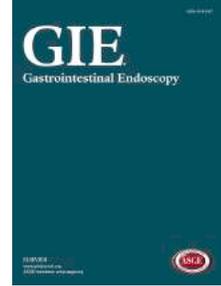


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Considerations in performing endoscopy during the COVID-19 pandemic

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Acronyms:

SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2

COVID-19: Coronavirus Disease 2019

HCP: Health Care Providers

PPE: Personal Protective Equipment

PAPR: Powered Air Purifying Respirator

AGP: Aerosol Generating Procedure

WHO: World Health Organization

CDC: Centers for Disease Control and Prevention

PUI: Person under investigation

BSL: Biosafety Level

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Introduction

Based on experiences and the literature, our objective is to provide practical suggestions for performing endoscopy in the setting of COVID-19 pandemic.

SARS-CoV-2/Novel Coronavirus-19 (COVID-19) has become a global pandemic. Human-to-human transmission occurs through respiratory secretions, aerosols, feces, and contaminated environmental surfaces.^{1,2} Transmission can occur in both symptomatic and asymptomatic individuals.³ Viable virus particles can be detected in aerosols up to 3 hours after aerosolization and up to 3 days on surfaces.⁴ A recent publication suggests that undocumented infections were the source of a substantial majority of documented cases.⁵ The risk of infection to healthcare workers is significant: in one of the earliest documentations of infection in Wuhan, 29% of patients (40 out of 138) were healthcare workers.⁶ It is unknown how much of the risk was related to the direct care of infected patients or to the inadequate use of personal protective equipment (PPE).

When performing endoscopy, it seems inevitable that healthcare providers (HCP) will be exposed to either respiratory or gastrointestinal fluids from patients. Thus, adequate protection of HCP is now critical. The World Endoscopy Organization has recently released a recommendation on infection prevention and control in digestive endoscopy based on experiences from China.⁷ Similarly, an Italian group has provided recommendations regarding the performance of endoscopy during the COVID-19 outbreak.⁸

Based on their experiences with a similar coronavirus, which caused SARS 17 years ago, Hong Kong adopted measures similar to those aforementioned immediately upon the first news of COVID-19 outbreak in late January.⁹ With numbers of COVID-19 cases continuing to rise in North America and Europe, we aim to provide practical suggestions to potentially avoid the transmissions of COVID-19 in the endoscopy unit.

Potential mode of transmissions of SARS-CoV-2 during endoscopy

The virus characteristics and its transmission make endoscopy a potential route for infection. Possible routes of SARS-CoV-2 transmission include (1) person-to-person, (2) respiratory droplets, (3) aerosols generated during endoscopy, and (4) contact with contaminated surroundings and body fluids.^{1,10} Additional care must be instituted when handling blood samples or specimens because the virus has been detected in the blood of COVID-19 patients. Lei Pan et al¹⁰ demonstrated that 48.5% of the patients presented with GI symptoms, including anorexia (83.8%), diarrhea (29.3%), and vomiting (0.8%), with the severity increasing as the disease progressed. With the detection of the virus in the feces, the Centers for Disease Control and Prevention (CDC) has suggested the use of separate bathrooms in cases of suspected COVID-19.¹¹ In line with these recommendations, extensive precautions need to be adopted to avoid potential oral-fecal transmission.

Importantly, staff with a travel history to COVID-19–affected areas or a history of exposure to COVID-19–affected individuals should first self-quarantine for 14 days, to eliminate risk of transmission.

Is endoscopy an aerosol-generating procedure?

All endoscopic procedures should be considered aerosol-generating procedures (AGP). Coughing and retching can occur during upper endoscopy, generating aerosols. Likewise, patients undergoing colonoscopy may pass flatus, which is also known to disseminate bacteria to nearby surroundings.¹² A prospective study has demonstrated unrecognized endoscopist exposure to infectious particles during GI procedures.¹³ Recently, the World Health Organization (WHO) has published an extensive guideline on the rational use of personal protective equipment (PPE) for COVID-19 and provided specific instructions for healthcare workers performing AGP on patients with COVID-19.¹⁴ These include the use of a respirator (N95, FFP2 standard, or equivalent), gown, gloves, eye protection, and apron although aprons are not usually not used in the United States. Their use should be immediately and strictly adopted in practice, if at all possible.¹³

Surface contamination during endoscopy

Patient-contaminated fluids often splatter when inserting or removing an accessory from the endoscope's working channel, adjusting the air/water button, retrieving tissue from a biopsy bottle, and while performing precleaning. Patients' saliva can contaminate the pillow or the bed, and stool mixed with water often drips to the bed during colonoscopy.

