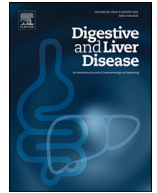




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Digestive Endoscopy

Safety in digestive endoscopy procedures in the covid era recommendations in progress of the Italian Society of Digestive Endoscopy

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AGP: Aerosol Generating Procedure

ABSTRACT

The new coronavirus disease has started in Wuhan - China at the end of 2019 and quickly spread with a pandemic trend across the rest of the world. The scientific community is making an extraordinary effort to study and control the situation, but the results are just partial.

Based on the most recent scientific literature and strong statements by the most prestigious international health institutions, the Italian Society of Digestive Endoscopy has drawn up some recommendations about the use of personal protective equipment, the correct way of dressing and undressing of endoscopists and nurses, before and after digestive endoscopy procedures. In addition, some other important indications are given to reduce the risk of contamination of healthcare providers during endoscopic activities, in the setting of a pandemic.

Nevertheless, because of the very quick evolution of our knowledge on this issue, these recommendations must be considered as evolving, because they could change in a short time.

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1. Introduction

The new coronavirus disease, so-called CoViD-19, started in Wuhan - China at the end of 2019 and quickly spread with a pandemic trend across the rest of the world [1]. The international scientific community is making its best effort to contain the problem; however, because of the scarcity of available information the effectiveness of these efforts suffers a measure of uncertainty. Moreover, the problem of undocumented infectious patients (with mild, limited or no symptoms) makes it exceedingly difficult to define univocal pathways [2].

As a consequence, at present, we should follow two lines of conduct: on one hand, we have to consider our new knowledge as temporary, subject to change in a short time; on the other hand, exactly for this reason, we have to act carefully to avoid further spread of the disease by inappropriate procedures.

In this paper, aimed at endoscopists, gastroenterologists, surgeons, and nurses we summarize data from selected recent literature on the topic and clinical recommendations from scientific societies and international institutions such as the World Health Organization (WHO), the Center for Disease Control and Prevention (CDC), the National Health Commission of the People's Republic of China, and the Italian Ministry of Public Health.

Based on these considerations, the Italian Society of Digestive Endoscopy (SIED) has drawn up these recommendations about the use of personal protective equipments (PPE), the correct way of

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dressing and undressing of endoscopists and nurses, before and after digestive endoscopy procedures. In addition, some other important indications are given to reduce the risk of contamination of healthcare providers during endoscopic activities, in the setting of a pandemic.

1.1. Clinical features of patients suffering from covid-19

The corona viruses are an important group of large, enveloped, positive-single-stranded RNA viruses causing a wide spectrum of diseases in animals and humans [3,4]. In 2002 and 2012 two different types of corona viruses were isolated, causing respectively severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) [5,6]. At the end of December 2019, a novel type of corona virus has been isolated as responsible of a new syndrome named corona virus disease 2019 (CoViD-19) by the WHO [7] and severe acute respiratory syndrome by corona virus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses [8]:

This virus, suspected to have a zoonotic origin [9,10], uses a densely glycosylated spike protein to enter the host cells and binds with high affinity to the angiotensin-converting enzyme 2 (ACE2) receptor in humans in a similar way to SARS-CoV1 [11].

Chinese data suggest that the mean age of the infected patients is around 53 years, with a predominance of male subjects [8,12]. In spite of these data, there are papers reporting no difference in the proportion of male and female subjects admitted to hospital. A possible explanation could be that the first reports of new corona virus infection were correlated to the hospitalization of a high number of workers of the Huanan Seafood Wholesale Market, most of whom were male [13].

The median incubation time of the disease is about 4-6 days, ranging from 1 to 15 days [8,14].

In clinical practice, most of the patients affected by CoViD-19 present with respiratory symptoms (dry cough, sputum production, sore throat, shortness of breath, dyspnea) with or without fever (40% on admission and about 85% during hospitalization), fatigue, and myalgia, sometimes presenting nasal and conjunctival congestion too [2,15-19].

