WEBINAR on COVID-19 and BIOMEDICAL WASTE in INDIA
(North Indian Region Webinar)

Best Practices for Managing COVID-19 Waste

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16TH SEPTEMBER 2020

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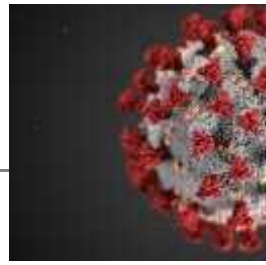
COVID-19 in Context



- **COVID-19 is transmitted primarily through**
  - **Respiratory droplets (and possibly airborne aerosols) from an infected person's sneeze, cough, (and possibly speech), and**
  - **Touching a contaminated surface and transferring the virus to t mouth, nose or eyes.**

- **COVID-19 is**
  - **MORE contagious than Ebola … but much LESS contagious than polio, mumps, rubella, diphtheria, pertussis, or measles [1]**
  - **MORE deadly than the seasonal flu … but much LESS deadly th MERS, H5N1 influenza A, Ebola, or untreated tetanus or rabies**

1. Based on comparisons of published R0 values; 2. Based on estimates of average case fatality rates.

Environmental Persistence of SARS CoV-2

How long does the virus remain infectious in the environme

Paper, tissue paper	3 hours	at 22°C and 65% relative humidity
Copper	8 hours	at 21-23°C
Aerosols in air	11 hours	at 21-23°C and 65% relative humidit
Cardboard	35 hours	at 21-23°C
Wood	2 days	at 22°C and 65% relative humidity
Cloth	2 days	at 22°C and 65% relative humidity
Glass	4 days	at 22°C and 65% relative humidity
Stainless steel	7 days	at 22°C and 65% relative humidity
Plastic	7 days	at 22°C and 65% relative humidity

Based on undetectable titre or 10 x half-life from $TCID_{50}$ data from laboratory studies: Chin *et al*., *Lancet Microbe* 2020; and Doremalen *et al*., *N Engl J Med*, 2020.

Key Point about COVID-19 Virus

SARS-CoV-2
(the coronavirus responsible for COVID-19)

is among the easiest pathogens to destroy.

erarchy of Microorganism Resistance to ermal and Chemical Disinfection

OORGANISM	EXAMPLES
as	PrP responsible for Creutzfeldt-Jakob disease, mad cow disease, scrapie
erial spores	Geobacillus stearothermophilus, Bacillus atrophaeus, B. anthracis spores
idia	Cryptosporidium
obacteria	Mycobacterium tuberculosis, M. terrae, M. phlei, M. bovis
lipid or small es	Polio virus, Hepatitis A virus, MS-2 bacteriophage, coxsackievirus, norovirus, parvovirus, rhinovirus, adenovirus
i	Aspergillus niger, Candida albicans, Penicillium chrysogenum
tative eria	Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus pneumonia, E. coli, Salmonella spp., Enterococci
or medium- viruses	Human immunodeficiency virus (HIV), Hepatitis B virus, Influenza virus, Ebola filovirus, coronaviruses including SARS-CoV-2 virus

What disinfectants (and contact time) inactivate SARS-CoV-2?

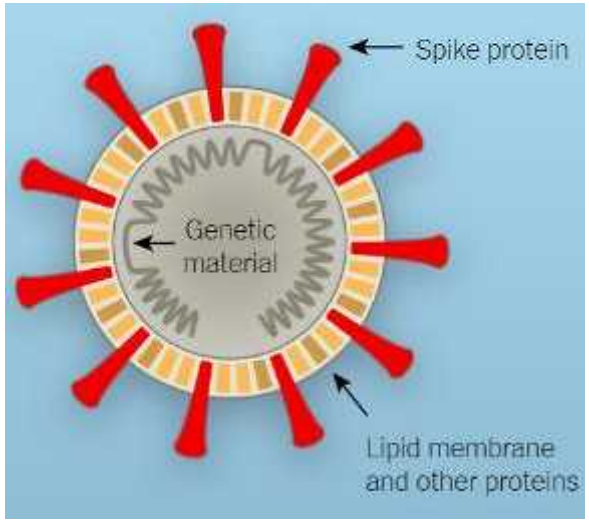
- **Chlorine (bleach or sodium hypochlorite)**
  - **1% and 2% bleach - within 5 minutes** [1]
- **Alcohol**
  - **70% ethanol - within 5 minutes** [1]
  - **50% isopropanol – about 10 minutes for coronaviruses** [2]
- **0.5% Hydrogen Peroxide – about 10 minutes for coronaviruses** [3]
- **Other Disinfectants** [1]
  - 7.5% povidone-iodine – within 5 minutes [1]
  - 0.1% benzalkonium chloride – within 5 minutes [1]
  - Chlorine dioxide, phenols, peroxyacetic acid [4]