Contamination of the room used by patients with COVID-19

Extensive environmental contamination can occur even from patients with mild COVID-19 upper respiratory symptoms. Ong and colleagues¹⁵ detected positive SARS-CoV-2 samples in various locations around the patient's room, including the patient's bed, sink, bathroom, light switches, and doors. In addition, positive samples were found on the shoes and stethoscope of staff exiting the patient's room. However, there was no contamination in the anteroom or corridor outside the room. The study illustrates the significant extent of contamination by patients with SARS-CoV-2 through respiratory droplets and fecal shedding.¹⁶

Our Challenge

The goal is to attain zero percent infection rates among HCP while providing essential services to patients. For the GI community, the key element will be to prevent exposure during any endoscopic procedure. As the outbreaks continue to occur, masks and personal protective equipment (PPE) may become scarce in quantity. An early inventory of what is available to the institute is essential to formulate a plan for PPE usage. Conservation of PPE is important and should be planned.

Suggested general measures

Management

1. Prepare. Plan. Test. Practice. Repeat. Ready the team. Being well prepared is the best we can do to reach our zero-contamination goal.

2. Staff management is an integral part of performing endoscopy during the COVID pandemic.
3. Establishment of a rapid response communication channel using smart phone apps, email, and video conferences to distribute information across the entire unit.
4. Regular updates with administrators, infectious control team, doctors, and nurses to stay updated on the development of the infection and discuss a unified plan.

Preparation

1. Ensure performance of fit testing for N95 respiratory masks for all HCP. During the course of the outbreak, some masks may run out of stock and HCP will need to plan for alternatives. Protection, however, may be achievable even without N95 through the use of medical masks.¹⁷ Note that as an AGP, endoscopy of PUI/COVID patients requires the use of respiratory protection. The powered air purifying respirator (PAPR) is a desirable alternative that does not require fit testing and can be used by employees with facial hair who would otherwise not achieve a good seal with the N95. Most units, however, are not stocked to have an adequate supply of PAPR.
5. Familiarize staff with the correct method of hand hygiene. An excellent review has been published.¹⁸ Compliance with correct hand hygiene practices is low; thus, a practice, review, and compliance check is necessary.
6. Follow the WHO recommendations for PPE (Table 1).¹⁴ Familiarize staff with the correct sequence of gowning up (donning) and down (doffing) through teaching

- videos and diagrams (Table 1)¹⁹. Note that there is poor correlation between self-perceived proficiency in PPE use and its appropriate use.¹⁷ Repetitive training and demonstrated competency are necessary. Use a buddy system, where another colleague observes the gown up and down procedures to advise on any breach of protocol (Table 2). Inform to conserve the use of masks and PPE.
7. Setting up a reception bay to screen and stratify risk of COVID-19 infection of the patient before allowing them to enter the waiting area alongside other patients. In the setting of substantial community spread, make efforts to separate all patients by approximately 6 feet.
 8. Set up a designated procedure and recovery room for suspected (PUI) and COVID-19 positive patients. The endoscopic procedures should be performed in an Airborne Infection Isolation Room that adheres to Level 3 biosafety requirements. Consider alternative sites with enhanced prevention capabilities for performing procedures if an isolation room is not available.
 9. Set up a designated area for donning PPE that is easily accessible and near the room. Doffing of PPE ideally occurs in an anteroom or a doffing area that is separate from the procedure room.²⁰
 - 10 Equally important, staff should take additional precautions to prevent contamination among providers. Work at individual working stations using a designated phone, computer, and chair, and stay at least 6 feet from any other coworkers while at work to the extent possible, recognizing that this will be difficult in some situations. Avoid sharing workstation items and equipment. Wipe

- workstations before and after use with virucide, following instructions on the virucide exactly as recommended.
- 11 Create a workflow to provide a clear job description and designation of authority with backup plans. Separate the workflow to minimize cross-contamination. For example, consider dividing the clinical workforce into 2 teams, alternating roles at predefined intervals (such as weekly). One team is on-site and providing direct clinical care. The second team is coordinating clinical care off-site, minimizing risk of exposure and providing back-up coverage if an on-site provider were to become ill or require quarantine.
 - 12 In the staff lounge/eating area, we allow sitting in one direction, thus preventing infection from face-to-face transmission.
 - 13 The bathroom is a potential site of transmission. Ideally patient and staff bathrooms are separated and disinfected frequently.