At current time, there is some uncertainty about the prevalence of extra-respiratory manifestations, such as those concerning the digestive tract. Some Authors define digestive symptoms as nausea, vomiting, diarrhea (often observed as first manifestation in young patients), anorexia, abdominal pain as uncommon [13,20,21] but many others indicate that they are quite common. In many case-series, up to 50% of clinical manifestations started with digestive and not necessarily with respiratory symptoms, which developed later, during the hospital stay [19,22-25].

In a recent Chinese study, an important risk hypothesis was presented. It seems that patients initially presenting digestive symptoms could have a longer interval from onset to admission and a worse prognosis, as compared to patients presenting with respiratory symptoms. This could be because if doctors rely only on pulmonary signs to raise the suspicion of CoViD-19, they may miss some cases showing, initially, only digestive symptoms. This could delay the diagnosis of the syndrome until the respiratory symptoms appear at an advanced stage [26]. However, at the moment, the evidence supporting this hypothesis is limited; therefore, further and more detailed investigations are needed before this information is taken for granted.

1.2. Patients risk definition and assessment

Early identification of suspected subjects represents the first step to prevent and contain the spread of the disease [27,28]. In this perspective, it is especially important to stratify the patients

using some risk indicators about the possibility of disease transmission. According to different studies, we must consider the following elements as risk indicators:

1. respiratory symptoms (dry cough, sputum production, sore throat, shortness of breath, dyspnea, acute respiratory infection of any severity) with or without fever;
2. clinical and/or radiological diagnosis of pneumonia;
3. digestive symptoms (nausea, vomiting, diarrhea, anorexia, abdominal pain);
4. fever > 37.5°C (even if without pulmonary involvement);
5. permanence in high risk areas (ongoing classification) in the previous 14 days;
6. contact with CoViD-19 positive patients in the previous 14 days;
6. contact with persons coming from high risk areas in the previous 14 days;

On the ground of these data and according to the latest report of the Italian Ministry of Public Health [29], SIED stratifies the risk of patients undergoing an endoscopic procedure in four different levels of growing severity, as shown in Table 1. These four definitions are based on currently (at the time of this writing) available information and could be reviewed based on the evolution of the epidemiological situation and of scientific knowledge.

2. Routes of infection transmission

The possible ways of corona virus transmission in health workers are several and comprise [11,26,30]:

- person-to-person, by respiratory secretions, salivary droplets;
- aerosol generated by medical procedures;
- contact with body fluids;
- contact with contaminated surroundings.

In addition the CDC and some other Authors detected the virus in the feces of CoViD-19 positive patients (in up to 54% of the cases), suggesting a potential fecal-oral transmission [31,32]. The virus has been isolated in the blood of infected subjects too, thus it is recommended to be very careful in the handling of blood samples and bioptic specimens [11,33-36].

Moreover, corona virus has been isolated in urine: as a consequence, this potential way of transmission needs to be investigated [37].

Person-to-person contamination, by respiratory secretions, salivary droplets, and aerosol, represents the most frequent way of virus transmission. A very interesting study has evaluated the stability of corona virus in aerosol (up to 5 µm of diameter) showing that it remains viable for up to 3 hours after aerosolization, with a decay in infectious titer (dosed in tissue-culture infectious dose TCID) from 10^{3.5} to 10^{2.7} TCID₅₀ per liter of air, as observed with SARS-CoV-1, from 10^{4.3} to 10^{3.5} TCID₅₀ per milliliter. The half-life of corona virus in aerosol shows a median of approximately 1.1 to 1.2 hours and 95% confidence intervals of 0.64 to 2.64. The virus has an exponential decay in titer, as indicated by a linear decrease in the log₁₀ TCID₅₀ per liter of air over time [38]. Based on these data and considering that all endoscopic procedures are aerosol-generating and performed in close and prolonged contact with the patient, digestive endoscopy must be considered as a discipline with a very high risk of contagion [24-26,30]. Cough, retching, and vomiting which can generate aerosols as well as flatus, occurring during colonoscopy, disseminate germs to the surroundings [39].

Besides, the half-life, stability, and decay of corona virus has been studied on different materials such as plastic, stainless steel, copper, and cardboard that can be present in several surfaces of

Table 1

CoViD-19 risk assessment of the patients undergoing endoscopic procedures, according to the latest report (at the moment of this writing) of the Italian Ministry of Public Health.

