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Pediatric Endoscopy in the Era of Coronavirus Disease 2019: A North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition Position Paper

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ABSTRACT

The delivery of endoscopic care is changing rapidly in the era of Coronavirus Disease 2019 (COVID-19). The North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) Endoscopy and Procedures Committee has formulated this statement to offer practical guidance to help standardize endoscopy services for pediatric patients with the aim of minimizing COVID-19 transmission to staff, patients, and caregivers and to conserve personal protective equipment (PPE) during this critical time. Appropriate use of PPE is essential to minimize transmission and preserve supply. Pediatric endoscopic procedures are considered at high risk for COVID-19 transmission. We recommend that all pediatric

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endoscopic procedures are done in a negative pressure room with all staff using proper airborne, contact, and droplet precautions regardless of patient risk stratification. This includes appropriate use of a filtering face-piece respirator (N95, N99, FFP2/3, or PAPR), double gloves, facial protection (full visor and/or face shield), full body water-resistant disposable gown, shoe covers and a hairnet. In deciding which endoscopic procedures should proceed, it is important to weigh the risks and benefits to optimize healthcare delivery and minimize risk. To inform these decisions, we propose a framework for stratifying procedures as emergent (procedures that need to PROCEEED), urgent (PAUSE, weigh the benefits and risks in deciding whether to proceed) and elective (POSTPONE procedures). This statement was based on emerging evidence and is meant as a guide. It is important that all endoscopy facilities where pediatric procedures are performed follow current recommendations from public health agencies within their jurisdiction regarding infection prevention and control of COVID-19.

Key Words: coronavirus disease 2019, gastrointestinal endoscopy, pediatric gastroenterology, severe acute respiratory syndrome coronavirus 2

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Delivery of medicine is changing rapidly since the World Health Organization declared the novel Coronavirus Disease 2019, known as COVID-19, a pandemic of international concern on March 11, 2020 (1). The causative pathogen, severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2 (2)], was first detected in China and has now spread worldwide, with over 2,314,600 confirmed cases and 157,800 deaths as of April 21, 2020 (3). On March 14, 2020, the US Surgeon General (4), the American College of Surgeons (5), and the Centers for Disease Control and Prevention (6) advised the medical community to suspend all elective medical procedures in the United States, and Chief Medical Officers across Canada have provided similar recommendations (7,8). These directives, however, have created uncertainty in how to provide endoscopy services to minimize the risk to patients, caregivers, and staff while preserving supplies of critical personal protective equipment (PPE).

To help guide decision-making, several adult-focused gastroenterology and endoscopy associations have published guideline statements that highlight recommendations, including pre- and postprocedure screening for risk stratification, maintaining appropriate social distance, preserving PPE, postponing nonurgent procedures, and strategic scheduling to avoid concomitant exposure of endoscopists with similar and/or unique skill sets (9–14). As outlined in Table 1, initial recommendations with regard to PPE included the use of droplet and contact precautions (ie, gloves, gown, surgical mask, face shield/goggles) for all endoscopic cases performed in patients considered to be at low risk of COVID-19. More recent statements recommend airborne, contact, and droplet precautions for all procedures, including use of a filtering face-piece respirator that will filter at least 94% of particles that are 0.3 μm in diameter or larger [N95, N99, FFP2/3, or powered air-purifying respirators (PAPRs) (11)] and negative pressure rooms. The recent guidelines, reflecting the increase of community spread in North America, have emphasized that endoscopic procedures are aerosol-generating procedures (AGP) (15) and transmission by COVID-19-infected asymptomatic individuals is possible (10,11,16–20). Additionally, there is evidence of fecal shedding of SARS-CoV-2, the virus, which causes COVID-19, which poses uncertain risk of fecal-oral transmission and/or endoscopically transmitted infection (11,21).

Pediatric gastroenterologists who care for children face unique challenges during this pandemic. Children more frequently have mild disease or are asymptomatic carriers of SARS-CoV-2, as compared with adults (17,18,23–27). The majority of pediatric endoscopic procedures are performed while using anesthesiologist-administered deep sedation and general anesthesia. Additionally, children undergo 3 times more upper endoscopic procedures than lower (28–30). These factors may increase the risk of aerosol generation and dispersion of viral particles during pediatric procedures. Furthermore, many children undergoing endoscopy present with nausea, vomiting, abdominal pain and/or diarrhea (30,31); symptoms reported in 17.6% of COVID-19 positive patients in 1 large meta-analysis (32), and gastrointestinal symptoms may be the sole presentation of COVID-19 (11,33–35). Furthermore, the differing epidemiology of pediatric gastrointestinal disease, as compared with adult disease, may influence the need for emergent or urgent endoscopy. For example, children present with greater overall disease severity of inflammatory bowel disease (36–38), have a higher incidence of foreign body ingestions (39,40), congenital malformations requiring endoscopic therapy, and need for enteral feeding devices for provision of nutrition support.

