A review of the management and safe handling of bodies in cases involving COVID-19

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Abstract
Wuhan Municipal Health Commission, China, reported a cluster of cases of 'pneumonia of unknown aetiology' in Wuhan, Hubei province in late 2019. The causative organism was eventually identified as a novel coronavirus. Subsequently, the disease spread to more provinces in China, then the rest of the world, and the World Health Organization declared it a pandemic. The virus was named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and the disease was termed COVID-19 (Coronavirus disease). Since then, an increasing number of people have succumbed to this infectious disease. High contagiousness and rapid spread of the disease has been a matter of concern, as it may overburden healthcare systems. Hence, it is vital to implement strict infection prevention and control measures to curb the spread of the disease. This article reviews the guidelines available for the handling of bodies of deceased persons with suspected or confirmed COVID-19, and for their safe disposal. It also provides a summary of recommendations for conducting autopsies in cases where COVID-19 is suspected.

Keywords
Dead body management, COVID-19, autopsy, dead body disposal, funeral guidelines

Introduction
Coronavirus disease (COVID-19) is an infectious disease which was first reported by Wuhan Municipal Health Commission, China, at Wuhan, Hubei province in late 2019. The aetiological agent responsible was termed as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). Globally, as of 8 June 2020, 6,931,000 confirmed cases of COVID-19 including 400,857 deaths have been reported to the World Health Organization (WHO). Among them, the highest number of confirmed cases has been recorded in the United States of America, amounting to 1,915,712. In India, the total confirmed cases are 256,611 and deaths reported are 7135. The case fatality rate for COVID-19 is reported to range from 2 to 7%. As the case fatality rate is dependent on the proportion of deaths from a particular disease compared with the total number of people diagnosed with the disease for a certain period, the above-quoted values must be interpreted with caution. In countries where extensive screening has been performed in the whole population, overall case fatality rates of less than 1% have been reported because the denominator included many mild or asymptomatic cases. However, in countries where only people requiring hospital admission are screened, case fatality rates have exceeded 5%, because the denominator is much smaller. With an increasing number of deaths being recorded due to this pandemic, the International Committee of the Red Cross has indicated that deaths caused by COVID-19 could overwhelm local capacity to properly handle dead bodies. It suggested that to overcome this risk, proper preparation and planning is essential so that the dignity of the deceased and surviving family is respected. While handling mortal remains of COVID-19 cases, balancing the rights of the family and infection prevention and control measures is a crucial factor. This article is a narrative review of the
currently available guidelines for the safe handling and management of dead bodies in cases involving COVID-19 based on our current understanding of the disease.

**Fundamental principles for the management of death related to COVID-19**

1. The safety and wellbeing of the staff involved in managing the dead from COVID-19 should be of paramount importance. Hence, implemented protocols should adhere to the advice and latest recommendations from national health authorities and international health organizations, particularly the WHO.
2. To ensure the protection and respect for deceased individuals and their families.
3. To establish the reliable identification of the dead, failing which their proper documentation and traceability are essential for making their future recovery and identification possible.
4. The management of the dead from COVID-19 should not impede the medicolegal investigation of death whenever required by the authorities.

**Transmission risk due to handling of bodies with suspected or confirmed COVID-19**

There is no evidence so far of transmission of SARS-CoV-2 through the handling of bodies of deceased persons. Although a case of COVID-19 has been reported in a forensic practitioner working in Bangkok, capital of Thailand, there is no scientific confirmation of disease transmission from the corpse. According to the current evidence, COVID-19 virus is primarily transmitted between people through respiratory droplets and contact routes. In an analysis of 75,465 COVID-19 cases in China, airborne transmission was not reported. Airborne transmission is different from droplet transmission as it refers to the presence of microbes within droplet nuclei, which are generally considered to be particles <5 μm in diameter, that can remain in the air for long periods and be transmitted to others over distances greater than 1 m. In the context of COVID-19, airborne transmission may be possible in specific circumstances and settings in which procedures or support treatments that generate aerosols are performed. As this is a new virus whose source and disease progression are not entirely clear, more precautions may be necessary until further information becomes available.

The potential risk of transmission related to the handling of bodies of deceased persons with suspected or confirmed COVID-19 is considered low, and can be related to:

- direct contact with human remains or bodily fluids where the virus is present.
- direct contact with contaminated fomites.

As studies have suggested that the human coronaviruses can remain infectious on inanimate surfaces at room temperature for up to 9 days, there is a possibility that the virus also persists on deceased bodies. Therefore, safety precautions must be adhered to while handling such dead bodies.

**Guidelines on the use of personal protective equipment (PPE)**

PPE is protective gear intended to safeguard health by minimizing exposure to a biological agent. Components of PPE include goggles, face shields, masks, gloves, coverall/gowns (with or without aprons), head-covers and shoe covers.

