Coronavirus Pandemic

Workplace safety concerns in medico-legal death investigations related to COVID-19

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Abstract

The personnel involved in the management of COVID-19 affected dead bodies, including law enforcement personnel at the scene of crime, personnel involved in transportation of the dead bodies, forensic practitioners, autopsy pathologists, mortuary personnel, as well as the family members of the dead, etc. are at risk of exposure to SARS-CoV-2 infection. Post-mortem examination is a high-risk procedure, considering that it involves aerosol generating procedures, and exposure to body fluids. The safety of the forensic practitioners and support staff in the management of suspected or confirmed COVID-19 deaths hence, is of extreme importance, especially in the absence of pre-autopsy testing for COVID-19 and due to non-availability of adequate first-hand medical history of the deceased. This communication aims to highlight the current practices and advises certain guidelines in ensuring occupational health and safety in view of these risks in medico-legal death investigations.

Key words: SARS-CoV-2; COVID-19; autopsy; death investigations; occupational health and safety; mortuary.


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Introduction

The novel coronavirus, SARS-CoV-2 (Severe acute respiratory syndrome coronavirus 2) is responsible for the COVID-19 (Coronavirus Disease 2019) which causes severe respiratory illness. As of 16:00 CET on 4 November 2020, SARS-CoV-2 has caused 79,232,555 infections and 1,754,493 deaths globally [1]. The Advisory Committee on Dangerous Pathogens of the British Government has classified SARS-CoV-2 as a Hazard Group 3 (HG3) pathogen, capable of causing serious illness to humans, with potential risk to personnel involved in managing the bodies of those who die from it [2]. SARS-CoV-2 is the pathogen (virus) causing the infection, while COVID-19 is the disease resulting from the infection by this virus.

Post-mortem examinations are integral part of medico-legal death investigations throughout the world. COVID-19 deaths are generally classified as natural deaths and are not routinely required to be examined by a coroner or medical examiner [3]. The need to research the pathophysiology of the disease and educate clinicians and epidemiologists on possible treatments often require autopsies to be performed even in diagnosed COVID-19 cases. Autopsies in COVID-19 cases are concerned with medico-legal and pathological investigations of the disease, and provide valuable epidemiological data through disease surveillance [4,5].

Medico-legal death investigation follows three systems globally, the coroner system, the medical examiner system and the police inquest system. The coroner system is followed mainly in the British Commonwealth. The medical examiner system is practiced over most of Europe. The police inquest system is primarily followed in the developing world, across most of Asia and Africa.

In the US, 14 states follow the coroner system. 25 states have a state medical examiner, with 16 having centralised medical examiner systems and another 6 having local medical examiner systems. An additional 18 states have mixed systems [6].

Concerns about personal safety related to infection prevention and control during death investigation procedures involve the following:

- handling, transportation and storage of the dead bodies
- post-mortem examinations
• use of PPE (personal protective equipment) by all personnel coming in contact with the dead body and relatives of the deceased
• cleaning and disinfection of equipment and facility
• and collection, storage and transportation of samples from the mortuary facility to a suitable laboratory.

In times of COVID-19, more than ever, it is essential to take standard precautions, and follow all infection prevention and control guidelines to ensure occupational safety.

Death scene investigation

The majority of the COVID-19 deaths occur in hospitals. However, numerous other deaths occur at home as well as at care facilities for the elderly [7]. Deaths caused by non-natural causes, including accidents, homicides and suicides, in those suffering from COVID-19, also require an investigation [3]. These medico-legal death investigations often include a visit to the scene by law enforcement and death investigators who are exposed to a great risk of contact with a variety of infectious foci. These include contaminated material and living infected individuals at the scene. All investigators at the scene are therefore vulnerable to exposure to SARS-CoV-2 and should be required to be attired in appropriate PPE. Furthermore, law enforcement personnel are required to contact and interview the next of kin and known acquaintances to ascertain information that may be valuable in the investigation. This may include:

• last known contact with the deceased
• circumstances of death
• medical history of cough, respiratory distress, fever
• travel history
• contact history

It is important for scene investigators to strictly adhere to physical distancing measures and stay at least 2 metres (6 feet) away from relatives during these interviews. Both examiners and interviewees also need to wear protective gear, especially face masks, at all times. It is also imperative to strictly follow hand-washing and other hygienic standards, like not touching one’s face and preventing overcrowding at the scene [8].