The NASPGHAN Endoscopy and Procedures Committee has formulated this statement to offer practical guidance to help standardize delivery of endoscopy services for pediatric patients with the aim of minimizing COVID-19 transmission to protect staff, patients, and caregivers, as well as optimize the utilization of PPE. Although this statement is meant as a guide, it is important that all endoscopy facilities where pediatric procedures are performed follow current recommendations from public health agencies within their jurisdiction regarding infection prevention and control of COVID-19. A visual infographic summarizing the recommendations provided in this statement is provided in Appendix 1 (Supplemental Digital Content, http://links.lww.com/MPG/B832).

PEDIATRIC ENDOSCOPIC PROCEDURES INVOLVE EXPOSURE TO CORONAVIRUS DISEASE 2019

The SARS-CoV-2 virus is spread through human-to-human transmission via contact, droplet, and based on emerging evidence, airborne routes (41). It is known to behave as an opportunistic airborne pathogen during a cough or an AGP, and is transmitted by both short- and long-range aerosols (42). The 2 prior epidemic coronaviruses, which caused Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) were believed to have potential for aerosol spread (43). In a laboratory setting, van Doremalen et al (44) found that SARS-CoV-2 behaves similarly to SARS-CoV-1, the virus which causes SARS, with ongoing viral detection in the air at 3 hours. Additionally, SARS-CoV-2 was recently shown to cause significant environmental contamination in the hospital rooms of COVID-19-confirmed patients. It was present in two-thirds of the personal air samplers worn by staff who maintained a distance of greater than 6 feet from patients (45). Furthermore, 66.7% hallway air samples were positive, indicating that virus-containing particles were being transported from the rooms to the hallway (45).

SARS-CoV-2 RNA has also been found in the feces of the majority of COVID-19 patients and asymptomatic carriers at up to 30 days after symptom onset, even after respiratory swabs are negative (46–48). SaRS-CoV-2 is known to enter cells by binding to the ACE2 receptor, which is expressed in high numbers not only in the lung, heart, and kidneys (49) but also in the enterocytes of the ileum, colon, hepatocytes, and cholangiocytes (50). A recent study by Liu et al (51) showed that toilet seats and bathrooms have high rates of surface contamination with viral RNA, suggesting a possibility of fecal-oral spread (52). The virus, however, has not been cultured from these samples, leaving the infectious transmission potential in question. Following these publications, the Food

TABLE 1. Overview of endoscopy-related statements pertaining to coronavirus 2019

Society	GI Society Joint Statement (9) (AASLD, ACG, AGA, ASGE)	CAG (10)	ESGE and ESGENA (13)	WEO (12)	APSDE (22)	BSG and JAG (14)	AGA (11)	NASPGHAN
Region/country	United States	Canada	Europe	Worldwide	Asia-Pacific	United Kingdom	United States	North America
Date published	March 15, 2020 Updated April 3, 2020[‖]	March 16, 2020	March 18, 2020	March 24, 2020	March 25, 2020	March 28, 2020	April 1, 2020	April 14, 2020
PPE recommendation								
Upper GI endoscopy[*]—low risk	Contact and droplet precautions[‡,¶]	Airborne, contact and droplet precautions[§,¶]	Contact and droplet precautions[‡]	Contact and droplet precautions[‡]	Contact and droplet precautions[‡]	Airborne, contact and droplet precautions[§,¶]	Airborne, contact and droplet precautions[§], negative pressure room	Airborne, contact and droplet precautions[§], negative pressure room
Upper GI endoscopy[*]—high Risk	Airborne, contact and droplet precautions[§,‖], negative pressure room	Airborne, contact and droplet precautions[§,¶]	Airborne, contact and droplet precautions[§], negative pressure room	Airborne, contact and droplet precautions[§], negative pressure room	Airborne, contact and droplet precautions[§], negative pressure room (if available)	Airborne, contact and droplet precautions[§,¶]	Airborne, contact and droplet precautions[§], negative pressure room	Airborne, contact and droplet precautions[§], negative pressure room
Lower GI endoscopy[†]—low risk	Contact and droplet precautions[‡]	Contact and droplet precautions[‡]	Contact and droplet precautions[‡]	Contact and droplet precautions[‡]	Contact and droplet precautions[‡]	Contact and droplet precautions[‡]	Airborne, contact and droplet precautions[§], negative pressure room	Airborne, contact and droplet precautions[§], negative pressure room
Lower GI endoscopy[†]—high risk	Airborne, contact and droplet precautions[§,‖], negative pressure room	Airborne, contact and droplet precautions[§,¶]	Airborne, contact and droplet precautions[§], negative pressure room	Airborne, contact and droplet precautions[§], negative pressure room	Airborne, contact and droplet precautions[§], negative pressure room (if available)	Airborne, contact and droplet precautions[§,¶]	Airborne, contact and droplet precautions[§], negative pressure room	Airborne, contact and droplet precautions[§], negative pressure room

