

## A Protocol for Safe-handling of Remains and Wastes of COVID–19 Patients

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**[Abstract]** The ongoing coronavirus disease-2019 (COVID-19) pandemic has raised significant public health issues which need to be attended. To ensure the containment of various aspects of the pandemic, standard operative procedures (SOPs) are required to enable efficient handling of the situation by the healthcare professionals. Emerging evidence suggest high infectivity of the novel coronavirus strain—severe acute respiratory syndrome virus-2 (SARS-CoV-2)—causing COVID-19. The remains and wastes of COVID–19 patients can be a potential source of the virus exposure to the healthcare professionals if not get handled with adequate precaution. Various institutions have issued SOPs in this regard, but those are deficient in a comprehensive approach hence causing difficulty in interpretation and application. We have developed a comprehensive protocol for disposal of remains and wastes of the COVID-19 patient which we are following at our institution without any untoward event until date.

**Keywords:** COVID-19, SARS-CoV-2, Dead body, Waste management, Guidelines, Safe-disposal

**[Background]** Handling and disposal of the remains of the dead during the ongoing pandemic of coronavirus disease-2019 (COVID-19) is one of the most important and demanding aspect for the health care systems globally. COVID-19 is caused a novel coronavirus strain (a positive sense single stranded RNA virus)—severe acute respiratory syndrome virus-2 (SARS-CoV-2). Emerging evidence suggest that SARS-CoV-2 has high infectivity (Atkinson and Petersen, 2020). The remains and wastes of COVID–19 patients can be a potential source of the virus exposure to the healthcare professionals hence should be handled with adequate precaution. It is important as the health care system has to ensure that the dead body of a COVID-19 patient should not become a source of the infection, and demanding because of the varied religious beliefs and cultural practices that are associated with the way of disposing the dead body around the globe. In order to enable efficient handling of the remains and wastes of COVID-19 patients by the healthcare professionals, a stepwise protocol of standard operative procedures (SOPs) is essential. The emphasis should be on making the SOPs comprehensive enough for easy interpretation and application.

A recent report (Sriwijitalai and Wiwanitkit, 2020) regarding the death of a forensic practitioner working in Bangkok, Thailand after contracting the virus from dead COVID-19 patient indicated the risk of transmission of the virus via dead bodies. This has called for a protective protocol for handling the remains and wastes of the COVID-19 patients. Institutions like WHO (World Health Organization), CDC (Centers for Disease Control and Prevention, USA), Department of Health of different governments country wise (such as Ministry of Health and Family Welfare, MoHFW, Government of India; Department of Health, Hong Kong), *etc.* have laid down the protocols regarding the handling and disposal of the dead during COVID-19 (References 3-6). Though these protocols do elaborately explain the procedure for the same but are often difficult to interpret and hence the application becomes inconvenient.

Here we have provided a set of instructions to be carried out in a sequential manner for handling of remains and wastes of the COVID-19 patients providing additional details for precautions and safety measures, protecting gears and disinfecting materials. This protocol will help healthcare professionals taking quick on-spot decisions and avoiding exposure risks while handling the remains and wastes of COVID-19 patients.

### **Materials and Reagents**

1. Liquid Soap
2. Water
3. 70% ethyl alcohol
4. EPA (United States Environmental Protection Agency) registered disinfectant<sup>7</sup> (such as Sodium hypochlorite 1%)

### **Equipment**

1. Personal protective equipment (PPE) which includes
  - a. Nitrile gloves
  - b. Water resistant gown/ plastic apron over water repellent gown
  - c. Surgical mask
  - d. Full length cover shoes/ boots
  - e. Goggles or face shield to protect eyes from the splashes
2. Measuring container
3. Plastic sheets for wrapping the body of the deceased
4. Zipper closed leak-proof transparent plastic bag (150 µm thick)
5. Tags
6. Gauge pieces
7. Spray bottle
8. Colored Bins (Yellow, Red, White, Blue)
9. Non chlorinated plastic bags (Yellow, Red)

