

**Risk Stratification and PPE Use in Pediatric Endoscopy During the COVID-19 Outbreak:
A Single-Center Protocol**

Daphne S. Say, MD^{1,5,7}; Arthur de Lorimier, MD^{1,5,7}; Cathleen R. Lammers, MD^{5,6,7}; JoAnne Natale, MD, PhD^{3,5,7}; Satyan Lakshminrusimha, MD^{4,5,7}; Jean Wiedeman, MD, PhD^{2,5,7}, Elizabeth Partridge, MD, MPH^{2,5,7}

Affiliations: Division of Gastroenterology, Hepatology, and Nutrition¹, Infectious Diseases², Critical Care³, and Neonatology⁴, Department of Pediatrics, University of California, Davis (Sacramento, CA); University of California, Davis Children's Hospital⁵ (Sacramento, CA); Department of Anesthesiology, University of California, Davis⁶ (Sacramento, CA); University of California, Davis Medical Center (Sacramento, CA)⁷

Corresponding Author: Daphne S. Say, MD
Assistant Clinical Professor
Division of Gastroenterology, Hepatology, and Nutrition
Department of Pediatrics
University of California, Davis
2516 Stockton Boulevard, Ticon II
Sacramento, CA 95817
TEL: (916) 734-7098 | FAX: (916) 734-4098
E-mail: dsay@ucdavis.edu

Key Words: endoscopy, personal protective equipment, COVID-19

Abbreviations: coronavirus disease 2019 (COVID-19); aerosol generating procedure (AGP); personal protective equipment (PPE); health care providers (HCP); powered air-purifying respiratory (PAPR)

Conflict of Interest Disclosure: The authors have no conflicts of interest relevant to this article to disclose.

Funding Source: No funding was secured for this study.

Financial Disclosure: The authors have no financial relationships relevant to this article to disclose.

Contributors' Statement:

Dr. Say conceptualized the protocol, drafted the initial manuscript, and reviewed and revised the final manuscript. Dr. de Lorimier reviewed and assisted in revision of the manuscript. Drs. Lammers, Partridge, Natale, and Wiedeman reviewed the manuscript. Dr. Lakshminrusimha provided editorial guidance and created all original artwork. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Co-Author Contact Information:

Arthur de Lorimier, MD
Professor of Pediatrics
Division of Pediatric Gastroenterology, Hepatology, and Nutrition
University of California, Davis
2516 Stockton Boulevard
Sacramento, CA 95817

Cathleen R. Lammers, MD
Professor, Director of Pediatric Anesthesiology
Department of Anesthesiology
4150 V Street, Suite 1200
Sacramento, CA 95817

JoAnne Natale, MD, PhD
Professor, Director of Quality and Safety
Department of Pediatrics
Division of Critical Care
University of California, Davis
2516 Stockton Boulevard
Sacramento, CA 95817

Satyam Lakshminrusimha, MD
Pediatrician-in-Chief, UC Davis Children's Hospital
Dennis and Nancy Marks Endowed Chair in Pediatrics
Professor, Department of Pediatrics
Division of Neonatology
University of California, Davis
2516 Stockton Boulevard
Sacramento, CA 95817

Jean Wiedeman, MD, PhD
Professor of Pediatrics
Division of Infectious Diseases
Department of Pediatrics
University of California, Davis
2516 Stockton Boulevard
Sacramento, CA 95817

Elizabeth Partridge, MD, MPH
Assistant Professor of Pediatrics
Division of Infectious Diseases
Department of Pediatrics
University of California, Davis
2516 Stockton Boulevard
Sacramento, CA 95817

ACCEPTED

Abstract

SARS-CoV-2, the novel coronavirus causing coronavirus disease 2019 (COVID-19), is now a global pandemic. Human-to-human transmission has been documented to occur through respiratory secretions, feces, aerosols, and contaminated environmental surfaces. Pediatric patients present a unique challenge as they may have minimal symptoms and yet transmit disease. Endoscopists face risk for infection with viruses like SARS-CoV-2, as the aerosol generating nature of endoscopy diffuses respiratory disease that can be spread via an airborne and droplet route. We describe our center's methodology for pediatric patient risk stratification to facilitate responsible use of endoscopic resources during this crisis. We also describe our recommendations for use of personal protective equipment by endoscopists, with the goal of ensuring the safety of ourselves, our anesthesiology and endoscopy staff, and our patients.