In addition, Homicide investigation units bring with them equipment for sorting and collecting a large volume of evidence. There is a risk of contamination of the equipment and associated material, therefore, it is important to limit the use of unnecessary equipment at the scene and follow protocols for sanitisation of all equipment used. Scene investigators may also be required to collect samples, including swabs from the deceased before the body is processed for autopsy. [9] Scene investigators may also have the additional responsibility of ensuring transfer of the body to the morgue. While forensic nurses are often knowledgeable of the need for preservation and non-manipulation of the body and avoid cleaning it [10], in suspected or confirmed COVID-19 deaths, it is advised to close body orifices and injuries using cotton, where appropriate, to prevent the release of body fluids when moving the body. Similarly, contrary to common practice in medico-legal cases of securing and preserving medical devices, all removable devices should be detached, including catheters and tubes [11].

None of the aforementioned tasks expected from death scene investigators are aerosol generating, and hence, do not require the use of N95 masks or powered respirators. However, other personal protective equipment, including, gloves, face shields and masks should be appropriately and judiciously used.

Hospital deaths of victims of violence

In addition to non-institutional deaths, a large number of violent deaths occur while undergoing medical treatment. The vast majority of these deaths occur from road traffic incidents. The medical staff undertaking the care of these individuals should follow all the health and safety measures as discussed in above section. Additionally, medical staff handling bodies with COVID-19, suspected or confirmed, should use the full set of PPEs, including appropriate masks or respirators, double gloves, surgical gowns and waterproof aprons, in addition to goggles or face shields, surgical scrubs, caps and boot covers. Additionally, medical personnel will be required to process and transfer the bodies for autopsy or for disposition. It is important to clearly label all confirmed or suspected cases, as well as all contaminated material. All removable medical devices should be detached and all wounds and body orifices closed with cotton, where appropriate [12]. The body should be transferred to a body bag and sealed. The outside of the body bag and all material should be decontaminated using 0.1% hypochlorite solutions, 0.5% hydrogen peroxide solutions or 70% ethanol solutions. The body should then be transferred following all administrative and legal requirements.

Transportation to mortuary

Transportation of the dead body poses a significant threat to those involved. Personnel involved in the
transportation may also be required to wrap and transfer the bodies in body bags. This is especially true in areas where the bodies need to be transported for long distances, where forensic personnel are not available at the local level. All bodies being transported should be properly recorded, in a centralised depository, where possible, to help in traceability. Any pressure or alteration in the position of the dead body can release body fluids and exposure to the infectious agent. This is especially true in decomposed bodies, where the putrefactive processes lead to distension of the body and purging. In addition, the gaseous distension causes increased rigidity and greater difficulty in movement and transfer of the body. All bodies, contaminated and suspected, as well as all contaminated material should be clearly labelled. The body bag and all associated material should be decontaminated using 0.1% hypochlorite solutions, 0.5% hydrogen peroxide solutions or 70% ethanol solutions. The vehicle used for transportation should also be sterilised after transportation to the mortuary facility [11].

Mortuary operations

Mortuary operations include the receipt of dead bodies, their storage, autopsy examination, as well as collection of samples for investigations and packaging and handover of the body for disposal. In the current circumstances surrounding the COVID-19 pandemic, mortuary personnel should receive all bodies from transportation personnel assuming them to be infective. The bodies should then be triaged and the risk assessed, before a decision on the procedure to be followed is made. Triaging and risk management is extremely valuable in low resource settings or in the event of a shortage in the supply of PPE as has been seen in most countries around the world.

Triage and risk assessment involve the determination of the COVID-19 status of the deceased. This can involve:

- collection of nasopharyngeal swabs
- interviews with family members and/or law enforcement about the medical history of cough, respiratory distress, fever, as well as history of travel and contact with diagnosed cases of COVID-19.