I level no risk patient	no symptoms no contact with CoViD-19 positive patients in the previous 14 days no permanence in high risk areas in the previous 14 days
II level suspected patient	acute respiratory infection with, at least, one of either fever or cough + respiratory distress, without any other possible etiology different from CoViD-19 + history of travel in high risk area in the previous 14 days Or any acute respiratory infection + contact with a probable or confirmed CoViD-19 positive patient Or severe acute respiratory infection with fever and, at least, one respiratory symptom + with need of hospitalization + without any other possible etiology different from CoViD-19
III level probable positive patient	a suspected case in which the test result for CoViD-19 is doubtful/inconclusive when using a Real Time PCR specific protocol performed in a selected Regional Referenced Laboratory or is positive using a pan-corona virus test
IV level confirmed positive patient	a case in which a positive test result for CoViD-19, performed at the National Reference Laboratory of the Istituto Superiore di Sanità (ISS) or in a selected Regional Referenced Laboratory, is confirmed regardless of any clinical symptoms

Table 2

Stability and half-life of CoVi-19 in aerosol (> 5 µm) and on various surfaces of different materials, according to the study by van Doremalen [38].

	Aerosol	Plastic	Stainless steel	Copper	Cardboard
STABILITY Hours In Which Virus Remains Viable	FOR UP TO	FOR UP TO	FOR UP TO	FOR UP TO	FOR UP TO
HALF-LIFE Hours In Which Virus Remains Infectious	3 HOURS 1.1 HOURS	72 HOURS 6.8 HOURS	48 HOURS 5.6 HOURS	4 HOURS 0.8 HOURS	24 HOURS 3.5 HOURS

the endoscopy room. The virus seems to be more stable on plastic and stainless steel surfaces, with viable particles up to 72 hours after application to these materials, compared to copper and cardboard. Nevertheless, the virus titer was greatly reduced after 72 hours on plastic (from $10^{3.7}$ to $10^{0.6}$ TCID₅₀ per milliliter of medium) and after 48 hours on stainless steel (from $10^{3.7}$ to $10^{0.6}$ TCID₅₀ per milliliter of medium). No viable virus particles were measured on copper, after 4 hours, and on cardboard after 24 hours. The half-life of corona virus is longest on stainless steel and plastic, compared to that on copper and cardboard; its estimated median half-life is approximately 5.6 hours on stainless steel and 6.8 hours on plastic. The virus has an exponential decay in titer, as indicated by a linear decrease in the log₁₀ TCID₅₀ per milliliter of medium over time [38]. Table 2 summarizes the results of this study.

Body fluids from positive CoV-19 patients can splatter during endoscopic procedures (insertion/withdrawal of devices from working channel, removal or change of air/water buttons, etc.), patients' saliva can contaminate the pillow or the bed, and water mixed with stool often drips on the bed during colonoscopy. Moreover, some Chinese studies show CoV-19 contamination on the shoes and stethoscope of healthcare workers and in several locations in the patient's room, as bed, sink, bathroom, light switches, and doors in absence of droplet or fecal shedding [30,40–43].

3. PPE: which ones to choose and how to use them correctly in the endoscopy room

The first TIMES magazine cover of April 2020 is dedicated to the healthcare workers called heroes of the front-line, many of whom died facing the CoViD-19 during their hospital shifts. Many thousands of doctors and nurses, all over the world, have died of COVID 19 infection, often because of the lack of the right PPEs or for having used them incorrectly. This, in the height of the third millennium, is frustrating and totally unacceptable.

As we mentioned above, all endoscopic procedures must be considered as activities at very high-risk of infection because of the prolonged and close contact with the patients, their salivary droplets and body fluids, and of the generation of aerosols [30,39,41,43]. On the other hand, in addition to the contagion risk for endoscopists and nurses, the problem of asymptomatic patients must always be kept in mind. Indeed, some patients show a wide range of symptoms, but others have minimal symptoms or are completely asymptomatic [17,18,25,44]. Moreover, the spread of the virus can occur from both symptomatic and asymptomatic patients, with the same severity [26,28,37,45]. These asymptomatic but infectious subjects represent a huge source of contagion, and for this reason some Authors named them as super-spreaders. For all these reasons, the potential infection risk of healthcare workers in performing endoscopic activities, even in case of negative or non-suspect patients, should never be underestimated and all appropriate PPEs must be correctly used.