10. Translucent, puncture, leak & tamper proof White bags
11. Blue water proof card board boxes/ containers
12. Incinerator
13. Industrial micro-wave/ hydroclave/ shredder

## **Procedure**

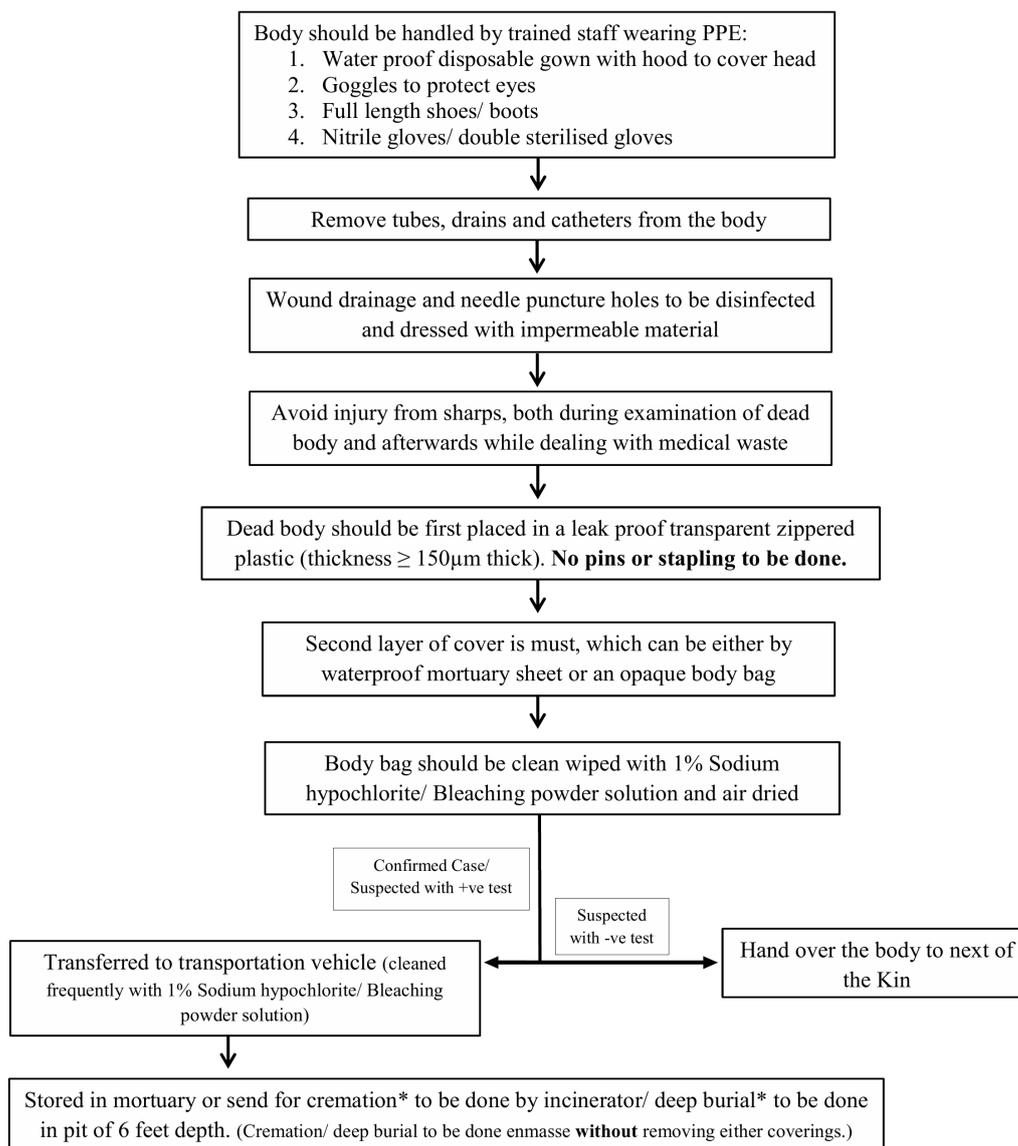
- A. Handling of the dead body by health care professionals (Tables 1-2) (Figure 1):