This will help elucidate suspicion in the majority of cases. As with scene investigators, it is important to maintain physical distancing and general health and safety norms during the interview period, including the use of face masks by both the interviewer as well as interviewee. In addition, risk of infection should be minimised by limiting contact with the family to as few individuals as necessary. The autopsy centre should have specific infection prevention and control protocols in place to manage the cases diagnosed as COVID-19 positive following RT-PCR test. It is important to note that asymptomatic carriers or undiagnosed cases of SARS-CoV-2 pose a greater risk to health care workers. Ideally, one should wait for the results of RT-PCR before proceeding for autopsy, however, it may not be possible in resource-stricken settings, where the testing facilities may be absent or limited, causing an unnecessary deferment of autopsy and increasing the risk of infection of mortuary personnel. In absence of RT-PCR testing facilities or the unavailability of results, those involved in conducting autopsy on COVID suspect or probable deaths should don the standard PPE, as would be required following diagnosis of COVID-19. In view of the worldwide shortages of PPE, it is important to develop specific protocols to either defer the autopsy or to proceed with standard precautions in all cases depending on the specific capabilities of the centre. The management of cases following risk assessment will lead to judicious use of autopsy facilities, including PPE, and would streamline COVID-19 response, especially in high volume autopsy centres. This will be significantly reducing the risk of cross-contamination. In addition to triaging and risk assessment, an important step in infection prevention and control in autopsy facilities includes the setting up of closed decontamination zones [13]. Autopsy involves dissections and manipulation of body tissues. The possible exposure of the prosector to aerosol produced during autopsy, as well as tissues and body fluid contaminated with infectious agents, requires special consideration. Autopsy on COVID-19 positive and suspected cases is considered a high-risk procedure. All personnel, including those involved in the death scene visit, transportation, storage and autopsy procedures, as well as all other personnel coming in contact with the dead bodies of suspected or confirmed COVID-19 cases should use appropriate masks or respirators, double gloves, surgical gowns and waterproof aprons, in addition to goggles or face shields, surgical scrubs, caps and boot covers, as part of recommended infection prevention and control measures [14]. In addition, all individuals performing autopsies should use cut-resistant mesh gloves between two layers of surgical gloves [11]. Exposure to sharp injuries during autopsy can be reduced by avoiding the use of sharp scissors and replacing them with blunt ended scissors, using PM40 blades with blunt ends, following standard needle-prick reduction procedures.
as well as ensuring that only a single prosector is working on the body at a time [2].

In order to minimise the burden of infection, autopsy procedures of high-risk cases should be performed in negative-pressure airborne infection isolation rooms (AIIRs) with heating, ventilation and air-conditioning circuit (HVAC) systems with at least 12 air changes every hour. Following the procedure, the equipment and structures should be cleaned with soap or detergent and disinfected using 0.1% hypochlorite solutions, 0.5% hydrogen peroxide solutions or 70% ethanol solutions [11].

The shortage of personal protective equipment may be managed by conducting multiple autopsies in one sitting, by the same team, wherever possible, including cleaning and transportation of bodies. Aprons, outer gloves, caps and boot covers however, should be changed between cases. Powered air purifying respirators along with reusable goggles may be used, to reduce the need of disposable N95 masks. In low resource settings, face shields, surgical masks and goggles can be used in the absence of powered air purifying respirators. While N95 masks may be sterilised using ultraviolet germicidal irradiation (UVGI) or vapourised hydrogen peroxide [15-18], it is not recommended to reuse N95 masks donned during aerosol generating procedures such as autopsies.

As part of the autopsy procedures, the medical personnel may be required to obtain lung swabs, which pose significantly higher risk of aerosol production and infectious exposure. Similarly, other aerosolising procedures are to be avoided in all high-risk cases, including the use of power saws. Where required, aerosolising procedures, including collection of lung swabs, should be performed ensuring adequate protection of the personnel – by using a negative-pressure AIIR with HVAC systems, and additionally providing respirators with HEPA filters [19].

In addition, forensic autopsies regularly require the collection of tissue samples for histopathology. It is therefore important to ensure adequate protection for those handling the samples and tissues preserved during autopsies. Protective measures to be undertaken in such cases include the use of PPEs, general hygienic procedures and hand washing. Additionally, body fluids collected for further investigations should be sealed using paraffin seals to avoid aerosol release [19].

Following the autopsy procedure in all high-risk cases, the body should be transferred to a body bag, with the outside of the body bag being disinfected with 0.1% hypochlorite solutions, 0.5% hydrogen peroxide solutions or 70% ethanol solutions. The body bag should then be sealed and inserted into a second body bag. The outer layer of the second body bag should also be sealed and disinfected before being handed over for transportation and disposition. In resource limited scenario, packing of the body in a single body bag is considered as a safe procedure [11].

Regular cleaning of all the surfaces as well as the entire facility should be done after performing autopsy procedures on all high-risk cases, including confirmed and suspected COVID-19 cases. All non-porous, hard surfaces should be cleaned with soap or detergent and further disinfected with 0.1% hypochlorite solutions, 0.5% hydrogen peroxide solutions or 70% ethanol solutions. The personnel involved in cleaning procedures should wear disposable gloves, water-proof gowns, goggles and masks or respirators as appropriate. Aerosolising procedures should be avoided [19].