A recent ad-interim guidance, about the preventive measures of infection control (shown in Table 3) and about the right use of appropriate PPE for healthcare workers performing endoscopy on subjects with CoViD-19, has been published by the WHO [45]. On the same topic, SIED has published a video-tutorial for endoscopists and nurses about the use of PPE in the endoscopy room and the correct way of dressing and undressing [46]. Preliminary recommendations are shown in Table 4.

Before starting the dressing procedure, it is necessary to make sure that the needed material is arranged in order of use as indicated in the internal protocols and check lists. Dressing must be carried out with the help of a mirror or, better, under the supervision of a trained observer who follows the appropriate check list and reads aloud each phase of the procedure, to ensure maximum adherence to the same.

Since digestive endoscopy procedures are at high risk of contagion (due to close and continuous contact with the patient who

Table 3
WHO (World Health Organization) preventive measures to control the spread of infection by CoViD-19.

Preventive measures of infection control
1. Perform hands hygiene frequently with an alcohol-based hand-rub if your hands are not visibly dirty or with soap and water if hands are dirty
2. Avoid touching your eyes, nose, and mouth
3. Practice respiratory hygiene by coughing or sneezing into a bent elbow or tissue and then immediately disposing of the tissue
4. Wear a medical mask if you have respiratory symptoms and perform hands hygiene after disposing of the mask
5. Maintain social distance (a minimum of 1 mt) from individuals

Table 4
SIED (Italian Society of Digestive Endoscopy) preliminary recommendations about the correct use of PPEs in the endoscopy room for healthcare workers performing endoscopy on subjects with CoViD-19.

Preliminary recommendations
1. Cut beard and moustache to allow a better adhesion of the respiratory and facial PPE
2. Tie and gather long hair
3. Remove all personal objects: pens, mobile phones, keys, watches, jewelry etc
4. Use eyeglasses only if strictly necessary; do not wear contact lenses
5. Do not wear earrings, necklaces, piercing, rings (including wedding ring) and bracelets, which can contribute to the breakage of gloves and could remain contaminated even after washing hands
6. Always work with a hospital disposable water-repellent uniform and plastic clogs, so they can be disposed/disinfected once the care activity is completed

Table 5
SIED (Italian Society of Digestive Endoscopy) dressing recommendations about the correct use of PPEs in the endoscopy room for healthcare workers performing endoscopy on subjects with CoViD-19.

Dressing recommendations
1. Wash hands with chlorhexidinedi-gluconate soap and then rub them with antiseptic alcoholic gel
2. Wear disposable water-repellent boot covers
3. Rub hands with antiseptic alcoholic gel
4. Put on the first pair of disposable gloves
5. Wear disposable water-repellent gown, fastening it well to the neck and belt
6. Wear a respiratory protection mask with facial filter* (FFP2 always, FFP3 in case of CoViD-19 positive patients)
7. Wear a disposable water-repellent scrub cap
8. Wear a disposable/multi-use face shield or, if not available, disposable/multi-use goggles
9. Put on the second pair of disposable gloves covering the cuffs of the gown

* The WHO suggests the use of a powered air purifying respirator as a desirable alternative to a respiratory protection mask with facial filter.

produces droplets and / or aerosols of secretions), the following PPE must be placed on a trolley, in order of use:

1. disposable water-repellent boot covers;
2. a first pair of disposable gloves;
3. disposable water-repellent gown;
4. respiratory protection mask with facial filter (FFP2 always, FFP3 in case of CoViD-19 positive patients);
5. disposable water-repellent scrub cup;
6. disposable/multi-use face shield or, if not available, disposable/multi-use goggles;
7. a second pair of surgical long gloves.

The WHO recommends the use of an apron, although this device is not usually used in many countries [44]. Dressing recommendations are shown in Table 5.