**Table 1. General recommendation for all persons handling the dead body of COVID – 19 patients**

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|--|
| 1. Body should be handled by trained staffs while maintaining high standard of personal hygiene such as washing hands with liquid soap and water or proper use of alcohol-based hand rub   |
| 2. Use of personal protective equipment (PPE) which includes: <ol style="list-style-type: none"> <li>a. nitrile gloves,</li> <li>b. water resistant gown/ plastic apron over water repellent gown,</li> <li>c. surgical mask,</li> <li>d. fool length cover shoes/ boots,</li> <li>e. use goggles or face shield to protect eyes from splashes</li> </ol>  |
| 3. No smoking, drinking or eating and No touching of your eyes, mouth or nose.   |
| 4. Avoid injury from sharps, both during examination of dead body and afterwards while dealing with waste disposal and decontamination.  |
| 5. Remove PPE after handling of the dead body and wash hands with liquid soap and water immediately.   |
| 6. In case of percutaneous injury or mucocutaneous exposure to blood or body fluids of the dead body, the injured or exposed areas should be washed with running water and soap for several minutes and inform your supervisor for prophylactic treatment and quarantine.  |
| 7. Clinical waste and its management are to be done according to the bio medical waste management criteria.  |
| 8. All the surfaces that came in contact with the patient, soiled linen and waste materials, along with the reusable equipment are to be disinfected by 70% ethyl alcohol for small areas – reusable dedicated equipment (e.g., thermometers) or Sodium hypochlorite at 1% for surface disinfection. Bodily fluids and blood stained wastes are to be first disinfected with Sodium hypochlorite at 1%, and then disposed as per bio medical waste management rules. |

**Table 2. Group specific guidelines for disposal of dead body of COVID – 19 patients**

	<b>Health Care Professionals (HCP)</b>	<b>Mortuary Staff</b>	<b>Funeral Workers</b>
<b>Personnel protection and cleaning of the dead body</b>	PPE should be properly put on by the staff handling the body	Autopsies or embalming of dead bodies of COVID - 19 patients expose staff to unwarranted risk and should generally be prohibited. In case autopsy is essential medico-legally, it should be done under strict precautionary measures as specified by concerned institutional guidelines.(Reference 4)	PPE should be properly put on by the staff handling the body
	Tagging the body for identification as infectious		Avoid direct contact with blood or body fluids from the dead body
	Removal of tubes, drains and catheters from the body		
	Wound drainage and needle puncture holes to be disinfected and dressed with impermeable material.		
	Body should be cleaned and dried		
<b>Dead body packaging for transport</b>	The dead body should be first placed in a leak-proof transparent plastic bag (150 µm thick) and zipper closed. NO pins or stapling to be done.		The body should not be exposed out of the double layer covering for viewing
	A second layer of cover is required, which can be either a wrapping with a mortuary sheet or placing the body in an opaque body bag.		
	The body bag should be cleaned with 1% Sodium Hypochlorite solution or bleach and then air dried.		
	Remove and dispose the PPE in container with lids marked for solid waste as per bio-medical waste disposal rules, and sanitize hands with water and soap.		Remove and dispose the PPE in container with lids marked for solid waste as per bio-medical waste disposal rules, and sanitize hands with water and soap.



\* Cremation/ deep burial of Covid 19 patients should be done by authorities in presence of the kin.