AASLD = American Association for the Study of Liver Diseases; ACG = American College of Gastroenterology; AGA = American Gastroenterological Association; APSDE = Asian Pacific Society for Digestive Endoscopy; ASGE = American Society of Gastrointestinal Endoscopy; BSG = British Society of Gastroenterology; CAG = Canadian Association of Gastroenterology; ESGE = European Society of Gastrointestinal Endoscopy; ESGNA = European Society of Gastroenterology and Endoscopy Nurses and Associates; JAG = Joint Advisory Group on Gastrointestinal Endoscopy; PPE = personal protective equipment.

[*]Includes esophagogastroduodenoscopy, small bowel enteroscopy, endoscopic ultrasound, endoscopic retrograde cholangiopancreatography, breath tests, and esophageal manometry.

[†]Includes colonoscopy, sigmoidoscopy, and anorectal manometry.

[‡]Surgical mask, eye protection (goggles or face shield), gloves, water-resistant gown, and hairnet.

[§]Filtering face-piece respirator (N95, N99, FFP2/3, or PAPR), facial protection (full visor and/or face shield), 2 pairs of gloves (ie, double gloves), full body water-resistant gown, shoe covers, and hairnet.

[‖]In areas with community spread, all patients undergoing GI endoscopy need to be considered ''high risk.''

[¶]No comment provided on use of negative pressure rooms in statement.

and Drug Administration in the United States recommended screening all fecal microbiota donor stool for SARS-CoV-2 (53).

Peri-endoscopic transmission of COVID-19 has been reported in both China (33) and Italy (54) and, overall, the risk to healthcare providers is significant. In a study from the Zhongnan Hospital in Wuhan, 29% (40 of 138) of COVID-19 infected patients were healthcare workers with presumed hospital-associated transmission (55). During upper endoscopy, endoscopists have prolonged contact with oropharyngeal secretions, including potential coughing and retching. Lower endoscopy involves exposure to feces and possible passage of flatus. All endoscopic procedures involve risk of generating aerosol and microdroplets by the inherent design of the instruments, valves, ports, and air pressures during insufflation and suction (56). Additionally, there is evidence of possible aerosolization during endoscopic procedures with insertion and removal of instruments through the biopsy channel (57). For these reasons, pediatric endoscopy is considered to be high risk for COVID-19 transmission (15).

RECOMMENDATIONS FOR PERSONAL PROTECTIVE EQUIPMENT DURING PEDIATRIC ENDOSCOPY

Appropriate use of PPE is essential to minimize transmission of COVID-19 during pediatric endoscopic procedures and to preserve supply. Pediatric endoscopic procedures are considered at high risk for COVID-19 transmission for several reasons: they are AGPs; additional AGPs may be performed during accompanying general anesthesia [eg, bag mask ventilation, open airway suctioning, and endotracheal intubation (58)]; there is risk of extensive splashing of body fluids, including feces, during procedures (59); endoscopic procedures involve short physical distance between patients and personnel; many children with COVID-19 are minimally symptomatic or asymptomatic (17,18,23–27); there is potential for virus transmission before symptoms manifest (16–19); and the prevalence of COVID-19 across North America is likely underestimated because of a lack of population-based testing contributed to in part by limited availability of testing materials and stringent testing criteria in some jurisdictions. **We, therefore, recommend that all pediatric endoscopic procedures are done in a *negative pressure room* with all staff using proper *airborne, contact and droplet precautions* (ie, enhanced PPE), regardless of patient risk stratification**. This includes appropriate use of a filtering facepiece respirator (N95, N99, FFP2/3, or PAPR), double gloves, facial protection (full visor and/or face shield), full body water-resistant disposable gown or coveralls, shoe covers, and a hairnet (Fig. 1). These recommendations are in line with the Center for Disease Control (CDC) and Prevention's recommendations for AGP (60) and more recent adult-focused statements outlining recommendations for endoscopic procedures during the COVID-19 pandemic (11).