PPE for the care of the deceased during the COVID-19 pandemic is listed in Table 1, which is adapted from the guidelines formulated by Department of Health and Social Care, Public Health Wales, Public Health Agency (PHA) Northern Ireland, Health Protection Scotland and Public Health England.

The PPE to be used is based on the risk profile of the healthcare worker. As per the guidelines issued by the Ministry of Health and Family Welfare, Government of India, dead body handling in the mortuary is considered to pose a moderate risk; hence wearing an N95 mask and gloves is recommended. To perform an autopsy, which is a high-risk procedure, it is advisable to wear a full complement of PPE. For transporting dead bodies, wearing a triple-layer mask and gloves would suffice. A triple-layer medical mask is a fluid-resistant disposable mask protecting the wearer from droplets of infectious material. An N95 respirator mask is a respiratory protective device with high filtration efficiency to airborne particles. The filtration capacity of these masks exceeds those of triple-layer medical masks. As these provide a much tighter air seal than triple-layer medical masks, they are designed to protect the wearer from inhaling airborne particles.

Medical masks/respirators such as FFP2, FFP3 or N95 can be used without removal for up to 6 h while caring for a group of patients with COVID-19; however, extended use may increase the risk of contamination with COVID-19 virus and other pathogens. They need to be replaced if they become wet, soiled or damaged, or if they become difficult to breathe through. If the mask is exposed to the splash of chemicals, infectious
substances or body fluids, or if it is displaced from the face, or if the front of the mask is touched to adjust it, it needs to be changed. Medical mask reprocessing is not advised. Respirators could be reprocessed using methods such as hydrogen peroxide vapour, ethylene oxide or UV radiation lamps; however, these methods are not validated. If cotton gowns are used by health workers, they can be reprocessed by machine washing with hot water (60-90°C) and laundry detergent. If machine washing is not possible, linen can be soaked in hot water and soap in a large drum, and stirred using a stick to avoid splashing. The linen then needs to be soaked in 0.05% chlorine for approximately 30 min. Finally, it should be rinsed with clean water and dried in sunlight. The use of plastic aprons or disposable laboratory coats is not recommended for aerosol-generating procedures. Goggles and face shields can be reused after cleaning using soap or detergent and water, followed by disinfection using either sodium hypochlorite 0.1% or 70% alcohol wipes.14

Guidelines for packing and transfer of the body from the isolation room, ward or other settings to a mortuary, crematorium or burial ground in non-autopsy cases

Personnel who interact with the body (e.g. healthcare or mortuary staff, or the burial team) are required to apply standard precautions, including hand hygiene before and after interaction with the body and the environment, and use appropriate PPE according to the level of interaction with the body.10

All tubes, drains and catheters on the body must be removed. Any puncture holes or wounds (e.g. resulting from the removal of the catheter, drains, tubes, or otherwise) are disinfected with 1% hypochlorite and dressed with impermeable material. It is essential to plug the oral and nasal orifices of the body to prevent the leakage of body fluids. If the family of the deceased wishes to view the body at the time of removal from the isolation room or area, they may be allowed to do so with the appropriate standard precautions.15

As per the guidelines issued by the WHO,10 there is no need to disinfect the body before transfer to the mortuary area; also, body bags are not necessary. However, they may be used for other reasons, for instance, if there is excessive body fluid leakage. However, as per the guidelines issued by the Ministry of Health and Family Welfare of the Government of India,15 the body needs to be placed in a leak-proof plastic body bag. The exterior of the body bag has to be decontaminated with 1% hypochlorite. The body bag is then wrapped with a mortuary sheet, or a sheet provided by family members. The body is then either handed over to the relatives or taken to the mortuary.

If zipped body bags as described are not available, the body can be wrapped in a minimum of two layers of thick, leak-proof plastic sheets, secured with adhesive tapes.16

All used or soiled linen should be put in a bio-hazard bag, and the outer surface of the bag disinfected with hypochlorite solution. Used equipment should be autoclaved or decontaminated with disinfectant solutions as per established infection prevention control practices. All medical waste must be handled and disposed of following biomedical waste management rules.15

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### Table 1. Personal protective equipment (PPE) for the care of the deceased during COVID-19 pandemic.

| Personal protective equipment (PPE) | Low-risk Procedures*: | Medium-risk Procedures**: | High-risk Procedures: Autopsy/Other invasive procedures |
|-----------------------------------|-----------------------|--------------------------|----------------------------------------------------------|
| Disposable gloves                 | Yes                    | Yes                      | Yes                                                      |
| Disposable plastic apron          | Yes                    | Yes                      | Yes                                                      |
| Disposable eye protection         | Yes                    | Yes                      | Yes                                                      |
| Shoe/shoe protection (ideally boots that can be easily disinfected) | Yes | Yes | Yes |
| Disposable gown                   | No                     | No                       | Yes                                                      |
| Fluid-resistant (Type IIR) surgical mask (FRSM) | No | No | No |
| Filtering face piece respirator (FFP)** | No | FFP2 or FFP3 | FFP3 |