Indications for procedures

In the epidemic area, the indications include management of upper gastrointestinal bleeding, acute cholangitis, foreign body, and obstructions.⁷ Care (initial diagnosis, biopsy, staging, palliation of biliary and luminal obstruction) of cancer patients may also be considered urgent. Reschedule nonurgent endoscopy services. This measure is aimed at reducing the risk of spreading infection from asymptomatic patients, reducing the risk of cross-infection among patients, reducing use of PPE, and reducing unnecessary admissions to free up hospital resources.

In Practice*In the setting of substantial community spread of COVID-19:*

1. Require all staff to have daily measurements of temperature before starting work. All febrile staff should not be allowed to work, and they should be evaluated according to local protocols to screen for potential COVID-19 infections.
2. CDC mitigation strategies in the setting of substantial community spread include requiring all HCP to wear a face mask when in the facility, depending on supply.²¹ There is a high viral load in the upper respiratory tract, and there is a significant potential for asymptomatic persons to shed and transmit virus.²² Data showing the prolonged stability of the virus on surfaces may have significant potential implications for use of staff PPE in the general area.²³
3. Require staff to perform work using individual stations: use the same phone, computer, and chair. Do not share. Do not answer phones elsewhere other than in your own station and disinfect your working space regularly.
4. Limit the number of HCP in the endoscopy suite to those essential for performance of the procedures (see below regarding trainees). Off-duty workers should stay at home as much as possible.
5. For HCP directly involved in the procedures, use the hospital-issued scrubs and dedicated endoscopy shoes. Leave these at work.
6. Although these continue to evolve, current COVID-19 screening guidelines include assessing patient's symptoms (such as fever and/or symptoms of acute respiratory illness) and potential contact with a suspected or laboratory-confirmed

COVID-19 patient. The decision to quarantine should be made at that time (Fig. 1).

7. With the availability of RNA testing against COVID, point-of-care testing in patients presenting for endoscopy may facilitate more accurate risk stratification.

Before the procedure:

Outpatients

1. Screen for symptoms, signs, and exposure to SARS-CoV-2 (contact and travel history). Measure their temperature to risk stratify (Fig. 1).
2. Test all suspected patients for COVID-19 whenever possible using RT-PCR.²⁴ If possible, wait until the test results have been received before proceeding.
3. Suspected or confirmed patients should be provided a mask while being triaged, and should be isolated or separated from other patients by at least 6 feet. Alternately, they should be placed in a negative pressure room.
4. Patients should be advised to minimize movements while waiting for the procedure to minimize facility contamination.

In-patients

1. Evaluate for COVID-19 status and reassess for symptoms suspicious for COVID-19 in all patients referred for endoscopy and triage accordingly.
2. PUI and COVID patients should be provided a mask while awaiting the procedure and should be stationed away from other patients as detailed above. Designated transportation corridors or lift/elevator should be used to transfer patients to the endoscopy unit.

During the procedure for PUI/ COVID-19 positive patients:

1. Include verification of the patient's status for COVID-19 in the Time Out protocol.
2. Ensure that a PPE supply is available before entering the procedure room.
3. Wash your hands according to the recommended hand-washing method.
4. Follow the CDC's recommendations for performing AGP: wear a respirator (N95, FFP2 standard, or equivalent); impermeable gown; gloves; apron; and eye protection (Fig. 2).
5. Follow the CDC sequence for putting on the PPE. Remove all personal items, such as jewelry, pagers, and badges. Use the buddy system to confirm that the PPE is correctly in place for those who are not familiar with gowning up and down.
6. Consider boot covers during ERCP.
7. If the patient requires tracheal intubation for the procedure, only the anesthesiologist and his/her assistant stay in the room during intubation. The remaining team stays outside.
8. After the procedure is completed, follow the CDC's recommendations for taking off PPE. Use a buddy system to observe for any breach. If there is, use an alcohol spray to decontaminate the potentially touched area(s).
9. Wash your hands according to the recommended hand-washing method. Confirm proficiency.¹⁸
10. Other HCP in the clean area can complete the procedure report, thus potentially avoiding contaminations.⁷

After the procedure, all patients:

1. Staff: After performing endoscopy in a person under investigation (PUI)/COVID-19 positive patient, shower before leaving the hospital.
2. Patients:
 - a. Provide patients with a suitable PPE, depending on their risk status, while waiting in the recovery area.
 - b. Toilet flush is known to generate bioaerosols (“Toilet plume”) and may transmit infection. Advise patients to flush the toilets after use with the lids closed.
 - c. Contact asymptomatic patients within 14 days to assess their progress after procedure.