PPE should always be donned (put on), doffed (taken off), and disposed of as per current recommendations (see *www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf*) (61,62). It is important to note that individuals should undergo respirator fit testing to determine the size and shape required to ensure the respirator's facepiece is sealed

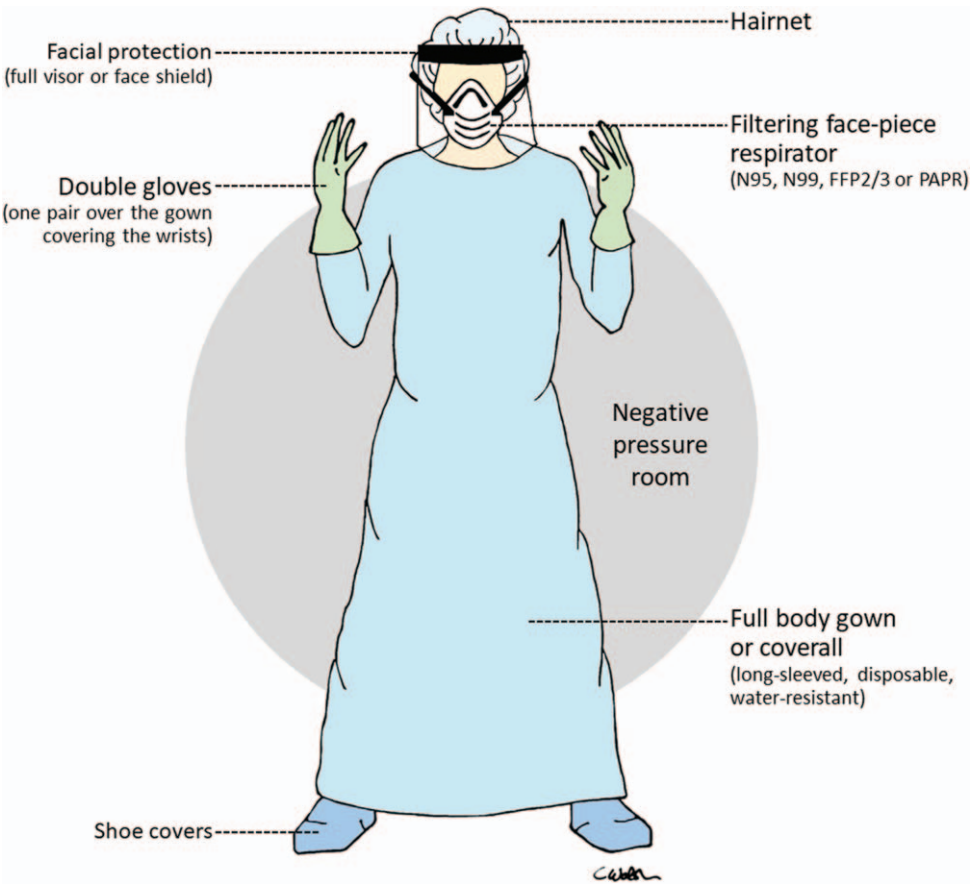

FIGURE 1. Enhanced personal protective equipment is recommended for pediatric endoscopic procedures during the coronavirus disease 2019 pandemic to ensure airborne, contact, and droplet precautions.

properly on the face. Additionally, once individuals have donned their PPE, they should not use their phone, eat, drink, or go to the washroom until PPE is removed.

We recognize that there are shortages of PPE in certain jurisdictions that may limit the ability of institutions to comply with suggested PPE guidelines. Prescreening pediatric patients using symptoms questionnaires is not useful to rule out active COVID-19 infection, as children can present with either no symptoms or mild symptoms in up to 55% of cases (17,18,23–27), and asymptomatic transmission has been shown to occur (16–20,63). Additionally, patients can present with exclusive gastrointestinal manifestations of COVID-19 (11,33–35). Symptom and exposure questionnaires may help to identify patients who are actively infected or have had recent exposure to COVID-19; however, in an area of community spread, all patients undergoing pediatric endoscopy need to be considered ''high risk'' given the high rate of transmission from asymptomatic (or presymptomatic) individuals.