*If procedure likely to cause droplet contact, use medium-risk procedure
**If procedure likely to generate aerosols, use high-risk procedure
***ECDC (European Centre for Disease Prevention and Control) recommends the use of FFP3 masks for performing aerosol-generating procedures. In case of shortage of Class 3 respirators, the use of Class 2 respirators (e.g. FFP2) may be considered, on a case-by-case basis and after assessing the risks of the procedures required.
Guidelines in the context of unidentified bodies infected with COVID-19

Personnel involved in the examination and identification process of human remains known or believed to be infected with COVID-19 are required to wear appropriate PPE. Remains infected with COVID-19 may pose a cross-contamination hazard to unprotected people, hence visual recognition by next of kin should be strictly controlled and should abide by the necessary precautions to be taken, including the wearing of PPE. In the case of unidentified and unknown dead bodies, samples – i.e. facial and multiple body photographs, fingerprints of both hands, scalp hair with the root by extraction by forceps including the hair bulb for DNA analysis – should be preserved for later identification.

Embalming bodies infected with COVID-19

The WHO states that embalming is not recommended to avoid excessive manipulation of the body. At the same time, some jurisdictions have identified that it can be accomplished with the appropriate use of infection prevention and control precautions (including PPE) and avoiding aerosol-generating procedures at all times during the embalming process.

Environmental cleaning and disinfection

Environmental surfaces, where the body infected with COVID-19 was prepared, should first be cleaned with soap and water, or a commercially prepared detergent solution. Surface disinfection with 0.1% sodium hypochlorite with the contact time of 30 min or 62–71% ethanol significantly reduces coronavirus infectivity on surfaces within 1 min exposure time. It is expected to have a similar effect against the SARS-CoV-2.

Personnel should use appropriate PPE, including respiratory and eye protection, when preparing and using the disinfecting solutions, and items classified as clinical waste must be handled and disposed of appropriately according to legal requirements.

COVID-19: Funeral guidelines

As per the WHO directive, people who have died with COVID-19 can be buried or cremated. Family and friends may view the body after it has been prepared for burial, as per their religious customs. However, they should not touch or kiss the body and should wash their hands thoroughly with soap and water after viewing. Those tasked with placing the body in the grave, or funeral pyre, should wear gloves and wash hands with soap and water after removal of the gloves once the burial is complete.

Public health recommendations on physical distancing, including avoiding common greeting practices such as hugging and handshakes, apply during funerals and visitation services too. Public Health Agency of Canada recommends a 2-m distance for those observing the preparation of the body, higher than the 1-m minimum suggested by the WHO. Individuals under isolation or quarantine and those who are at high risk of contracting the infection such as children, older people (>60 years old), and anyone with underlying illnesses (such as respiratory illness, heart disease, diabetes, or compromised immune systems) should take measures to ensure that they are physically distancing, or avoid attending the funeral services. Alternatively, death care providers should consider the use of virtual technologies (e.g. telephone, video conference and video recordings) in place of in-person services and gatherings. These technologies allow for broader inclusion and participation, thus improving the bereavement process.

Psychosocial considerations associated with death due to COVID-19

Psychologically, the disease can have a tremendous impact on bereaved families, as the time available before cremation is reduced and the number of family members able to attend the funeral is restricted. Insufficient knowledge about how the disease is transmitted and how infection can be prevented has led to the stigmatization of victims and their families, to such an extent that opposition to the burial of the COVID-19 victims has been reported.

Repatriation of dead bodies infected with COVID-19

Given the global public health response to COVID-19, there are currently very few flights available to transport human remains because of travel restriction policies practised within countries affected by the pandemic. As per the Canadian guidelines, human remains identified as those that have died with COVID-19 can be safely repatriated to Canada. In all cases, appropriate documentation must be received with the remains. Two options for repatriation of remains exist for people who were suspected or confirmed to have had COVID-19:

1. the body is cremated, or
2. the body is transported in a hermetically sealed container.
If the remains have been cremated or are transported in a hermetically sealed container, no additional infection prevention and control measures, including PPE, is required by the transportation staff. A screening officer must inform a quarantine officer if there are reasonable grounds to suspect that the human remains arrive in a damaged state (e.g. the hermetic seal appears broken, the container has been damaged, or appears to have been compromised). Quarantine officers and screening officers should follow standard procedures for handling repatriated remains of a person presenting with a communicable disease.19