Disinfection management:

Reprocessing reusable medical equipment. We are not aware of a change in the RME protocol. Note that the most significant HCP contamination occurs during precleaning of the endoscope in the procedure room due to splashing from the air/water button. Follow the protocol to turn off the processor when replacing the air/water button with the credit card button.

SARS-CoV-2 is deactivated by commonly used disinfectants such as alcohol or chlorine-based solutions. The CDC cleaning and disinfection recommendation can be adopted. Please see Table 2 for the recommended attire for the personnel cleaning the

unit. Personnel cleaning the endoscopy unit must also undergo repeated practice and have their proficiency documented.

Special considerations: trainee involvement

Trainees are an integral part of most academic endoscopic units. With the potential surge in COVID-19 infection, the role of a trainee in endoscopy procedures requires re-evaluation. Because there is too much uncertainty with regard to its transmissible potential and associated morbidity and mortality, we recommend the following plan of actions in managing trainees during endoscopy:

1. They master the prevention of transmission described previously through repeated practice and documented proficiency.
2. Fellows' involvement increases procedure time, and thus increases the potential for exposure. Our practice is to preserve critical resources and minimize the risk of exposure; thus, we limit trainees' involvement during endoscopic procedures.²⁵ As board-certified internists, however, fellows may provide essential physician support in a time of crisis, such as during a surge. They may contribute to the COVID-19 management workforce.
3. At many institutions, fellows cover multiple clinical sites as part of their on-call duties or for ACGME required continuity clinics. In the absence of point-of-care testing, we suggest that fellows be stationed at one hospital to avoid inadvertent spread of infection across multiple sites.

Our guidance is based on our practical experience, observations, and published literature. Note that present understanding of SARS-CoV-2, however, is still rapidly evolving.

The success of preventing endoscopy unit transmission of SARS-CoV-2 is contingent upon the compliance of every member of the team. We must cooperate and collaborate in order to adhere to the prevention steps the best we can and prevent transmissions.

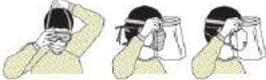
Figure legends

Figure 1. A schematic representation of the workflow for managing suspected (PUI) or COVID-19 patients in an endoscopy unit. Note that this workflow is still evolving. The availability of testing kits would likely change it.

Figure 2. Typical PPE used in our unit in Hong Kong (Image courtesy of Dr Anthony Teoh, Hong Kong, China). Designated shoes to be worn in the endoscopy unit only.

Tables

Table 1. Recommended protocol for putting on and removing personal protective equipment (PPE). Adapted from CDC guidelines

<p>How to put on PPE</p>	<p>1. Gown Fully cover torso from neck to knees, arms, to end of wrists and wrap around the back</p> 	<p>2. Mask Secure ties or elastic bands at the middle of head and neck. Fit flexible band to nose bridge. Fit snug to face and below chin. Fit-check respirator</p> 	<p>3. Goggles Place over face and eyes to adjust fit.</p> 	<p>4. Gloves Extend to cover the wrist of isolation gown</p> 
<p>How to remove PPE (Example 1)</p>	<p>1. Gloves Grasp palm area of the other gloved hand and peel off first glove. Hold removed glove in gloved hand. Slide fingers under the glove at the wrist and peel off the second glove over the first.</p> 	<p>2. Goggles Lift headband or earpiece from the back to remove goggles or face shield.</p> 	<p>3. Gown Unfasten gown ties while ensuring the sleeves do not contact your body. Pull the gown away from the neck by touching the inside of the gown only. Turn inside out and roll into a bundle to discard.</p> 	<p>4. Mask Grasp bottom and top ties of the mask. Remove ties without contacting the front of the mask.</p> 

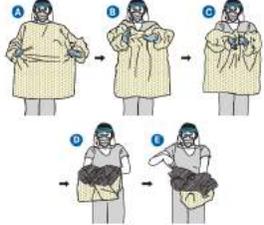
<p>How to remove PPE (Example 2)</p>	<p>1. Gown and gloves Grasp gown in the front and pull away from your body so the ties break. Touch outside of the gown only with gloved hands. While removing the gown, roll it inside-out into a bundle and peel your gloves off at the same time.</p> 	<p>2. Goggles Lift headband or earpiece from the back to remove goggles or face shield.</p> 	<p>3. Mask Grasp bottom and top ties of the mask. Remove ties without contacting the front of the mask.</p> 
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Table 2. Recommended personal protective equipment (PPE) to be used in the context of COVID-19 disease, according to the setting, personnel and type of activity.

(*) Use the buddy system to confirm that PPE is correctly in place. Adapted from WHO and CDC guidelines.