Some pediatric centers are employing core body temperature checks as a prescreening tool; however, these are of limited value given an incubation period of up to 14 days and a high rate of minimal or no symptoms in the pediatric population. In 1 large cohort, fever was present in 44% of patients on admission (64) and studies have shown that fever may resolve within 24 hours in children (65). To preserve PPE, some institutions are now employing a universal testing strategy for all children coming to the hospital, to risk stratify patients based on known negative test results. One must use caution, however, in applying this strategy as there is a false-negative rate associated with COVID-19 testing [over 30% in some studies (19,66–69)]. This may be explained by differences in sample processing, varying sensitivities, and specificities of assays being employed, differing viral loads by disease stage and anatomical site, and the possible mutations of COVID-19 for the molecular-based assays (70). We also recognize that there is limited availability of negative pressure rooms. If such rooms are unavailable, pediatric endoscopy should be performed in a dedicated room with adequate ventilation in accordance with previously outlined guidelines issued by the CDC during the SARS outbreak (71).

RECOMMENDATIONS FOR PRIORITIZING PEDIATRIC ENDOSCOPIC PROCEDURES

As there is a high risk associated with pediatric endoscopic procedures and a potential for scarcity of healthcare resources (eg, PPE, staff shortages through illness, self-quarantine, and/or redeployment), it is important for centers to postpone nonessential endoscopic activities. Minimizing endoscopic volume will help to preserve PPE supply and limit exposure of endoscopic personnel.

Evidence regarding the urgency with which to perform specific pediatric endoscopic procedures and data on patient outcomes associated with delayed procedures is sparse. For each case, it is important to weigh the risks and benefits of proceeding with the procedure, including patient symptoms, sick contacts, availability of a negative COVID-19 test, geographic distribution of disease and availability of resources (eg, PPE, a negative pressure room, endoscopic personnel). In children with known or highly suspected COVID-19 infection, endoscopic procedures should only be performed if essential or emergent/urgent and should be performed in a negative pressure room by experienced staff.

Table 2 outlines a proposed framework for stratifying pediatric endoscopy procedures as emergent (procedures that need to PROCEEED), urgent (PAUSE, weigh the benefits and risks in deciding whether to proceed), and elective (POSTPONE procedures). This framework, which was developed through consensus voting by the NASPGHAN Endoscopy and Procedures Committee (n = 31 members) and current and past Chairs, is meant as a guide to help practitioners decide which procedures are time-sensitive, and if delayed, may negatively impact patient outcomes. This list is neither exhaustive nor prescriptive, thus, each institution will need to decide on their criteria for ''essential'' pediatric endoscopic procedures, considering resource availability and relevant jurisdictional and institutional rules. If a patient is undergoing a concurrent nonendoscopic procedure, the decision to perform endoscopy should be based solely on the urgency of the endoscopic procedure. If healthcare resources, such as PPE are critically low, procedures will need to be restricted to those that are considered emergent to help preserve PPE supply and the safety of staff should be prioritized. The CDC has provided strategies to help optimize use of PPE under crisis conditions (72).

Adult endoscopy-related COVID-19 statements have similarly classified procedures (73,74). The BSG-JAG statement stratified procedures as ''needs to continue,'' ''defer until further notice,'' and ''needs discussions (74).'' The GI multisociety recommendation (AASLD, AGA, ACG and ASGE) classified procedures as either ''urgent/emergent'' procedures that should not be delayed and ''elective'' procedures that should be delayed (73). Finally, the American College of Surgeons categorized pediatric surgical procedures, including endoscopy, as emergent, urgent, and elective cases (75).

It is recommended that all pediatric endoscopic procedures are reviewed by trained medical personnel to categorize procedures as essential or nonessential and consider alternative means of diagnosis or management [eg, employing ESPGHAN criteria for diagnosis of celiac disease (76)]. Delays in diagnosis and management may have significant impact on patient outcomes and lead to anxiety among patients, caregivers, and staff. It is, therefore, important to closely follow children for whom procedures are delayed and ensure timely booking once the immediate impact of the COVID-19 pandemic has eased or passed.

PRACTICAL CONSIDERATIONS

In this section, we outline some additional practical recommendations for endoscopy units in COVID-19 outbreak areas where pediatric procedures are performed to minimize the risk of potential exposure and spread of infection to staff, patients, and caregivers. Within this section, the term ''endoscopy suite'' refers to the room in which an endoscopic procedure is performed—it may be within an endoscopy unit, a freestanding procedure room, or the operating room.