1. Chin *et al.* *Microbe*, 2020
2. Saknimit *Jikken Dob* 1988.
3. WHO: Lab biosafety February
4. US EPA: Li Disinfecta Use Again CoV-2, up April 16, 2

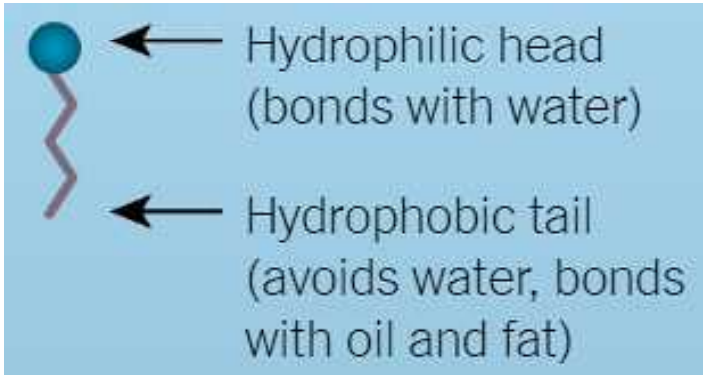
What disinfectants (and contact time) inactivate SARS-CoV-2?

Soap

- **Hand soap (about 2% in water) – some virus detected after 5 minute soaking, no virus detected after 10 minutes soaking** [1]



