

Guidelines

# Management of the corpse with suspect, probable or confirmed COVID-19 respiratory infection – Italian interim recommendations for personnel potentially exposed to material from corpses, including body fluids, in morgue structures and during autopsy practice

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## Introduction

The **COVID-19 (Coronavirus Disease-19)** is the most urgent health emergency worldwide and all professionals are called to give support in the diagnosis and treatment of patients affected by this disease.

The Scientific Society of Hospital Legal Medicine of the National Health System (COMLAS) and the Italian Society of Anatomical Pathology and Cytology (SIAPEC) produced this document with the intent of offering a technical support to professional involved in the autoptic activities during

the **Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)** epidemic infection.

Coronaviruses are a broad category of viruses known to cause diseases ranging from the common cold to Middle Eastern Respiratory Syndrome (MERS) and Acute Severe Respiratory Syndrome (SARS). Recently, a novel coronavirus (nCoV) was identified that had never previously been found in humans<sup>1-3</sup>.

The viruses responsible for SARS include **SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2)**; the disease caused by the new Coronavirus is called **COVID-19 (Coronavirus Disease-19)** and represents a cluster of pneumonia that has spread to China and other countries of the world since 31 December 2019<sup>4-8</sup>.

Initial reports suggest that transmission occurs during close contact with an infected subject, mainly through respiratory droplets produced in the act of speaking, coughing or sneezing<sup>9,10</sup>. Droplets can settle on the eyes, nose or mouth, as well as being inhaled by people nearby. At present, long-distance aerial transmission from person to person is unlikely.

Common signs of infection include fever, cough and breathing difficulties. In severe cases, the infection can cause pneumonia, severe acute respiratory syndrome, multi-organ dysfunction or failure, and death<sup>11-16</sup>.

WHO, CDC and ECDC have provided clear details on measures to prevent the spread of the virus<sup>17-21</sup>. Standard recommendations to prevent the spread of infection include regular hand washing, covering the mouth and nose when coughing or sneezing and avoiding close contact<sup>22,23</sup>.

At the Italian national level, the extra- and intra-hospital path of suspect or confirmed cases of COVID-19 and the indications relating to the use of personal protective equipment (PPE) by healthcare personnel are extensively defined<sup>24-28</sup>.

In view of the limited scientific knowledge and evidence on SARS-CoV-2 infection, it is therefore considered appropriate to proceed systematically with the management of COVID-19 cases<sup>29,30</sup>, whether they are suspect, probable or confirmed, accepted at the morgue. Hence the need to condense the available evidence on biological risk, individual protection and autopsy investigation with the aim of providing a practical guidance.

The recommendations expressed in this document have been developed to help healthcare professionals and morgue staff manage COVID-19 deaths by advising on possible risks and preventive measures. In the same way, indications will be provided about the post-mortem investigation of suspect, probable or confirmed cases of COVID-19.

## Purpose and field of application

The classification of infectious hazards needs to be periodically reviewed and updated in light of global epidemiological trends. The categorization of infectious biological agents provides for the attribution to hazard groups (Hazard Group 1-4) based on the probability of causing disease in humans, the probability of spreading the infection in the community, the availability of prophylactic or therapeutic measures<sup>31</sup>.

The Advisory Committee on Dangerous Pathogens (ACDP) in early 2020 established a provisional classification of SARS-CoV-2 as an HG3 pathogen (Hazard Group 3). In this regard, it should be emphasized that HG3 agents can cause serious diseases in humans and constitute a serious risk for professionals; the agent may spread in the community, but effective prophylactic or therapeutic measures are usually available. The risks for personnel operating in the morgue facilities, in most infections, are minimal when standard universal precautions for infection prevention are applied<sup>32-35</sup>.

The purpose of the operating procedure is, therefore, to indicate how to manage the bodies of suspect or confirmed cases of COVID-19 in order to minimize the risk of environmental contamination and the contagion of personnel involved in the process. According to this perspective, the document is intended to recommend:

- the preparation of standard operating procedures (SOP) for the containment of infectious risk;
- adequate conduct for carrying out activities and maneuvers at risk during autopsy checks on cases of SARS-CoV-2 infection;
- personal protective equipment (PPE) to be used in daily practice;
- the optimal evaluation pathways for the diagnosis of SARS-CoV-2 infection.

The present document is mainly aimed at staff serving in morgues (health professionals, trainees, as well as auxiliary, administrative and surveillance staff) and must be applied to every death from COVID-19, whether suspect, probable or confirmed.

## Terms and definitions

### COVID-19 CASE DEFINITION

The case definition is based on the information currently available and can be updated based on the evolution of the epidemiological situation and the scientific knowledge available<sup>36</sup>.

The Circular issued by the Italian Ministry of Health on 09.03.2020 provides - in updating and replacement of the previous ones - the definition of suspect, probable and confirmed case<sup>37</sup>.