Preprocedure

1. *Triage procedures*: postpone non-essential endoscopic procedures as outlined above.
2. *Plan for essential procedures*: endoscopy facilities where pediatric procedures are performed should develop a clear plan for providing essential endoscopic procedures during the COVID-19 pandemic.
3. *Infection prevention and control*: endoscopy facilities where pediatric procedures are performed should develop standard operating procedures for COVID-19 infection prevention and control in conjunction with their local infection control team and disseminate these widely among staff members (eg, handwashing protocols). Consider use of adjunctive educational sessions and visual materials to enhance learning.
4. *Risk assessment*: before any endoscopic procedure, patients and caregivers should undergo a risk assessment and stratification, adjusted by evolving local and global epidemiology of COVID-19.

TABLE 2. Risk stratification of pediatric endoscopic procedures during the coronavirus disease 2019 pandemic[†]

Emergent → PROCEED

Endoscopic procedure for intervention and/or diagnosis of potentially life-threatening conditions and/or for conditions where if left untreated has significant morbidity/mortality

Need to continue

- Potentially life-threatening gastrointestinal bleeding
- Small bowel endoscopy for ongoing transfusion dependent bleeding
- Foreign bodies classified by NASPGHAN clinical report as emergent (eg, esophageal button battery, multiple magnet ingestions) (39)
- Bowel obstruction amenable to endoscopic therapy
- Evaluation of caustic injury, if unable to tolerate oral intake and/or placement of NG required under direct visualization
- Tissue sampling required to diagnose a life-threatening disease, including graft-versus-host disease, posttransplant lymphoproliferative disorders, and suspected intestinal graft rejection
- Volvulus decompression
- Endoscopic vacuum therapy for perforations/leaks
- Acute biliary obstruction decompression secondary to stone, lesion, or cholangitis
- Endoscopic ultrasound for infected pancreatic necrosis or walled off necrosis
- Liver biopsy ± PTC for neonatal cholestasis, suspicious for biliary atresia
- Liver biopsy ± PTC for acute liver failure, or impending acute liver failure (eg, hepatitis with rising INR)

Urgent → PAUSE, weigh risks and benefits

Endoscopic procedure for which findings can change management significantly and/or intervention for stable patient which is not immediately life-threatening; however, can lead to significant complications if delayed.

Weigh benefits and risks in deciding whether to proceed, including patient risk factors (symptoms, sick contacts, availability of negative COVID-19 test), geographic distribution of disease and availability of resources including PPE, negative pressure room, and endoscopic personnel.

- Reevaluation of life-threatening bleeding as indicated
- Nonlife-threatening gastrointestinal bleeding
- Follow-up endoscopic band ligation of high-risk varices that have recently bled
- Small bowel endoscopy (or capsule) for suspected small bowel malignancy on radiology or capsule endoscopy
- Foreign bodies classified by NASPGHAN clinical report as urgent (eg, esophageal coin) (39)
- Evaluation of caustic injury, able to tolerate oral intake
- Severe dysphagia/odynophagia (inability to tolerate liquids)
- Moderate dysphagia/odynophagia (inability to tolerate solids)
- Dilation of stricture, acute presentation
- Dilation of stricture, expecting to be symptomatic in a few weeks
- ERCP or PTC for bile leak
- Removal or exchange of temporary stent
- EUS for symptomatic pancreatic fluid collection
- Urgent initial nutrition support (eg, PEG/NJ)
- Urgent replacement PEG/NJ
- Suspected gastrointestinal malignancy
- Planned polypectomy, EMR/ESD for complex/high-risk lesions
- Inflammatory bowel disease (IBD): high suspicion of new IBD diagnosis; guide treatment decisions (including flare) in patient with moderate to severe activity; guide treatment decisions for complications of established/new diagnosis IBD (eg, partial bowel obstruction)
- Severe and progressive failure to thrive, unresponsive to medical management
- Severe chronic diarrhea, unresponsive to medical management
- Severe *Clostridioides difficile* colitis refractory to medical therapy for fecal transplant[*]
- Anorectal manometry or suction rectal biopsy for suspected Hirschsprung disease
- Liver biopsy for hepatitis of uncertain cause with one of elevated aminotransferases (persisting or rising), jaundice, rising INR, and/or serological evidence for autoimmune hepatitis; liver transplant rejection; or suspected malignant tumor

Elective → POSTPONE

Endoscopic procedure that can be postponed and/or managed alternatively; encompasses conditions not considered emergent or urgent