Setting	Target personnel or patients	Activity	Type of PPE or procedure
Healthcare facilities, Inpatient facilities			
Patient room	Healthcare workers	Providing direct care to COVID-19 patients.	*Medical mask, Gown, Gloves Eye protection (goggles or face shield).
	*Use buddy system to prevent protocol breach	Aerosol-generating procedures performed on COVID-19 patients.	*Respirator N95 or FFP2 standard, or equivalent. Gown, Gloves, Eye protection, Apron
	Cleaners	Entering the room of COVID-19 patients.	Medical mask, Gown, Heavy duty gloves Eye protection (if risk of splash from organic material or chemicals). Boots or closed work shoes
	Visitors	Entering the room of a COVID-19 patient	Medical mask, Gown, Gloves
Other areas of patient transit (eg, wards, corridors).	All staff, including healthcare workers.	Any activity that does not involve contact with COVID-19 patients.	Medical mask

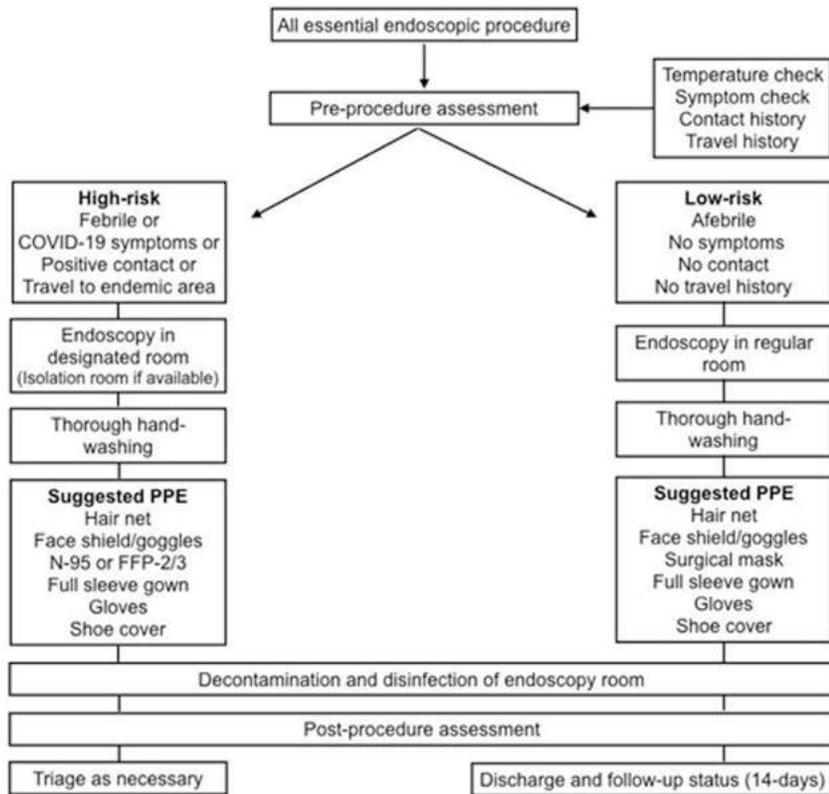
Triage	Healthcare workers	Preliminary screening not involving direct contact.	Maintain spatial distance of at least 1 meter Medical mask required ²¹
	Patients with respiratory symptoms.	Any	Maintain spatial distance of at least 1 meter Provide a medical mask if tolerated by patients
	Patients without respiratory symptoms.	Any	No PPE required
Outpatient facilities			
Consultation room	Healthcare workers	Physical examination of patients with respiratory symptoms.	*Medical mask, Gown, Gloves, Eye protection
	Healthcare workers	Physical examination of patients without respiratory symptoms.	PPE according to standard precautions and risk assessment.
	Patients with respiratory symptoms.	Any	Provide a medical mask if tolerated.
	Patients without respiratory symptoms.	Any	No PPE required
	Cleaners	After and between consultations with patients with respiratory symptoms.	Medical mask, Gown, Heavy duty gloves Eye protection (if risk of splash from organic material or chemicals), Boots or closed work shoes
Waiting room	Patients with respiratory symptoms.	Any	Provide a medical mask if tolerated. Immediately move the patient to an isolation room or separate area away from others; if this is not

			feasible, ensure spatial distance of at least 1 meter from other patients.
	Patients without respiratory symptoms.	Any	No PPE required
Triage	Healthcare workers	Preliminary screening not involving direct contact.	Maintain spatial distance of at least 1 meter Medical mask required. ²¹
	Patients with respiratory symptoms.	Any	Maintain spatial distance of at least 1 meter Provide medical mask if tolerated.
	Patients without respiratory symptoms.	Any	No PPE required

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