# Clean all the surfaces that came in contact with dead body with 1% Sodium Hypochlorite/ Bleaching powder solution

**Figure 1. Flowchart for steps of handling dead bodies of Confirmed/ Suspected COVID-19 patients**

1. Body is to be handled by trained staffs after maintaining high standard of personal hygiene by washing hands with liquid soap and water or proper use of alcohol-based hand rub
2. Donning of the personal protective equipment (PPE) is to be done in following sequence (Reference 8):
  - a. Perform hand hygiene by washing hands with soap and water for 60 s or rubbing hands with alcohol based hand rub for 30 s

- b. Put on the gown covering your feet and head
  - c. Put on shoe covers
  - d. Wash your hand with soap and water for 60 s or rubbing hands with alcohol based hand rub for 30 s
  - e. Put on the mask
  - f. Put on eye protection gears
  - g. Put on the gloves
3. Prepare 3 liter solution of EPA registered disinfectant (Reference 7) (such as 1% Sodium hypochlorite solution is prepared by mixing 2700 ml of water with 300 ml of stock Sodium hypochlorite) with the help of measuring container and transfer the solution in a spray bottle.
  4. Shift the body on a plastic sheet big enough to wrap the body (dimensions = 7 \* 6 feet)
  5. Remove the tubes, drains and catheters from the body of the deceased and close the puncture sites with the help of rubber or plastic adhesive tape in order to prevent any leakage.
  6. Pack the nostrils and oral orifice with gauge piece.
  7. Spray the entire body with 1% Sodium hypochlorite and wait for it to dry.
  8. Now, wrap the body in the plastic sheet sealing the same with adhesive plastic tape (remember, no stapling or pinning is to be done to avoid puncturing the sheet leading to leakage)
  9. Spray the wrapped sheet with 1% Sodium hypochlorite and wait for it to dry.
  10. Transfer the wrapped body in a zipper closed leak-proof transparent plastic bag (150 µm thick)
  11. Spray the plastic bag with 1% Sodium hypochlorite and wait for it to dry.
  12. Body bag should be tagged which should bear name, age, sex, address and COVID-19 test status of the deceased.
  13. Now, transfer the body with the bag on the transportation vehicle on its way to the mortuary.
  14. Doffing of the personal protective equipment (PPE) is to be done in following sequence (Reference 8):
    - a. Remove the gloves
    - b. Remove the gown
    - c. Perform hand hygiene by washing hands with soap and water for 60 s or rubbing hands with alcohol based hand rub for 30 s
    - d. Remove the eye protective gear
    - e. Remove the mask
    - f. Perform hand hygiene by washing hands with soap and water for 60 s or rubbing hands with alcohol based hand rub for 30 s
  15. Dispose the PPE in container with lids marked for solid waste as per bio-medical waste disposal rules, and sanitize hands with water and soap.
- B. Handling of the body by mortuary staff (Table 2):
1. Staff at the mortuary should wear disposable surgical cap, mask, gown, gloves and shoe cover while handling the dead body brought in sterilized body bag.

2. The mortuary cooler cabin (to be maintained at 4° Celsius) where the body of the deceased brought in the body bag is to be kept should also be tagged with identifying facts of the deceased to prevent any misadventure.
3. Autopsies or embalming of the dead bodies of COVID-19 patients may expose staff to unwarranted risk hence should be prohibited. In case autopsy is essential medico-legally, it should be done under strict precautionary measures (Reference 4; Hanley *et al.*, 2020).
4. While returning the body to next of the kin after test results (for viral RNA) are reported, one must ensure that correct body is being handed over and to the authentic kin.
5. If the test result is positive for the viral RNA (testing of each case should be done at least twice by the independent centres before declaring the patient positive) then inform the concerned authorities for maintaining the data and also to ensure that the body bag remains unopened until being cremated or buried.