Postpone

- Staged ligation of esophageal varices
- Foreign bodies classified by NASPGHAN clinical report as elective (39)
- Mild dysphagia
- Upper GI endoscopy for eosinophilic esophagitis diagnosis or re-evaluation
- Staged dilation of gastrointestinal stricture
- Staged ERCP with stent exchange (eg, q3mo planned exchange)
- ERCP cases—stones where there has been no recent cholangitis and a stent is in place; therapy for chronic pancreatitis; ampullectomy follow-up
- EUS for suspected autoimmune pancreatitis or EUS for 'benign' indications—biliary dilatation, possible stones, submucosal lesions, pancreatic cysts without high-risk features
- Nonurgent initial nutritional support or replacement (eg, PEG, NJ)
- Polyposis surveillance
- Polypectomy; considered to be at low risk for malignancy
- Inflammatory bowel disease; to guide therapy in patients with mild disease activity
- Endoscopy and/or biopsy for clinical trials or other research
- Upper GI endoscopy to diagnose suspected celiac disease or to re-stage
- Upper GI endoscopy for *Helicobacter pylori* culture/sensitivity (nonbleeding)
- Upper GI endoscopy for abdominal pain with reasonable medical alternatives available and/or low suspicion of organic disease, routine symptomatic referrals, low risk follow-up and repeat endoscopy (eg, re-assessment of eosinophilic esophagitis)
- Esophageal manometry with concern for primary motility disorder (eg, achalasia), or before fundoplication
- Anorectal manometry for patients with fecal incontinence
- Colonic manometry
- POEM
- Bariatric endoscopy
- pH impedance, breath tests
- Liver biopsy for NAFLD/NASH or to assess histologic remission in AIH

[†]Voted on by 31 members of the NASPGHAN Endoscopy and Procedures Committee.
[*]Donor stool should be tested.

AIH = autoimmune hepatitis; EMR = endoscopic mucosal resection; ERCP = endoscopic retrograde cholangiopancreatography; ESD = endoscopic surgical dissection; EUS = endoscopic ultrasound; IBD = inflammatory bowel disease; INR = International normalized ratio; NAFLD = non-alcoholic fatty liver disease; NASH = non-alcoholic steatohepatitis; NASPGHAN = North American Society of Pediatric Gastroenterology, Hepatology, and Nutrition; NJ = nasojejunal; PEG = percutaneous endoscopic gastrostomy; POEM = per-oral endoscopic myotomy; PPE = personal protective equipment; PTC = percutaneous transhepatic cholangiography.

5. *Children with highly suspected or confirmed COVID-19 infection*: consider using separate pre- and postendoscopy recovery areas or recover in the endoscopy suite.
6. *Virtual care*: consider providing pre- and postprocedure care remotely whenever possible [eg, conducting rounds using telemedicine (77,78)].
7. *Distancing*: during the preprocedure interview and informed consent process, maintain a distance of at least 6 feet (2 m) when possible, consider use of a physical barrier (eg, glass or plastic) if available and follow institutional recommendations for infection prevention and control.
8. *Patient PPE*: whenever possible, all patients and caregivers entering the endoscopy area should wear respiratory protective equipment (eg, surgical face mask) (79,80).
9. *Caregivers*: caregivers should not be brought into the endoscopy suite. If it is exceptionally required, they should undergo the same risk assessment as patients.

Intraprocedure

1. *Limit to essential personnel*: only essential endoscopy personnel (1 endoscopist if possible) should be present during cases to minimize exposure and conserve PPE. Minimize staff changeover and room traffic.
2. *Intubation/extubation*: whenever possible, endoscopy staff should not be in the room during intubation and extubation.
3. *Protecting equipment and supplies*: bring only the minimally required equipment and supplies (eg, medications) into the endoscopy suite to prevent contamination and resource wastage; consider having a dedicated runner posted outside the endoscopy suite to obtain supplies as needed (81); cover equipment with plastic whenever possible (eg, keyboards); do not share equipment whenever possible; and clean equipment thoroughly between users—anything in the room should be considered contaminated.
4. *Single-use endoscopic devices*: employ single-use (ie, disposable) equipment whenever possible.
5. *Personal items*: personnel should limit personal items brought into the endoscopy suite (eg, phone) and disinfect them postprocedure.
6. *Infection prevention and control*: institutional standard operating procedures for COVID-19 infection prevention and control should be followed (eg, donning/doffing of PPE; washing of hands with soap and warm water, or alcohol-based hand rub for at least 20 seconds [including palms, back of each hand, between fingers, thumbs, and under nails (82)], before and after all patient interactions, after contact with potentially infectious sources and before and after gowning).
7. *Adapt endoscopy technique to minimize exposure*: minimize the use of air/CO_2 during the procedure to limit generation of aerosol and microdroplets. Removal of endoscope caps should be avoided as they may cause air and fluid to be released.
8. *Biopsy technique*: applying air suction while removing biopsy forceps (a high aerosol burden) may decrease transmission of infectious agents (57).
9. *Teamwork*: teamwork and communication are essential to help prevent and control transmission of infection during procedures to reduce risk to the team. Consider implementation of preprocedure multidisciplinary huddle or time-out to discuss case logistics, potential risks [including verification of patient's COIVD-19 status (83)] and agree on a plan that best manages risk, safety, and efficiency. Ensure clear and open communication during the procedure.