### Suspect case

Laboratory investigations for COVID-19 should be performed for suspect cases according to the following criteria, based on the updated WHO and ECDC definitions:

- patient with acute respiratory tract infection (sudden onset of at least one symptom between fever, cough, and dyspnoea) with no other etiology that fully explains the clinical presentation and with a history of travel or residence in a country or area that has reported local transmission or community in the 14 days preceding the onset of symptoms (consult the WHO reports on the situation; [www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/](http://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/)), *or*;
- patient with any acute respiratory infection who has been in close contact with a probable or confirmed case of SARS-CoV-2 infection in the last 14 days before the onset of symptoms, *or*;
- patient with a severe acute respiratory infection (fever and at least one symptom or sign of respiratory diseases such as coughing and difficulty breathing) who requires hospitalization (SARI), with no other etiology that fully explains the clinical presentation, *or*;
- in the context of primary care or in the hospital emergency room, all patients with symptoms of acute respiratory infection must be considered suspect cases if the local transmission has been reported in that area or in the country.

Any positivity found for common respiratory pathogens may not exclude co-infection with SARS-CoV-2 and therefore samples must be tested for this virus anyway.

### Probable case

Suspect case for which the result of the test carried out at the Reference Laboratories using specific Real Time PCR protocols for SARS-CoV-2 is doubtful or not conclusive, *or*, for which a positivity to the pan-coronavirus test is confirmed.

### Confirmed case

Case with ascertained positivity for SARS-CoV-2 infection, regardless of the presence of clinical signs and symptoms.

### DEFINITION OF CLOSE CONTACT

Close contact with a probable or confirmed case is defined as:

- person living with a case of COVID-19;
- subject who had physical contact with a COVID-19 case (e.g. handshake);
- subject who had unprotected direct contact with secretions from a COVID-19 case;

- subject who had direct contact with a COVID-19 case at a distance of less than 2 meters and for a time greater than 15 minutes;
- subject who has been in a closed environment (e.g. classroom, meeting room, waiting room, *etc.*) with a COVID-19 case for more than 15 minutes and at a distance of less than 2 meters;
- healthcare professionals or other subjects providing direct assistance for a COVID-19 case, or laboratory operator handling specimens of a COVID-19 case without the recommended personal protective equipment (PPE);
- aircraft contact with a case of COVID-19 sitting in the same row or in the two preceding or subsequent rows, traveling companions or assisting persons and crew members serving in the section of the aircraft where the case was housed (if the case manifests serious symptoms or has made movements inside the aircraft, the passengers seated in the whole section or all the passengers of the aircraft can be considered close contacts).

The epidemiological link can be established if contact is documented between the suspect case under consideration and a confirmed case within a period of 14 days before the onset of symptoms.

### Hygiene precautions in the management of suspect, probable or confirmed case of COVID-19

In compliance with scientific evidence and the provisions of the Italian Ministry of Health, all health professionals involved in the management of suspect or documented cases of COVID-19 are required to adopt, in addition to standard safety measures, the necessary precautions to prevent the transmission of the virus<sup>38,39</sup>.

#### HAND HYGIENE

Carry out antiseptic hand washing with alcoholic solution or antiseptic soap and water after each contact with the body.

The antiseptic hand washing technique must comply with the WHO sequence<sup>40,41</sup>. Failure to comply with proper hand hygiene negates the protective efficacy of personal protective equipment.

#### CONTACT PRECAUTIONS

In addition to the standard precautions, anyone who comes into contact with a suspect case of COVID-19 must strictly adhere to the contact precautions.

Is essential:

- to pay close attention to avoid accidentally touching with the face (eyes, nose, and mouth);

- to minimize the number of people present at the same time in the area where the body is allocated;
- to always close the door of the room where the body is located and keep the openings to a minimum.

#### INDIVIDUAL PROTECTION MEASURES

PPE offers the highest possible protection against HG3 infectious agents. The morgue staff must use the following PPE in the coded manner for the different operational phases of body management (acceptance, custody, handling and autopsy) (Tab. I):

- disposable headgear;
- double pair of disposable gloves;
- cut-resistant protective gloves;
- respiratory filter FFP2 or FFP3 (the latter recommended in the procedures that produce aerosols) and face protection (goggles or protective visor);
- disposable long-sleeved gown or waterproof suit;
- disposable overshoes.

#### DRESSING PROCEDURE

It must take place in the filter area according to the following steps:

- 1 Remove all jewelry
- 2 Check the integrity of the personal protective equipment
- 3 Put on the disposable headgear and overshoes
- 4 Put on the first pair of disposable gloves

- 5 Wear the disposable gown, fastening it on the neck and hips, or the waterproof suit
- 6 Wear FFP2 facial filter (FFP3 filter in case of procedures that produce aerosols)
- 7 Wear protective goggles and/or visor
- 8 Put on the second pair of disposable gloves

The main stages of the dressing procedure are summarized below on the basis of the recommendations of the CDC on the correct use of personal protective equipment <sup>42</sup>.