SARS-CoV-2 coronavirus

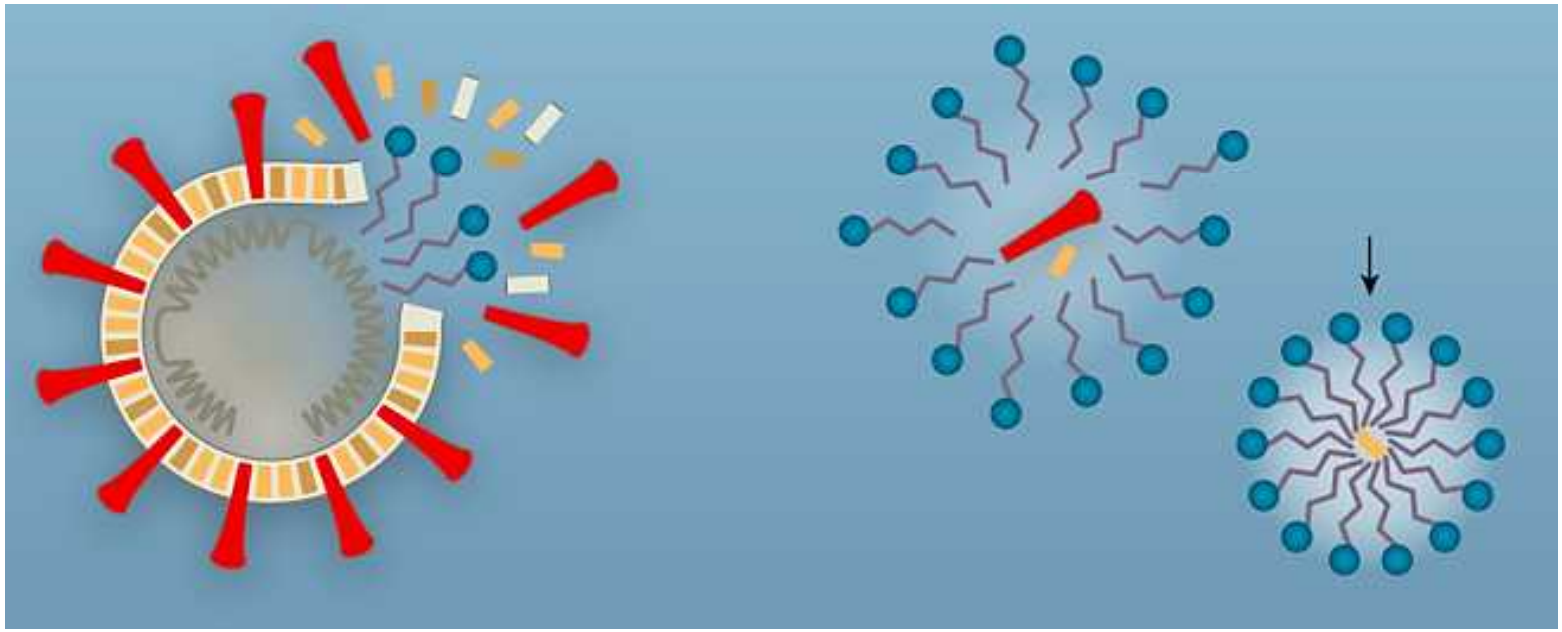


Typical soap molecule

1. A. Chin *et al.*, *L*
Microbe, April

What disinfectants (and contact time) inactivate SARS-CoV-2?

- **Soap**
  - **Hand soap (about 2% in water) – within 10 minutes of soaking**



Micelles trap remnants of the virus

At what temperature (and time) is SARS-CoV-2 inactivated?

Based on laboratory tests with the COVID-19 virus:

	TEMPERATURE	TIME
ool day	22 °C	Within 2 weeks
ot day	37 °C	Within 2 days
ot water	56 °C	Within 30 minutes
	70 °C	Within 5 minutes

A. Chin *et al.*, *Lancet Microbe*, April 2, 2020

If 70°C or 1% bleach inactivates CoV-2 in 5 minutes, then so will …

Any of the following medical waste treatment technologies [1, 2]

- **Gravity-Flow Autoclaves** that typically operate between 121°C to 149°C for 60 to 30 minutes
- **Vacuum Autoclaves** that typically operate at 121°C for 45 minutes or 135°C for 30 minutes
- **Hydroclaves** that fragment and sterilize at 121°C for 30 minutes
- **Microwave units** that typically operate at around 100°C for 30 minutes or more
- **Dry heat treatment systems** that typically operate at 185°C for 90 minutes
- **Chemical disinfection methods** with sodium hypochorite (bleach) or non-chlorinated chemical disinfectants

alidation: ≥ 4 Log kill of *Geobacillus stearothermophilus or Bacillus atrophaeus spo*

1. Bio-Medical Wa (Management a Handling) Rules MoEFCC, 2016.
2. Y. Chartier, J. En *et al.*, *Safe man of wastes from care activities*, 2014

o we need INCINERATION or PLASMA PYROLYSIS for OVID-19 waste?

Bio-Medical Waste Management Rules require incineration o plasma pyrolysis at 800°C + 1050°C or at >1200°C for :

Anatomical waste, pharmaceutical waste, and chemical waste

But this is overkill *and could worsen the situation* for bio-medical wastes that can be treated using autoclaves, microwaves, dry heat, chemical disinfection, etc.

Sharps, wastes contaminated with blood and body fluids, contaminated linens, microbiological cultures and stocks, contaminated recyclable waste, and contaminated glassware

Two Pressing Side Issues

Why could Incineration, Pyrolysis and Gasification of biomedical waste worsen the situation?

1. **Recent findings regarding emissions from incinerators, pyrolysis and gasification technologies**
   - Continuous monitoring of highly toxic dioxins/furans is essential protect public health but this is not required in India and most developing countries
2. **Very recent findings regarding toxic air pollutants from incineration, pyrolysis and gasification in relation to COVID-1**

Particulate Matter and COVID-19 Mortality

- **Particulate Matter (PM) limit for incineration/pyrolysis under Bio-Medical Waste Management Rule:**

  50 mg/Nm^3 (or 50,000 µg/Nm^3)

- **Particulate Matter and COVID-19 Mortality Rate:**

  "A small increase in long-term exposure to $PM_{2.5}$ leads to a large increase in the COVID-19 death rate."

  "… [A]n increase of only 1 µg/m^3 of $PM_{2.5}$ is associated with an 8% increase in the COVID-19 death rate …."

X Wu, RC Nethery, BM Sabath, D Braun, F Dominici. Exposure to air pollution and COVID-19 mortality in the United State
A nationwide cross-sectional study. medRxiv 2020.04.05.20054502; doi: https://doi.org/10.1101/2020.04.05.20054502

Some Best Practices: COVID-19 Waste Management

ollow basic standard procedures

- **Rigorous segregation at the point of generation** (separate infectious from non-infectious wastes in proper color-coded, marked bins)
- **Regular cleaning and disinfection** (disinfect surfaces of commonly touched items such as waste containers, trolleys, door handles, etc.)