The personal belongings of the deceased should also be decontaminated using 0.1% hypochlorite solutions, 0.5% hydrogen peroxide solutions or 70% ethanol solutions. In addition, clothing and linen should be machine washed, with warm water (60-90°C/140-195°F) and detergent. All material should then be soaked in 0.05% chlorine solution for 30 minutes before being dried in sunlight [11]. Additionally, all contaminated material should be appropriately disposed. The Central Pollution Control Board suggests the disposal of bio-hazardous waste in labelled double leak-proof bags [20].

Apart from the risk of exposure to the infection, mortuary personnel are also under extreme mental and emotional stress. These stresses can lead to severe adverse effects on the functioning of the staff and can lead to perilous mistakes. It is therefore important to ensure adequate psycho-social support for mortuary staff. This can be managed by conducting regular briefing and debriefing sessions as well as psychiatric and/or psychological consultations. In addition, autopsy centres are advised to develop rotational rosters to ensure that their staff are well rested, and allow for replacement teams to continue work, following decontamination procedures, in case of exposure to infection and the need for quarantine.

It is also pertinent to consider the risk of infections to the family members of the deceased. While the risk to mortuary personnel during the contact with family members has already been discussed earlier, there is also a possibility of family members being exposed to the virus in the mortuary complex. Family members should be briefed on the importance of undertaking appropriate protective measures to guard against infection, especially the importance of hand washing,
avoiding crowding as well as maintaining safe physical distance. In addition, access to the mortuary facility should be strictly restricted and where necessary, movement within the facility should be minimised. Interactions with the family can also be restricted by using other modes of communication including through telephone, video conference etc.

As with previous epidemics, standard guidelines and operating protocols dictate effective management of the deceased to control infection. Unlike in previous epidemics, the bodies of the deceased have been recommended to be cleared of all removable medical devices, including catheters, tubes etc. On the other hand, all infection prevention and control measures including the use of PPE, hand washing etc. have been recommended, as with previous epidemics [21, 22].

Transportation from mortuary and performing the last rites

The standards to be followed by transportation personnel for transferring the body from morgue remain similar to what has been discussed earlier for transportation of bodies to the morgue. Additionally, bodies need to be wrapped in sealed body bags before being released. While there are no restrictions on the procedure of the disposal of the dead, legal requirements as well prevalent religious and cultural practices should be respected. It should be emphasised here that like in previous epidemics, the sealed body bags should not be opened after release of the bodies [23]. Similarly, family members should be informed to refrain from practices that increases the risk of exposure, including washing, dressing, kissing, hugging the body etc. In addition, family members should also be advocated to limit the participants in funerary processions and to maintain physical distancing requirements [11,24].

Conclusions

The exposure to SARS-CoV-2 is a serious occupational risk to all the personnel involved in the management of the dead bodies. This report highlights the current practices in the management of the suspected or confirmed COVID-19 deaths, and provides suggestions for protecting those involved in the management of the dead. Measures to be undertaken include, adequate pre-autopsy RT-PCR testing, use of appropriate PPE, ensuring decontamination protocols, following standard hygienic practices, and infection prevention and control practices.

Two standard checklists have been proposed for use by scene responders and hospital staff handling suspected or confirmed COVID-19 deaths.

Scene Checklist

Death investigators, transportation/ law enforcement/funeral home personnel:
- Wash hands before donning PPE
- Don appropriate PPE
  - gloves, masks, face shields/goggles, caps, aprons, boot covers
- History taking –
  - Ensure distance of > 2m (6 ft) between interviewee and interviewer
  - Elicit and record the following
    - last known contact with the deceased
    - circumstances of death
    - medical history of cough, respiratory distress, fever
    - travel history
    - contact history
- Remove all removable medical devices
- Transfer the body – Label and Seal
- Decontaminate the body bag
- Collect and decontaminate belongings, equipment and samples.
- Doff PPE and dispose appropriately
- Wash hands after doffing PPE
- Use hand sanitizer when touching something – with or without gloves
- Do not touch the face

In-Hospital Checklist

Emergency medical/forensic personnel/Mortuary staff:
- Wash hands before donning PPE
- Don appropriate PPE
  - appropriate masks or respirators, double gloves, surgical gowns, waterproof aprons, goggles or face shields, surgical scrubs, caps and boot covers.
- Inform appropriate authorities – administrative and legal requirements
  - Ensure distance of > 2m (6 ft) between individuals
  - Elicit and relay the following
    - circumstances of death
    - medical history of cough, respiratory distress, fever
    - travel history
    - contact history
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KK and TK conceived the idea of writing this paper. RS collected data, conducted analysis and compiled the available information under the guidance of KK and TK. The data and the materials are available with RS. RS, KK, and TK wrote the initial draft of the manuscript. RS, KK, and TK wrote and approved the final version of the manuscript.

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