#### Correct use of the facial filter

- 1 Check the integrity of the device
- 2 Open the ends of the lower flaps of the mask, making sure that the valve (FFP3) is correctly oriented
- 3 Turn the mask upside down allowing the elastics to come out
- 4 Slightly bend the upper part of the mask forming a "V" to favor a better dressing
- 5 Remove the adhesive tab (if present)
- 6 Put on the mask by adjusting the elastic bands with both hands
- 7 First place the upper elastic in the middle of the back surface of the head, then the lower elastic on the nape
- 8 Place the mask under the chin and shape the upper part to allow adequate adherence to the face
- 9 Perform the mask tightness test. Cover the facial filter with both hands and perform an inhalation or exhalation test, as described below:

**Table I.** Specific risks and recommended PPE for the different operational phases of body management.

| Phase                      | Risks  | PPE  |
|----------------------------|--|--|
| Admission and Handling     | - Contact with potentially infected material from corpses  | - Disposable gloves (single pair)<br>- Respiratory filter FFP2<br>- Goggles or protective visor<br>- Disposable long-sleeved gown or waterproof suit<br>- Disposable overshoes   |
| Swab collection            | - Contact with potentially infected material from corpses  | - Disposable gloves (single pair)<br>- Respiratory filter FFP2<br>- Goggles or protective visor<br>- Disposable long-sleeved gown or waterproof suit<br>- Disposable overshoes   |
| Autopsy investigation      | - Contact with potentially infected material from corpses<br>- Sharp injuries<br>- Production of splashes and aerosols | - Disposable headgear<br>- Disposable gloves (double pair)<br>- Cut-resistant protective gloves<br>- Respiratory filter FFP3<br>- Goggles or protective visor<br>- Disposable long-sleeved gown or waterproof suit<br>- Disposable overshoes |
| Environmental disinfection | - Contact with potentially infected material from corpses<br>- Production of splashes and aerosols                     | - Disposable gloves<br>- Respiratory filter FFP3<br>- Goggles or protective visor<br>- Disposable long-sleeved gown or waterproof suit<br>- Disposable overshoes   |

- perform a deep inhalation; if the mask collapses slightly, the tightness is adequate; if air is perceived from the edges of the mask, better adjust the position and length of the elastics; if an air leak is felt around the nose, correctly position the upper support, the patch, and the nose clip;
- perform a forced exhalation; if there is no air leak, the mask is properly sealed.

#### UNDRESSING PROCEDURE

At the end of the procedures, in the filter areas, it is essential:

- avoid touching any surface before carrying out the undressing procedure;
- avoid any contact between potentially contaminated PPE and the face, mucous membranes or skin.

The undressing procedure must take place in the filter area, taking care to avoid self-contamination, respecting the following sequence:

- 1 Remove the disposable gown and the overshoes by disposing of them in the special container
- 2 Remove the first pair of gloves and dispose of it in the special container
- 3 Remove the protective glasses and sanitize them
- 4 Remove the facial filter, taking care not to touch the front surface of the mask (remove it from the elastics with back-forward movement) and dispose of it in the appropriate container
- 5 Remove the headgear
- 6 Remove the second pair of gloves and dispose of it in the special container
- 7 Perform antiseptic hand washing

The main stages of undressing are illustrated below in two different sequences, in accordance with the recommendations of the CDC on the correct use of personal protective equipment <sup>42</sup>.

Before leaving the autopsy rooms, carefully remove the PPE to avoid contamination and dispose of it in the appropriate containers.

Any reusable PPE (goggles, visors, respirators, etc.) must be properly cleaned, decontaminated and kept in view of subsequent use.

After the undressing procedure, scrub the hands with soap and water for at least 20 seconds. If the hands are not visibly dirty and there is no running water available, an alcoholic solution with a concentration of 60-95% can be used. However, in the event that the hands are visibly dirty, always scrub with soap and water before using any type of disinfectant.

Avoid contact of face, mouth, and eyes with gloved or unwashed hands <sup>43</sup>.

Ensure the availability of hand hygiene devices in the immediate vicinity of the PPE removal area.

## Operating procedures

### OPERATING PROCEDURE FOR THE MANAGEMENT OF THE CORPSE WITH SUSPECT, PROBABLE OR CONFIRMED DIAGNOSIS OF COVID-19

The proposed procedure is aimed at the safe management of the phases of acceptance, handling, custody, and discharge of the body with suspect, probable or confirmed diagnosis of COVID-19 <sup>44-47</sup>. The objective has been pursued by drawing up the following recommendations:

- the acceptance and handling of the body must be done by personnel equipped with the recommended PPE;
- the body must be positioned on a sanitized metal stretcher for custody and subsequent investigations;
- at the end of the investigations, the body must be placed in the coffin with the clothes and wrapped in a sheet soaked in disinfectant solution;
- if the stay of the corpse in the morgue is necessary - pending or at the conclusion of the investigations - the same must take place inside a special closed body bag and dedicated refrigerated room;
- at the end of the handling and transport operations, all the equipment used must be subjected to sanitization.