Postprocedure

1. *Postprocedure debriefs*: consider implementation of a postprocedure team debrief to provide an opportunity to identify potential areas for improvement.
2. *Time between procedures*: the endoscopy suite should be left untouched for an appropriate amount of time between cases for complete air exchange (time to remove 99% of airborne particles), to dissipate any potential aerosolized virus before cleaning is initiated (84). The time interval is based on the number of air changes per hour as described by the CDC and will be dependent on whether the room is negative pressure, air exchange rates, filtration efficiencies, and so forth (usually 30 minutes for negative pressure rooms) (84).
3. *Cleaning the endoscopy suite*: the endoscopy suite must be thoroughly cleaned and disinfected using viricidal cleaning agents between endoscopic procedures, including all surfaces in the procedure room followed by proper disinfection (54,85,86).
4. *Endoscope reprocessing*: reprocess endoscopes and endoscopic accessories according to published guidelines. Standard endoscope reprocessing is sufficient to kill the SARS-CoV-2 virus (54,85,86).
5. *Symptom follow-up*: consider contacting patients and their caregivers 7 to 14 days postprocedure to ask about new diagnosis and/or development of symptoms suggestive of COVID-19.

Other Consideration

Procedures

1. *Rebooking postponed procedures*: institutions should implement a standardized mechanism to ensure nonessential procedures that were cancelled or postponed are tracked and rebooked once the immediate impact of the COVID-19 pandemic has eased or passed. Implementation of a system to classify procedural urgency may help to facilitate this process.

Personnel

1. *Strategically schedule endoscopy personnel*: assign available personnel strategically to minimize concomitant exposure of those with similar and/or unique skill sets.
2. *Protect personnel at high risk for COVID-19*: consider minimizing or eliminating exposure to endoscopy for individuals who are at high risk of COVID-19, including individuals over 65 years of age; those who are immunocompromised or have underlying serious chronic medical conditions, including chronic lung disease, cardiac conditions (eg, poorly controlled hypertension, coronary artery disease, and heart failure), cancer, obesity, or diabetes; and possibly pregnant women (87–90).
3. *Screen health professionals*: staff should be screened for COVID-19 as per institutional policy. Those with highly suspected or confirmed COVID-19 infection should be isolated.
4. *Training*: all personnel involved in endoscopy must be appropriately informed of infection prevention and control strategies for COVID-19 as per institutional policies.

Fellows

1. *Fellow participation in procedures*: the decision regarding whether to limit fellow participation should be decided at the institutional level. Including trainees in procedures may further limit the availability of PPE, prolong procedure time, and expose them to undue risk.

2. *Fellows' education*: if fellows' participation in endoscopic procedures is limited or stopped during the COVID-19 pandemic, consider supplemental educational strategies such as endoscopy videos, online resources, or simulation-based training (91).

CONCLUSIONS

The aim of the NASPGHAN Endoscopy and Procedures Committee recommendations is to help minimize COVID-19 transmission during the provision of pediatric endoscopic services in order to protect staff, patients, and caregivers, and to conserve PPE during this time of critical need. The principles highlighted in this manuscript reflect current limited evidence. As the pandemic evolves, these recommendations will likely need to be updated based on emerging evidence, evolution of testing capabilities, resource limitations, and the evolving geographic distribution and institutional case-burden of COVID-19. Key areas for future research highlighted in this report include: the determination of risk during pediatric endoscopy as it relates to possible fecal-oral transmission, the potential for endoscopic transmission of infection, the use of rapid accurate testing for COVID-19 before pediatric endoscopic procedures, and the risk of aerosolization during lower gastrointestinal (GI) procedures performed on pediatric patients.

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