Even undressing must be carried out with the help of a mirror or, better, under the supervision of a trained observer who verifies that the PPE has been removed correctly. If there is no filter area in the endoscopy room, the undressing must begin inside the room in which a division between a dirty and a clean zone must be prepared and, finally, completed outside the room. Undressing recommendations are shown in Table 6.

The topic of protective mask is an extremely hot one. Surgical masks are designed to block large particles and they are ineffective in blocking small aerosol particles (< 5 µm) to reduce the risk of CoViD-19 contagion [42]. Unlike surgical masks, FFP2 and FFP3 masks are very reliable to reduce the risk of CoViD-19 contagion, filtering at least 95% of aerosols (<5 µm) and droplet-size (5 µm to

50 µm) particles. The only difference between these two types of masks consists in the maximum loss of filtering: up to 8% for FFP2 and up to 2% for FFP3 [47]. Note that FFP3 is the European measurement standard equivalent to the American N95. The Food and Drug Administration defines the N95 mask as a respiratory protective device designed to achieve a very close facial fit and very efficient filtration of airborne particles. The 'N95' designation means that when subjected to careful testing, the mask blocks at least 95 percent of very small (0.3 micron) test particles. If properly fitted, the filtration capabilities of N95 respirators exceed those of face masks. However, even if properly fitted, N95 mask does not completely eliminate the risk of infection [48]. The technical features of the different types of facial masks are summarized in Table 7.

People with chronic respiratory, cardiac, or other medical conditions that make breathing difficult should check with their health care provider before using an N95 respirator because the N95 respirator can make it more difficult for the wearer to breathe. Some models have exhalation valves that can make breathing out easier and help reduce heat build-up. Note that N95 respirators with exhalation valves should not be used when sterile conditions are needed. All FDA-cleared N95 respirators are disposable devices [48].

The American Gastroenterological Association (AGA) Institute has recently published four recommendations about the use of masks for healthcare workers during endoscopy during the CoViD-19 pandemic [43]:

Table 6

SIED (Italian Society of Digestive Endoscopy) undressing recommendations about the correct use of PPEs in the endoscopy room for healthcare workers performing endoscopy on subjects with CoViD-19.

Undressing recommendations
1. Remove the external gloves in the same way in which sterile gloves are removed after surgery and dispose of them in the biohazard waste container
2. Rub the inner gloves with antiseptic alcoholic gel
3. Remove the disposable gown: open the laces at the neck and at the waist, removing the gown from the inside of the shoulders, being careful to fold it with the contaminated part folded inside; dispose of the gown in the biohazard waste container
4. Rub the inner gloves with antiseptic alcoholic gel
5. Remove the face shield by grasping it by the back strap, or protective glasses by holding them by the stems and dispose of everything in the biohazard waste container, in the case of disposable items, or in a special container dedicated to disinfection, in the case of multi-use devices
6. Rub the inner gloves with antiseptic alcoholic gel
7. Remove the disposable scrub cap and then the disposable boot covers and dispose of everything in the biohazard waste container
8. Rub the inner gloves with antiseptic alcoholic gel
9. Leave the area dedicated to the undressing
10. Rub the inner gloves with antiseptic alcoholic gel
11. Remove the respiratory protection mask by grasping the rubber bands from their back side and treat it according to the specific case: FFP3 used in the case of CoViD-19 positive patient: dispose of it in the biohazard waste container FFP2 used in negative or otherwise not suspected CoViD-19 patients: dispose of it or reuse after adequate disinfection, according the type of Mask
12. Rub the inner gloves with antiseptic alcoholic gel
13. Remove the inner gloves in the same way in which sterile gloves are removed after surgery and dispose of them in the biohazard waste container
14. Wash hands with chlorhexidine di-gluconate soap and then rub them with antiseptic alcoholic gel

Table 7

Technical features of different types of face masks.