### RECOMMENDATIONS FOR AUTOPSY INVESTIGATION IN CASES OF SUSPECT, PROBABLE OR CONFIRMED COVID-19

For the safe and effective performance of HG3 (Hazard Group 3) autopsy investigations, is required (Fig. 1):

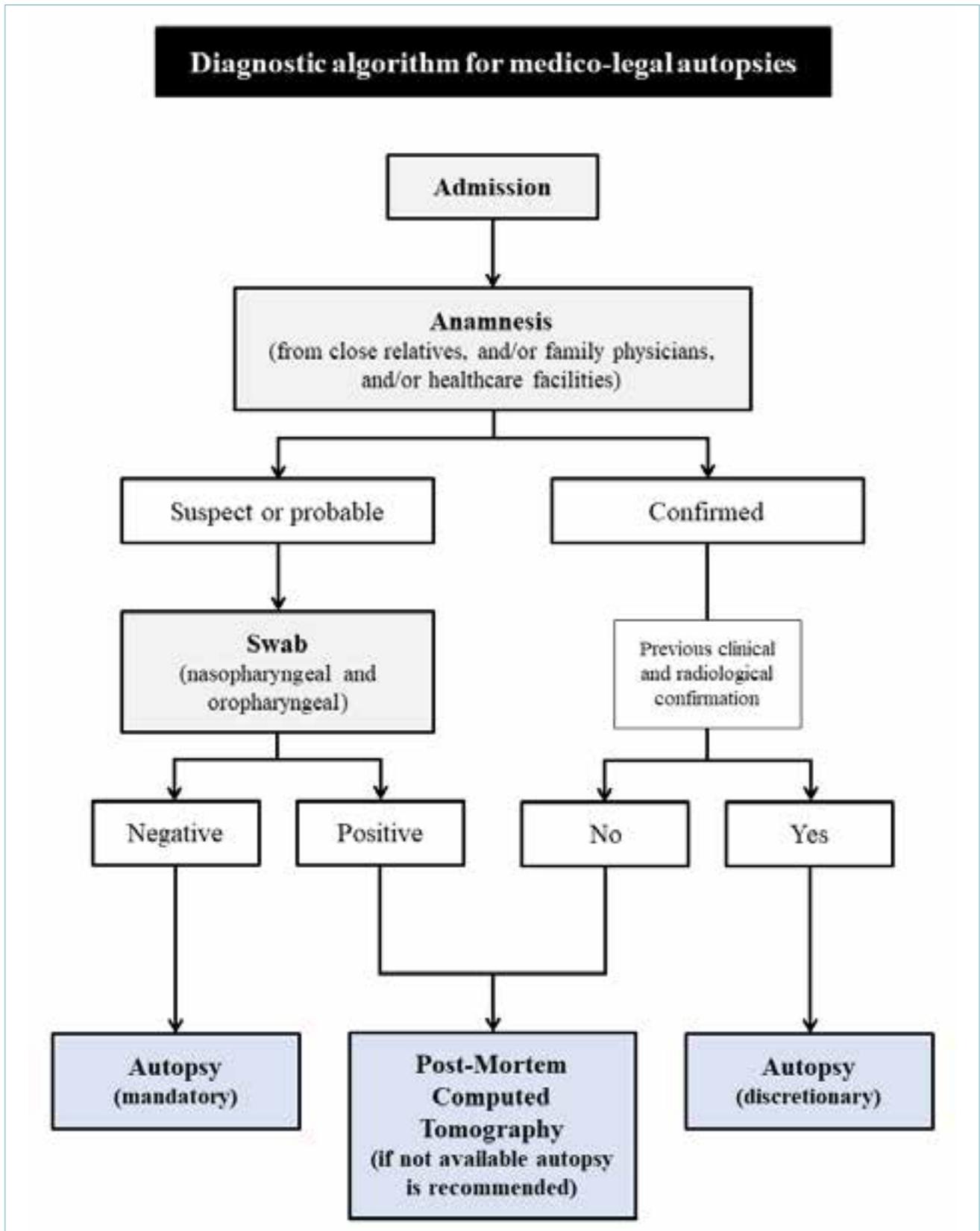
- generic risk assessment and adoption of universal standard precautions;
- knowledge of possible pathological findings that can be highlighted;
- the definition of SOP (Standard Operating Procedures) for the management of autopsies with high biological risk.

The use of universal precautions effectively protects against most risks related to SARS-CoV-2 infection. Professionals have a duty to carry out risk assessment for each case in order to prevent actions that could put operators at risk.

Pre-autoptic risk assessment should include:

- anamnestic information collected from close relatives or acquaintances;
- information from family physicians;
- information obtained from healthcare facilities.

Information on the circumstances of the death is essential. In addition to information on the state of health and the place of death, knowledge of any previous national and international trips, as well as laboratory data (positive and negative), is fundamental. It is im-



**Figure 1.** Diagnostic algorithm for medico-legal autopsies.

portant not to assume that the information acquired is accurate.

The criteria for the preliminary assessment of deaths and the definition of any cases are the same as those used to evaluate the possible risk of infection in living patients.

If after the preliminary assessment it is believed that a death may be due to COVID-19, the subsequent investigations must be oriented towards confirmation of the diagnosis and the precise definition of the role of the SARS-CoV-2 infection in the determinism of death (study of any pre-existing conditions and comorbidities capable of characterizing a condition of fragility of the subject). Judicial autopsies are an exception as any diagnostic activity depends on the prior consent of the Prosecutor.

