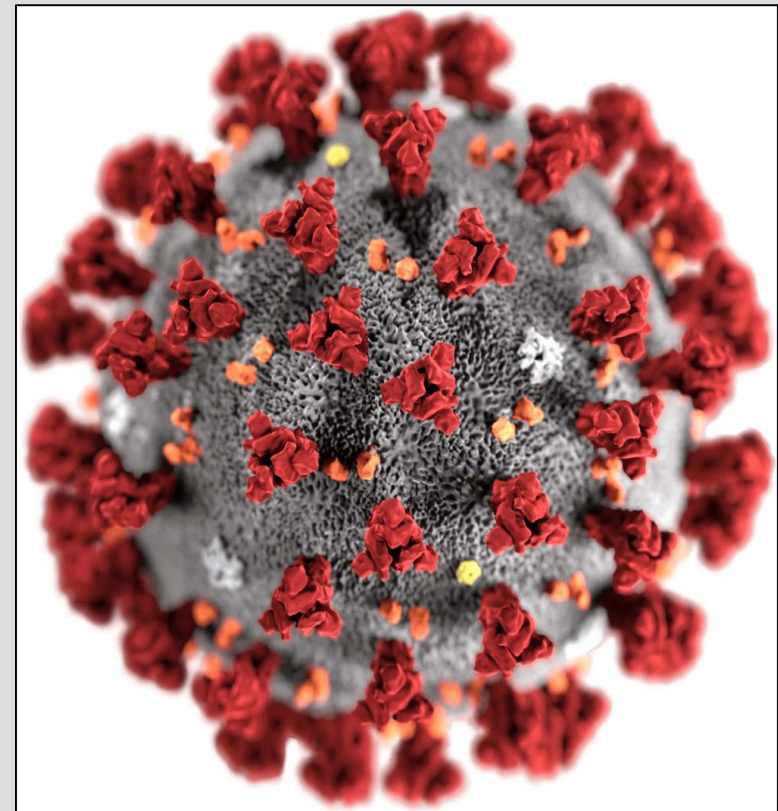
Use Standard Precautions
to provide a barrier
between the specimen and
personnel during specimen
manipulation



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PROCEDURES WITH A HIGH LIKELIHOOD TO GENERATE DROPLETS OR AEROSOLS

- Many routine lab procedures can potentially generate aerosols and droplets (especially vortexing, centrifugation, aggressive pipetting)
- Use a certified Class II Biological Safety Cabinet (BSC) for uncapped samples, or for respiratory samples
- Additional precautions to provide a barrier between the specimen and personnel may include:
 - Splash guards or face shield
 - Centrifuge safety cups
 - Sealed centrifuge rotors



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DECONTAMINATION OF SURFACES

- Wear disposable gloves when cleaning
- If surfaces are dirty, clean using a detergent or soap and water prior to disinfection
- For disinfection, effective protocols include:
 - diluted household bleach solutions (diluted to 10%)
 - Alcohol solutions with at least 70% alcohol
 - Use when equipment may be damaged by use of bleach
 - Other common EPA-registered household disinfectants

NOTE: Always follow designated contact times



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LABORATORY WASTE MANAGEMENT

- **NO** evidence to suggest need for additional packaging or disinfection procedures
- Handle waste from testing suspected or confirmed COVID-19 patient specimens as all other biohazardous waste in the lab



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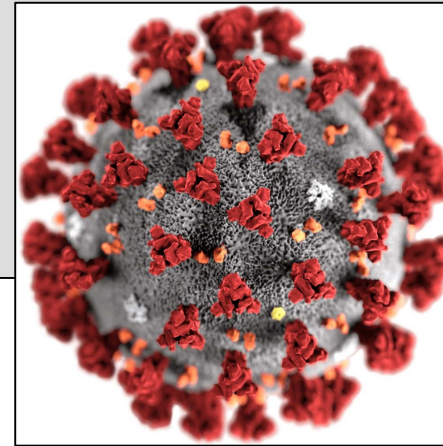
UCSF COVID-19 BIOSPECIMEN GUIDELINES

- **NO additional handling precautions** are recommended (Standard precautions OK)
- **NO additional storage requirements** are recommended
- In the event you are exposed (inhalation, ingestion, injury, or contact with mucosal surface) to any biospecimens, contact the **UCSF Exposure Hotline at 415-353-7842** immediately and follow UCSF's policy on seeking medical care and reporting
- In the event of a biospecimen spill or leak onto a surface, follow UCSF's Bloodborne Pathogen's Exposure Plan and immediately contact EH&S at 9-911

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BOTTOM LINE

- For routine diagnostic tests on serum, stool, blood, or urine specimens follow standard laboratory practices, including **Standard Precautions**, when handling potential COVID-19 patient specimens
 - Wear a lab coat in the lab, & remove before exiting. Consider it dirty.
 - Wear gloves when handling specimens. Change if torn/damaged. Consider gloves dirty.
 - Be aware of hand motions and what you touch
 - Treat every sample as if it is infectious
- If risk of splash (eg uncapping samples, pour-offs, minimal pipetting) use splash shield/ face shield
- For procedures with the potential to generate aerosols or droplets (e.g., vortexing, centrifuging)
 - use certified Class II BSC if uncapped samples
 - Capped samples (non-respiratory origin) may be processed outside a BSC
- Manipulations of respiratory samples, use certified Class II BSC



RESOURCES

- CDC: [Interim Laboratory Biosafety Guidelines for Handling and Processing Specimens Associated with Coronavirus Disease 2019 \(COVID-19\)](#)
- CDC: [Recognizing the Biosafety Levels](#)
- Pan et al. [Viral load of SARS-CoV-2 in clinical samples](#). The Lancet: Infectious Diseases. Available online 24 February 2020.
- Chang L, Yan Y, Wang L. [Coronavirus Disease 2019: Coronaviruses and Blood Safety](#). Transfus Med Rev. 2020 Feb 21. pii: S0887-7963(20)30014-6.
- Ling Y et al. Chin Med J (Engl). 2020 Feb 28. [Epub ahead of print]. Persistence and clearance of viral RNA in 2019 novel coronavirus disease rehabilitation patients
- Chen W et al. Emerging Microbes & Infections 2020 Vol 9. Detectable 2019-nCoV viral RNA in blood is a strong indicator for the further clinical severity
- Xie C et al. International Journal of Infectious Diseases. Comparison of different samples for 2019 novel coronavirus detection by nucleic acid amplification tests
- [UCSF COVID-19 Biospecimen Guidelines](#) (March 15, 2020)
- Public Health England Guidance - [COVID-19: safe handling and processing for samples in laboratories](#) (Updated 12 March 2020)

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