C. Handling of the body at Funeral homes/ Cremation/ Burial site (Table 2):

1. The transportation to the funeral place in confirmed positive cases should be done under supervision of government officials, and only trained staff should handle the dead body at the crematorium/ or burial ground.
2. If the deceased is COVID-19 positive, then the body should be cremated or buried in the presence of government officials to ensure that the relatives have not opened the bag at any time during the transit or have handled the body without taking precautionary measures.
3. If the deceased is COVID-19 positive, the body bag can be opened just enough as to visualize the face to the relatives watching from at least 2 meter distance and the staff should be wearing the full personal protective equipment (PPE) as being explained previously.
4. If the deceased is COVID-19 negative, then the body can be handled by the relative and the last rites can be performed as per will or religion of the deceased.
5. Dispose the PPE in container with lids marked for solid waste as per bio-medical waste disposal rules (References 10-12), and sanitize hands with water and soap.

D. Handling and disposal of the waste generated while caring a COVID–19 patient (References 10-12) (Table 3):

**Table 3. Biomedical wastes categories with their collection, packaging, treatment, processing and disposal options (References 10-12)**

Colour coding (Type of bag/container)	Type of waste	Treatment disposal options
<b>Yellow (Non chlorinated color coded bags in colored bins)</b>	Anatomical waste (Human tissue) Solid waste (Items contaminated with blood, and body fluids including cotton swabs, dressings, soiled plaster casts, disposable gowns, caps, bags containing residual or discarded blood and blood components, discarded linen, mattresses, beddings)	Incineration/deep burial* (deep burial is permitted only in rural or remote areas where there is no access to common bio-medical waste treatment facility)
<b>Red (Non chlorinated plastic bags in coloured bins/containers)</b>	Contaminated Waste (Recyclable) Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and fixed needle syringes) and vaccutainers with their needles cut) and gloves	Autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to landfill sites
<b>White (Translucent, puncture, leak &amp; tamper proof)</b>	Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and contaminated metal sharps	Autoclaving or Dry Heat Sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete; combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State Pollution Control Boards or Pollution Control Committees) or sanitary landfill or designated concrete waste sharp pit
<b>Blue (Water proof card board boxes/containers)</b>	Glassware waste - Broken or discarded and contaminated glass including medicine vials and ampoules	Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium Hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.

1. The wastes are categorized and color coded into solid (yellow); liquid; contaminated waste (recyclable -red and non – recyclable - yellow); waste sharps – white/translucent and glassware wastes - blue.
2. The liquid waste is to be treated with EPA registered hospital disinfectant and discharged into drains.

3. Solid wastes comprising of human tissues, items contaminated with blood of the patient, and body fluids including cotton swabs, dressings, soiled plaster casts, and disposable caps, masks, gowns, and shoe cover, bags containing residual or discarded blood and blood components, discarded linen, mattresses, beddings are to be kept in non-chlorinated yellow plastic bags inside yellow colored bins. This categorical waste is to be disposed by incineration (or deep burial is permitted only in rural or remote areas where there is no access to common bio-medical waste treatment facility).
4. Contaminated waste which are recyclable i.e. wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and fixed needle syringes) and vacutainers with their needles cut and gloves are to be kept in non-chlorinated red plastic bags inside red colored bins. These are disposed of by autoclaving or micro-waving or hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste is to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible.
5. The translucent, puncture, leak & tamper proof white colored bags in white colored bins are used in keeping needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes used, discarded and contaminated metal sharps. These are disposed by autoclaving or dry heat sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete; combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State Pollution Control Boards or Pollution Control Committees) or sanitary landfill or designated concrete waste sharp pit.
6. Glassware waste such as broken or discarded and contaminated glass including medicine vials and ampoules are kept in blue colored water proof card board boxes/containers which is then disposed of by disinfection by soaking the washed glass waste after cleaning with EPA registered disinfectants (Reference 7) (such as detergent and 1% Sodium Hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.
7. Plastic waste should not be sent to landfill sites.
8. All the containers and bins are to be marked with the universal biohazard symbol (Figure 2).



**Figure 2. Bio-hazard Symbol** (Reference 10)

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## **Competing interests**

Authors declare there are no competing interests. No funding was received for this work.

## **Ethics**

Ethical issues related to disposal of human remains and wastes in a hospital setting were considered during preparation of this protocol.

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