For suspected or probable HG3 infection, preliminary nasopharyngeal and oropharyngeal swabs are recommended for diagnostic confirmation. In the event of a positive swab, especially if there is clinical, laboratory and radiological confirmation, the execution of the autopsy investigation is discretionary. In cases of swab positivity in which there is no clinical or radiological confirmation of the diagnosis, the study using post-mortem computed tomography (PMCT) is recommended in accordance with the availability and the care loads on the hospital structure; if a post-mortem radiological study is not possible, an autopsy should be performed. If the swab is negative, the autopsy is mandatory.

The autopsy must concern all the body districts and be oriented towards the search for significant findings for diagnosis<sup>48-50</sup>. For this purpose, en bloc extraction of the cervical and thoracic organs is recommended in order to adequately define the respiratory pathological manifestations and facilitate sampling operations.

In general, the following measures are recommended for the safety of autopsy practice:

- maintain all the necessary equipment on hand to avoid leaving the autopsy area to find additional items;
- in order to prevent accidents, limit the phases in which the intervention of multiple operators is foreseen and privilege the activity of expert operators;
- use PM40 scissors or blades with blunt tips, in order to reduce the risk of injury;
- minimize the presence of cutting edges in the work area; their position must be known to all operators at all times;
- cut the organs not fixed in formalin keeping them still on the table and using a sponge, paying attention to protect the hands;
- use the oscillating saw with aspiration of the bone aerosol for the opening of the cranial cavity; in

case of unavailability use a hand saw wearing metal mesh gloves;

- avoid incongruous maneuvers for the disposal of needles after sampling; needle and syringe must be placed in the appropriate container for cutting edges;
- maintain adequate water pressure to avoid splashing;
- clothing worn by the corpse must be disposed of as contaminated special waste;
- prepare a register to record the specific activities carried out (cadaveric inspection, autoptic assessment, collection of samples, etc.), the date of performance of the same, as well as the names of the operators directly involved and of the staff present in the morgue structure during the activity.

The team performing an autopsy at high infectious risk should ideally include an operating forensic pathologist/pathologist, a “clean” assistant forensic pathologist/pathologist and a technician. The assistant forensic pathologist/pathologist performs auxiliary tasks such as sample management.

Residents should be involved in autoptic activity only under the supervision of senior staff, but especially when they have demonstrated knowledge of the risks, awareness of the protective measures and proven experience in autopsy practice<sup>51,52</sup>; briefly, as regards HG3 cases, the Authors’ recommendation is to limit the involvement of residents in the most risky procedures such as evisceration.

From a structural point of view, performing HG3 autopsies requires effective ventilation in the autopsy room and the possibility to maintain an adequate distance in carrying out the different activities<sup>53</sup>.

In accordance with the CDC indications, autopsies in cases of suspect or confirmed COVID-19 are always practicable as long as the conditions of maximum safety and infectious disease protection for operators and work environments can be guaranteed.

In particular, the CDC reports that “Autopsies on decedents with known or suspected COVID-19 should be conducted in Airborne Infection Isolation Rooms (AIIRs). These rooms are at negative pressure to surrounding areas, have a minimum of 6 air changes per hour (ACH) for existing structures and 12 ACH for renovated or new structures, and have air exhausted directly outside or through a HEPA filter. Doors to the room should be kept closed except during entry and egress. If an AIIR is not available, ensure the room is negative pressure with no air recirculation to adjacent spaces.

A portable HEPA recirculation unit could be placed in the room to provide further reduction in aerosols. Local airflow control (i.e., laminar flow systems) can be

used to direct aerosols away from personnel. If use of an AIIR or HEPA unit is not possible, the procedure should be performed in the most protective environment possible. Air should never be returned to the building interior, but should be exhausted outdoors, away from areas of human traffic or gathering spaces and away from other air intake systems”<sup>54-55</sup>.

### *Recommendations for the safe collection and transport of samples*

The present document provides specific guidance for the collection and management of cadaveric specimens for the diagnostic in-depth of COVID-19. Similarly, recommendations are made for biosafety and infection control during specimen collection and handling<sup>55,56</sup>.

In cases where an autopsy is performed, the collection of the following samples for SARS-CoV-2 research is recommended:

- upper respiratory tract swabs (nasopharyngeal swab and oropharyngeal swab);
- swabs of the lower respiratory tract (from each lung);
- organ and tissue samples to be kept in formalin for subsequent histopathological investigations.

If the investigation ends with the cadaveric inspection, only the collection of swabs from the upper respiratory tract is recommended.

It is important to keep the SARS-CoV-2 samples separate from the samples taken for other microbiological and non-microbiological investigations.

The presence of health professionals in autopsy rooms should be limited to operators engaged in sampling. Since the collection of cadaveric samples does not induce coughing or sneezing, a negative pressure environment is not required.

Personnel must comply with the standard precautions previously described.

Use only synthetic fiber swabs with plastic rods; different devices with wooden barrels or with calcium alginate can inactivate the viral agent and make the PCR test ineffective<sup>57,58</sup>.