Type of face mask	Production material	Workplace of use	It protects the wearer from	APF value	FPL value	ILR value	MDF value
SURGICAL	MULTI-LAYER NON-WOVEN	HOSPITALS	LARGE PARTICLE DROPLETS SPLASHES, SPRAYS, SPLATTERS Up to 120 mm Hg of pressure	ND	10 - 87% according to quality/efficacy	12 - 25%	5 µm
FFP2	FOAM POLYPROPYLENE POLYESTER	HOSPITALS INDUSTRIES	FIBROGEN AND FINE DUSTS ORGANIC VAPOUR, FUMES SOLID/LIQUID AEROSOL MOULD, FUNGUS, BACTERIA, VIRUS	10 x OEL	94%	< 8%	0,6 µm
FFP3	FOAM POLYPROPYLENE POLYESTER	HOSPITALS INDUSTRIES	FIBROGEN AND FINE DUSTS ORGANIC VAPOUR, FUMES SOLID AND LIQUID AEROSOL MOULD, FUNGUS, BACTERIA, VIRUS	20 x OEL	99%	< 2%	0,6 µm

ND = Not Declared

APF = Assigned Protection Factor, indicates how well the mask protects the wearer from hazardous substances.

OEL = Occupational Exposure Limit is a standard that determine the amount, or concentration, of a hazardous substance allowable in the workplace air.

FPL = Filter Penetration Limit, indicates the percentage of airborne particles filtering

ILR = Inward Leakage Rate, indicates the percentage of leakage around the mask edges

MDF = Minimum Dimension of Filtering, indicates the minimum measure up to which the mask is able to filter

1. In healthcare workers performing upper GI procedures, regardless of CoViD-19 status, the AGA recommends the use of N95 (or N99, or powered air-purified respirator PAPR) masks instead of surgical masks, as part of appropriate PPE (strong recommendation, moderate level of evidence).
2. In healthcare workers performing lower GI procedures, regardless of CoViD-19 status, the AGA recommends the use of N95 (or N99 or PAPR) masks instead of surgical masks as part of appropriate PPE (strong recommendation, low certainty of evidence).
3. In healthcare workers performing any GI procedure, in known or presumptive CoViD-19 patients, the AGA recommends against the use of surgical masks only, as part of adequate PPE (strong recommendation, low level of evidence).
4. In extreme resource-constrained settings involving health care workers performing any GI procedures, regardless of CoViD-19 status, the AGA suggests extended use/re-use of N95 masks over surgical masks, as part of appropriate PPE (conditional recommendation, very low level of evidence).

Because of the global PPE shortage their use must be rationalized, minimizing the waste and reserving them for the appropriate cases [45].

4. Some specific issues about endoscopic activities

4.1. How to organize the staff workstations and workflow?

Before starting work, daily, all staff members must measure their temperature. In case of fever, the subject must not be allowed to work and must be tested for CoViD-19 infection.

To prevent the spreading of infection among the staff, it is important to organize the work at individual working stations using dedicated phones, computers, and chairs staying at 2 meters' minimum distance from one another. Avoid sharing the same equipment. Wipe and disinfect the workstations before and after use with virucide, following the decontamination protocols [30].

Provide the staff with a clear job description and, eventually, backup plans. To minimize cross infections, separate the workforce into two teams: the first one is on-site, providing direct clinical

care; the second one is off-site, programming clinical care. This way will make it possible to minimize the risk of contagion and provide substitution if a member of the staff falls ill or needs quarantine [30].

4.2. How to organize the endoscopy unit spaces?

Set up a reception area to assess and stratify the patients' risk of CoV-19 infection before allowing them to enter the waiting room with other persons. They must be separated two meters from one another.

A designated room for suspected and positive CoViD-19 patients, fitted adhering to all biosafety requirements, must be set up.

Set up a designated area for PPE dressing, near the endoscopy room. PPE undressing ideally occurs in an anteroom or a dedicated area, separated from the endoscopy rooms [43].

In the staff relax/eating room, the persons will be separated by two meters from one another, sitting in the same direction, by preventing face-to-face infection transmission [30].

The bathroom is a potential site of transmission. For this reason, patient and staff bathrooms must be separated and frequently disinfected [30].

4.3. Which patients must undergo endoscopy?

In outbreak time, particularly in red zones, it is mandatory to limit the indications for endoscopic procedure to emergencies (acute digestive bleeding, foreign bodies extraction, and acute suppurative cholangitis) and cancers care. All non-urgent cases must be rescheduled. This is aimed at reducing the risk of spreading infection from asymptomatic patients, the risk of patients-to-patients and patients-to-healthcare workers cross-infection, the use and costs of PPE, and unnecessary admissions to free up hospital resources [22,25,30].