**Autopsy in suspected COVID-19 cases**

Micro-organisms are classified into four hazard groups by the Advisory Committee on Dangerous Pathogens (ACDP) based on pathogenicity to humans, the risk to laboratory workers, transmissibility to the community and whether effective prophylaxis is available.22SARS-CoV-2 has been categorized as an HG3 (Hazard group 3) organism. Other viruses within HG3 include rabies, poliovirus, dengue virus, hepatitis virus B, C, D and E, HIV 1 and 2.23

The team performing these post-mortem examinations should ideally include the pathologist, the anatomic pathology technician and a circulator. The presence of a circulator is beneficial but not essential. The circulator assistant carries out auxiliary tasks such as sample labelling. Suitably experienced autopsy pathology trainees (as assessed by senior staff) may be involved in HG3 autopsies with adequate supervision. No specific infection risk to pregnant trainees has been identified; however, they may decide not to undertake autopsy work. Using PPE is vital in such autopsies. Typical surgical masks are not considered to provide sufficient protection. Valved fold-flat and moulded protection masks are over 95% effective and are suitable for use in anticipated COVID-19 cases. Whole-body suits with individual respirators seem to provide almost complete protection, although these are impractical and not necessary.24

Adequate ventilation is needed where HG3 autopsies are being performed, with enough separation from the rest of the mortuary. Natural ventilation with at least 160 l/s/patient airflow or negative pressure rooms with at least 12 air changes per hour (ACH) and controlled direction of airflow when using mechanical ventilation is a requirement.25

Whole-room ventilation or down-drafts at work stations are acceptable, and the following universal precautions in autopsy dissection practice must be practised:26

- Round-ended scissors and PM 40 blades with blunted points should be used to minimize the risk of prick injuries, and a single practitioner should be operating within the body cavity at any given time.
- Unfixed organs must be held firm on the table and sliced with a sponge. Care should be taken to protect the hand.
- An oscillator saw with suction extraction of the bone aerosol into a removable chamber should be used for sawing the skull; alternatively, a hand saw with a chain-mail glove may be used.
- Needles should not be re-sheathed after fluid sampling. Needles and syringes should be placed in a sharps bucket.
- It is essential to have all necessary equipment to hand, to avoid the need to leave the area to find additional items.

To reduce aerosol-generating procedures during an autopsy, the use of containment devices is recommended whenever possible (e.g. biosafety cabinets for the handling and examination of smaller specimens). High-pressure water sprays should not be used, and if the intestine needs to be opened, this should be done under water.27

If the autopsy is being performed for suspected COVID-19 case, the recommended post-mortem specimen for testing is to collect nasopharyngeal swab and lung swab from each lung. If the diagnosis of COVID-19 was established before death, collection of these specimens for COVID-19 testing may not be necessary. The specimens need to be stored at 2–8°C for up to 72 h after collection. If a delay in testing or shipping is expected, specimens need to be stored at −70°C or below.28

Formalin-fixed and formalin-fixed paraffin-embedded tissue specimens, obtained at autopsy, can be used to establish a post-mortem diagnosis of COVID-19 infection by using immunohistochemical and molecular techniques. The collection of fixed tissues can be particularly important when conventional swab-based testing methods are not available or have provided inconclusive results. A minimum of three representative sections of the lung parenchyma – preferably from different locations – and a minimum of two sections of the airway, to include trachea, bronchi, or both airways should be collected. Tissues collected should be of 5 mm thickness and should be placed in 10% buffered formalin, in a volume that is approximately 10 times greater than the volume of tissue for 3 days for optimal fixation. Serologic tests for SARS-CoV-2 look for the presence of antibodies. It typically takes 1–2 weeks after COVID-19 illness onset for antibodies to develop; in some people this may take longer. Per FDA guidance, antibody tests have not been validated for
diagnosis of COVID-19 infection, and antibody tests by themselves are of limited value in the immediate diagnosis of a patient where COVID-19 infection is suspected.28

One of the effects of the pandemic on medicolegal work, as reported in Italy, is that within 2 months of the outbreak, medicolegal autopsies drastically decreased by 70%. There are a number of possible reasons for this; for example, the system is generally under pressure, there is a lack of protective equipment in some cases, and forensic autopsy rooms may be inadequate and unable to guarantee sufficient negative pressure or other fundamental prerequisites for the safeguard of environmental and operator health.29

Full medicolegal autopsies are therefore not being performed, except in extreme circumstances, and frequently with targeted dissection and percutaneous sampling of fluids, as described in several protocols from across the world.16,29

Conclusion
This article has reviewed the available guidelines for the safe management of bodies infected with COVID-19, to aid body-handlers who are expected to come into contact with them. The guidelines discussed are based on our current understanding of COVID-19 and may change as more information about the disease becomes available. The awareness of the general public regarding safe handling practices will go a long way in preventing and addressing social stigma associated with COVID-19.

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