For the proper collection of a nasopharyngeal swab:

- 1 insert a swab into the nostril parallel to the palate;
- 2 leave the swab in place for a few seconds to absorb secretions;
- 3 perform a contralateral swab in the same way and with the same device.

Proper carrying out of the oropharyngeal swab requires:

- 1 insertion of the device into the oral cavity until it reaches the posterior pharyngeal wall (attention to avoid contact with the tongue);
- 2 leave the swab in place for a few seconds to absorb secretions.

To perform an adequate lower respiratory tract swab:

- 1 insert the swab into the branches of the main bronchus;
- 2 leave the swab in place for a few seconds to absorb secretions;
- 3 perform a contralateral swab in the same way but with a different device.

Immediately after the procedure, place each of the swabs in a different sterile tube containing 2-3 ml of transport medium for subsequent storage in the refrigerator at 2-8°C before processing. Each container must be labeled indicating the identification number of the subject, the identification code of the sample, the type of sample and the date of collection of the same. Safe preparation of specimens for transport involves:

- 1 insertion of sterile tubes containing the swabs into a secondary container;
- 2 placing the containers inside a sealable clean plastic bag;
- 3 if possible, the insertion of the sealable bag in an additional bag for biological samples;
- 4 transfer outside the autopsy area and delivery to an operator equipped with disposable nitrile gloves for transport.

Regarding the sampling of organs for formalin fixation<sup>59,60</sup>, the collection of tissue samples with a size of 4-5 mm thickness is recommended. The volume of formalin used for fixation should be 3 times greater than the volume of the tissues. Use 10% buffered formalin for at least 48 hours to achieve optimal fixation. With respect to standard samples for histological investigations, particular care must be taken with a sampling of the trachea (proximal and distal) and lung (the hilar region with segmental and primary bronchi, as well as parenchyma representative of all the lobes of both lungs).

This sampling method finds its rationale in the viral tropism for the epithelia of the upper respiratory tract (in particular primary airways and segmental bronchi) which for this reason exhibit greater performance in molecular tests and immunohistochemical investigations<sup>61,62</sup>.

Further sampling should be guided by the anamnesis, as well as by the autopsy findings and may include, for example, samples for bacteriological culture tests or toxicological investigations.

### **POST-PROCEDURAL PROPHYLACTIC RULES AND ENVIRONMENTAL DISINFECTION**

Below are the general guidelines for cleaning and disposal of waste following a necropsy investigation of a suspect or confirmed case of COVID-19<sup>63,64</sup>; it should be noted that at present the persistence time of SARS-CoV-2 on surfaces is uncertain<sup>65,66</sup>.

At the end of the autopsy investigations, the body must be positioned in a body bag and transported in a refrigerated room. Disinfect the outside of the body bag with a hospital disinfectant applied according to the manufacturer's recommendations. It is also recommended in this phase the use of suitable PPE by each operator involved in the movement and exit phases of the body.

In addition, following an autopsy on a subject with suspect or confirmed COVID-19, the following recommendations for disinfection of autopsy rooms should be applied:

- keep ventilation systems active during cleaning;
- wear disposable gloves when cleaning and handling cleaning or disinfectant solutions;
- dispose of gloves after cleaning; do not wash or reuse the gloves in any case;
- use eye protection, such as a visor or goggles, if splashing is expected;
- if necessary, use respiratory protection based on the type of detergent or disinfectant;
- wear a long-sleeved waterproof device to protect skin and clothing;
- use disinfectants with indications of efficacy against human coronaviruses;
- clean the surfaces and apply the disinfectant ensuring an adequate contact time for effective disinfection;
- comply with the safety precautions and warnings indicated on the product label (for example, allow adequate ventilation in restricted areas and ensure correct disposal of the unused product or used containers);
- avoid product application methods that cause the production of splashes or aerosols.

Regarding environmental disinfection, the available evidence has shown that coronaviruses are effectively inactivated by adequate sanitization procedures that include the use of common hospital disinfectants, such as sodium hypochlorite (0.1-0.5%), ethanol (62-71%) or hydrogen peroxide (0.5%). There is currently no evidence to support a greater environmental survival or a lower sensitivity of SARS-CoV-2 to the aforementioned disinfectants<sup>67</sup>.

Hard and non-porous surfaces can be cleaned and disinfected as previously described.

Handle with gloves and disinfect properly after use, equipment such as cameras, telephones and keyboards, as well as all objects that remain in the autopsy room.

Cleaning activities must be supervised and periodically checked to ensure that correct procedures are followed. Sanitation personnel must be properly trained and equipped with suitable PPE.

After cleaning and removing the PPE, wash the hands immediately. Avoid touching the face with gloved or unwashed hands.

Environmental disinfection must include cleaning with water and detergent soap on all vertical and horizontal surfaces, followed by disinfection with hospital disinfectants effective against SARS-CoV-2.

For environmental decontamination, it is necessary to use dedicated or disposable equipment. Reusable equipment must be decontaminated after use with a chlorine-based disinfectant. The use of special trolleys is strongly recommended, different from those used for cleaning common areas.