rovide **personal protection equipment** (mask, face shield, heavy duty loves, long-sleeve gown and boots) to waste workers and train them in equent hand hygiene and **hand hygiene after PPE removal** [1]

se **environmentally sound treatment methods**

- Use autoclaves, microwaves, hydroclaves, dry heat systems, and other environmentally sound treatment methods where possible
- Follow validation procedures to ensure high level disinfection

1. WHO sanit hygie wast mana for C virus 2020

Some Best Practices: COVID-19 Waste Management

nvironmental Cleaning

- **Blood spills: 1% bleach** [1]
- **General surface cleaning: 0.5% or 0.1% bleach** [1,2]
- **General cleaning of non-critical items: 0.05% bleach for 10 minutes**
- **Washing of contaminated linen: soak in 0.05% bleach for 30 minutes** [2,3] **and then wash in soap and hot/warm water**

1. WHO: Laborat biosafety guid February 12, 2
2. WHO: Infectio prevention an of epidemic- a pandemic-pro respiratory inf 2014
3. WHO: Water, s hygiene and w management f 19 virus, Marc

IOTES regarding bleach (sodium hypochlorite):

- Organic matter such as body fluids can inactivate bleach.
- High concentrations can be corrosive to the eyes, skin and respiratory tract. Mixing with acids releases deadly chlorine gas.
- Bleach degrades with time, heat, and when exposed to the sun. Prepare fresh bleach solutions regularly.
- Spent or used bleach solutions can be used to disinfect toilets or clean-up blood spills. can be neutralized, left under the sun to decompose or otherwise properly disposed of

Some Best Practices: COVID-19 Waste Management

- Disposable PPE wastes (especially face masks and gloves) are now a major source of pollution on land and in the world's seas and oceans [1]

- Possible Solutions:
  - **Use reusable PPE masks** (elastomer respirators with replaceable cartridges, powered air-purifying respirators, etc.) &

Provide guidelines and training on proper disinfection, fit testing, and use of reusable respirators

PPE collected from the se

Reusable elastomer resp

E found in global seas and ocean (Opération Mer Propre, France); masks found off Hong Kong coasts (OceansAsia); masks a
oves floating and scattered across seabeds (Plastic Soup Foundation); a lot of PPE ending up in the ocean (The Ocean Found

o: Laurent Lombard/Opération Mer Propre video in The Guardian. Bottom photo: MSA Safety Company website

Some Best Practices: COVID-19 Waste Management

NOTES ON PPE REUSE FOR FRONTLINE HEALTH WORKERS

Respirators (including N95 facemasks) are recommended for use during **aerosol generating procedures and other high risk activities**. High filtration efficiency and fit testing to ensure facial seal are important.

Single-use “filtering facepiece respirators” (such as N95, N99, N100 in the US; FFP2 and FFP3 in Europe; KN95, KN99, KN100 in China; P2 and P3 in Australia, New Zealand and Brazil; or DS2 and DS3 in Japan) **CANNOT be treated for reuse** using bleach, soap & water, autoclaving, alcohol, etc. since they degrade the electret (surface charge essential for achieving high filtration efficiencies) and could degrade the non-woven polymer fibers of the mask.

Some treatment methods (e.g., vapor hydrogen peroxide, ultraviolet germicidal irradiation, dry heat) may allow decontamination and reuse of single-use N95 or FFP2 masks but only for a limited number of decontamination cycles.

Some Best Practices: COVID-19 Waste Management

- Other Possible Solutions:
  - **Provide guidelines on decontamination and safe reuse of other reusable PPE** (face shields, nitrile gloves, reusable gowns, cloth masks, etc.) and **training on proper disinfection, storage, and reuse.**
  - **Sample procedure for decontamination:**
    1. Soak in soap and hot/warm water (water temperature depends on material) for 30 minutes
    2. Rinse well
    3. Soak in 1% bleach for another 30 minutes
    4. Rinse to remove bleach
    5. Dry under the noon-day sun for two hours [1, 2]

eriments with SARS-CoV-2 in simulated saliva and culture medium showed that 90% of the virus was inactivated every 6.8 – utes under simulated sunlight. Ratnesar-Shumate *et al*. *J Infectious Diseases* 2020; Schuit *et al. J Infectious Diseases* 2020. oretical studies indicate a 90% infectivity reduction of SARS-CoV-2 under the noon day sun in 11 minutes and 99% inactivati rs for Mumbai, India. Sagripanti and Lytle. *Photochemistry and Photobiology* 96: 731-737, 2020.

I hope this information has been useful.

Stay safe.