4.4. Are negative pressure rooms really necessary?

The virus characteristics and the ways in which it is transmitted make digestive endoscopy a perfect route for infection [29,49]. Moreover, the potential infection spreading from asymptomatic subjects amplifies the need to apply whatever behavior and protocol is suitable to prevent infection in healthcare workers [33,49–51]. In details, the power of CoVi-19 to remain viable for several hours on different materials [37,39] and the aerosol generation suggest that endoscopic procedures [37–40] may contribute to the nosocomial transmission of CoViD-19. Thus, the use of negative pressure rooms with anterooms may reduce the spread of the infection in the hospitals [43]. Accordingly, on this point, the AGA institute says: "in health care workers performing any GI procedure, with known or presumptive CoViD-19, the AGA suggests the use of negative pressure rooms over regular endoscopy rooms, when available (Conditional recommendation, very low level of evidence)" [43].

Thus, the use of negative pressure rooms is strongly suggested to perform endoscopic procedures in suspected and positive CoViD-19 patients. When negative pressure rooms are unavailable, portable industrial-grade high-efficiency particulate air (HEPA) filters may be a reasonable alternative, according to CDC suggestions [52,53].

4.5. What do we have to do before endoscopic procedures?

For out-patients:

1. provide all patients with mask during triage and waiting for the procedures;

2. screen and assess the risk of patients (clinical evaluation of symptoms, recent contact and travel history);
3. test the suspected patients and, if possible, wait for the test result before the procedure.

For in-patients:

1. provide all patients with masks during triage and waiting for the procedures;
2. re-screen and re-assess the risk of patients (clinical evaluation of symptoms, recent contact and travel history);
3. dedicated routes of transportation, corridors, and lifts must be used to transfer suspected and positive CoViD-19 patients to the Endoscopy Unit [54,55]

What do we have to do during endoscopic procedures on suspected and positive CoViD-19 patients?

1. ensure that all needed PPE is available;
2. follow the preliminary and dressing recommendations as shown in Tables 3 and 4;
3. if tracheal intubation is required, only the anesthesiologist and his/her assistant stay in the room during intubation. The remaining team stays outside.

What do we have to do after endoscopic procedures?

1. follow the undressing recommendations as shown in Table 5;
2. provide patients with the suitable mask, according to the patient's status;
3. notify the patients about the need of flushing the toilet, after use, with the lid closed and, then, sanitize the bathroom;
4. 14 days after the procedure, contact the suspected patients to verify their evolution.

4.6. Which decontamination protocol should we use in a covid-19 setting?

As other corona viruses, CoV-19 is inactivated by the most commonly used disinfectants (such as hydrogen peroxide, alcohols, sodium hypochlorite or benzalkonium chloride) and no additional measures are needed to clean and disinfect endoscopes [56–58]. For the endoscopy center environment, UV irradiation and ozone treatment are recommended for the cleaning and sterilization of air and all surfaces, such as endoscopic equipment, office tables, and walls of the examination room. Chlorine-containing detergent is recommended for daily floor cleaning [59–61].

5. Conclusion

The CoViD-19 outbreak spread from China very quickly and, in just over three months, it reached almost the whole world with a pandemic attitude. Many studies have been carried out about different issues of the disease, even if some of them have notable limitations (incomplete clinical documentation and retrospective data collection are the most frequent). For all these reasons, our knowledge on the severe acute respiratory syndrome caused by the novel '19 corona virus is partial and subject to change. Thus, these recommendations, even if based on the most recent and pertinent scientific literature and strong statements by the most prestigious international health institutions, must be considered as evolving because they could change in a short time.

Authors contribution

G. Galloro, A. Pisani, L. Pasquale: study design, data analysis, paper writing.

A. Lamazza, G. Cengia, E. Ciliberto, R L. Conigliaro: data acquisition and interpretation.

P. Da Massa Carrara, B. Germanà, R.M. Zagari study supervision. All authors have seen and approved the final draft of the paper.

Declaration of competing interest

All the Authors declare that they have no conflict of interest.

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