The instruments used for autopsies should be autoclaved or treated through chemical sterilizers.

#### MANAGEMENT OF ACCESS AND MOVEMENT OF VISITORS WITHIN THE FACILITY

Conclusively, it is necessary to formulate recommendations regarding the management of access and movement of visitors within the morgue area. Specifically, it is essential to establish procedures for monitoring, managing and informing all visitors:

- educate visitors on the usefulness of hand hygiene and standard precautions, especially in common areas;
- invite visitors to stay in the facility for the time strictly necessary, avoiding stops and movements in non-essential areas;
- inform visitors about the appropriate use of PPE according to local policies for access and circulation in the facility;
- actively evaluate all visitors for fever and respiratory symptoms at the entrance; if present, visitors should not be allowed access to the facility;
- limit access points;
- encourage the use of alternative mechanisms for interactions with administrative offices;
- schedule the discharge of the dead bodies in order to avoid the coincidence of multiple exits;
- install physical barriers in the access and reception areas to limit close contact with visitors;
- allow access to administrative rooms and exhibition halls in the manner imposed by their size and turnout with the aim of avoiding gatherings and allowing compliance with the interpersonal safety distance of at least one meter;
- limit access to funeral services, allowing them to stay for the time strictly necessary for administrative needs as well as for the preparation and transport of the body;
- allow access to the ministers of worship for the time strictly necessary for the blessing of the body; suspend any further ceremonial rite.

## Autopsy of inpatient subjects

Most of the autopsies performed by the pathologists are requested by clinicians with the aim to clarify or confirm the causes of death of inpatient subjects. By correlating clinical data with morpho-histological alterations of different organs and tissues the pathologists draw the epicrisis.

In the case of death for SARS-CoV-2 the forefront diagnosis of the infection is based on the detection of the virus on nasal and oropharyngeal swabs with PCR technique. Lung involvement is paramount in SARS-CoV-2 infections and Computerized Tomography (CT) is the routine imaging modality to diagnose and monitor patients with SARS-CoV-2 pneumonia<sup>68</sup>. CT may assist in the early diagnosis of lung alterations typical of SARS-CoV-2 during screening of patients with highly suspicious conditions, in particular patients with an initial negative RT-PCR screening result<sup>69</sup>. The histopathological pattern of early SARS-CoV-2 infection in the lung has been described<sup>14</sup> as an incidental finding on specimens obtained from patients operated for lung cancer, for whom the infection was not diagnosed at the time of surgery. The histological finding of advanced infection phase was reported on biopsy samples obtained from lung, liver and heart<sup>15</sup>. The pathological characteristics of COVID-19 closely resemble those observed in SARS coronavirus and Middle Eastern respiratory syndrome (MERS)<sup>16,70</sup>. The above reported data suggest that in SARS-CoV-2 infection the histological examination does not have a diagnostic role in the first instance but confirms the result of the laboratory test and of imaging.

### AUTOPSY OF SUBJECTS WITH, SUSPECT, PROBABLE OR CONFIRMED SARS-COV-2 INFECTION

If an autopsy of inpatient subjects with, suspect, probable or confirmed SARS-CoV-2 infection is requested **to diagnose the death causes**, the procedure must be performed by the pathologists following the above reported operating procedures, including the procedure to collect tissue specimens (Fig. 2).

If the collection of tissue samples on the corpse of a subject with a full picture of infection or suspect of being infected with SARS-CoV-2 is considered essential for the **disease diagnosis**, an option is also to collect specimens from multiple organs (lung, liver, skeletal muscle) using core biopsy sampling, albeit with the limits of such procedures performed on cadaver (Fig. 2). The specimens must be immediately fixed in buffered formalin for no less than 48 hours.

The post-mortem biopsy sample collection must be: (a) requested on the advice of a multidisciplinary team that includes at least one clinician and one radiolo-

gist; (b) agreed with the reference pathologist; (c) the request must report patient personal data; outcome of swabs for COVID-19; clinical /anamnestic data and imaging report.

In the case of specific research protocols that require molecular or immunohistochemical analyses for which it is necessary to proceed with the collection of samples taken and stored in ways other than those indicated (for example, fresh or frozen samples) it is mandatory to agree with the regional reference center that will take care of the procedures for collecting, storing and transporting the material.

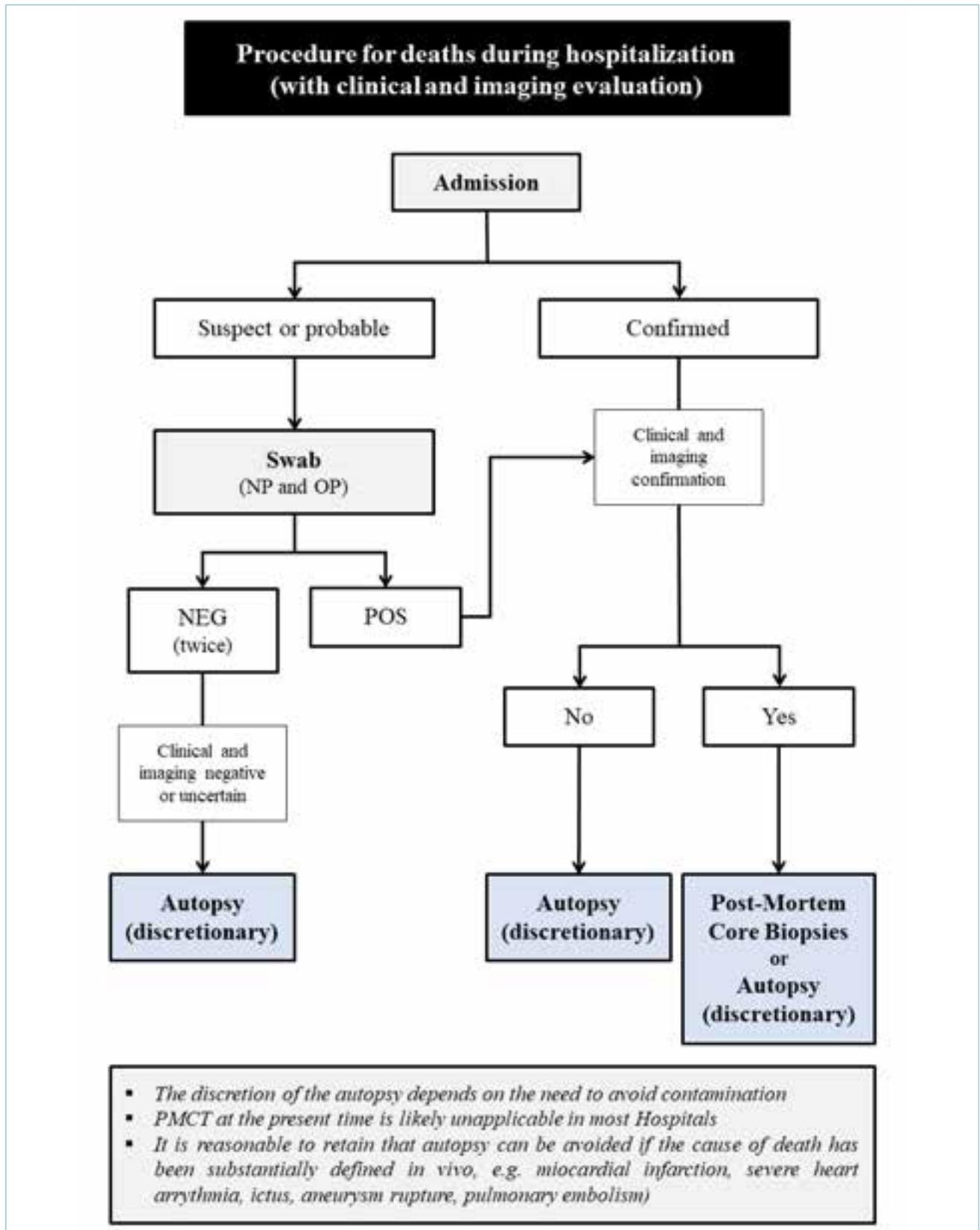
### AUTOPSY FROM PATIENTS WITHOUT APPARENT SARS-COV-2 INFECTION AND FOR CLINICAL REASONS INDEPENDENT OF PULMONARY PROBLEMS AND/OR COMPLICATIONS

In the event that a diagnostic autopsy is required for clinical reasons independent of lung pathology and/or complications in subjects who apparently do not have SARS-CoV-2 infection, it is recommended:

- to discuss with the clinicians the clinical and imaging findings and the reason why the postmortem examination is requested;
- to perform within 2 hours of death an oropharyngeal swab to evaluate the presence of SARS-CoV-2 infection;
- to obtain within 24 hours the result of the oropharyngeal swab. If the result of the swab is not available autopsy cannot be performed.

These precautions are necessary in order to preserve the safety of the health workers involved in the procedure and the quality of the diagnosis, responding to the clinical question by focusing on the real reasons for which the postmortem examination was requested. In addition, **colleagues working in the Northern part of Italy in the areas with a greater spread of infection, who performed autopsy of patients with negative swab described histological changes consistent with those of lungs specimens obtained from autopsy of positive patients (necrosis microfoci, thrombosis of small vessels, hyperplasia of second-order pneumocytes, polynucleations and nuclear cytopathic alterations affecting endothelium and pneumocytes).**

Thus considering the current spread of the disease throughout the national territory, regardless of the hospital structure where the autopsy is carried out, but certainly in all those structures with a high number of positive COVID-19 inpatients, the execution of the diagnostic autopsy in any case must assume that the body is potentially infected and therefore take all appropriate precautionary measures as **indicated in the section "Hygiene precautions in the management of suspect, probable or confirmed case of**



**Figure 2.** Diagnostic algorithm for patients dead hospitalized and with clinical and imaging evaluation.

**COVID-19**” so as to avoid any risk of contagion, not necessarily from SARS-CoV-2. Consequently, all the procedures indicated for sanitizing the anatomical table and the sector environment must be followed after performing the autopsy.

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