SARS-CoV-2, the novel coronavirus causing coronavirus disease 2019 (COVID-19), is now a global pandemic. Human-to-human transmission has been documented to occur through respiratory secretions, feces, aerosols, and contaminated environmental surfaces.^{1,2} Transmission can occur from both symptomatic and asymptomatic individuals.³ The risk of infection to healthcare providers (HCP) is substantial: in one of the earliest documentations of infection in Wuhan, China, 29% of patients were healthcare workers.⁴ It is unclear how much of the risk was related to community transmission or to breaches in use of personal protective equipment (PPE) during the care of patients with COVID-19. It appears inevitable that, when performing endoscopy, HCP will be exposed to either respiratory or gastrointestinal fluids from patients. Thus, adequate protection of HCP during endoscopic procedures is now critical. An Italian group has provided recommendations regarding the safe performance of endoscopy of adult patients during the COVID-19 outbreak.⁵

Pediatric patients requiring endoscopy represent a unique challenge, as they are disproportionately asymptomatic or mildly ill if infected, yet can still transmit disease.⁶ Despite the need for mobilization of resources to address this pandemic, there remain children who require ongoing care and evaluation from a specialized gastroenterology team, including endoscopy. Delaying such procedures may compromise patient health and strain future resources. The inability to predict when the surge in community infection and demand for hospital resources will occur further complicates care decisions. We here report our methods for pediatric patient risk stratification and associated utilization of PPE to facilitate responsible and safe procedures for patients in this pandemic. It is based on review of the available and relevant literature, primarily from China, and local experience.

Risk Stratification and Personal Protective Equipment (PPE) During Endoscopy

There are currently no reports in the literature of SARS-CoV-2 infection directly linked to an endoscopic exposure. However, as endoscopy is an aerosol-generating procedure (AGP), the risk for infection remains. Coughing and retching during upper endoscopy generates aerosols.⁷ Patients undergoing colonoscopy may pass flatus or liquid stool, which disseminates organisms to nearby surroundings. Fecal carriage of SARS-CoV-2 has been documented, implying that the virus actively replicates in the gastrointestinal tract even after viral clearance in the respiratory tract.⁸ Recently, the World Health Organization (WHO) has published guidelines for rational use of PPE for COVID-19, including specific instructions for healthcare workers performing AGP on patients with known/documented COVID-19.⁹ These include the use of a respirator (N95 respirator or equivalent), water-resistant gown, gloves, and eye protection for personnel in the endoscopy suite. At the same time, we also recognize the need to conserve PPE and other needed resources in anticipation of the surge of COVID-19 patients that require hospitalization.

This report is designed to ensure the safety of ourselves, our anesthesiology and endoscopy staff, and our patients without overly taxing front-line responders' need for PPE during this crisis. In the absence of routine viral testing, in keeping with guidelines outlined by Repici et al., we stratify the patient's COVID-19 risk based on symptoms and sick contacts (TABLE 1).⁵ Decisions regarding appropriate PPE use are then made based on the patient's assessed risk (FIGURE 1). Our proposed stratification takes into account the higher probability that an asymptomatic or mildly ill child may be infected with SARS-CoV-2 and is infectious. Review of the data from Wuhan, China reveals that nearly 18% of all children with SARS-CoV-2 infection are asymptomatic.³ Given initial limitations in the availability of testing for SARS-

CoV-2 infection, however, our institution's current screening algorithm specifies testing only individuals with influenza-like illness and exposure to a patient with known COVID-19. As our own lab-developed testing capabilities increase, we anticipate future modifications of our pre-procedure screening to incorporate oropharyngeal and nasopharyngeal swabs for SARS-CoV-2 infection. Stool testing, along with anal swab tests, may also present future pre-procedure screening possibilities.

We advise placing a surgical mask on the high-risk and unknown risk patient for transport in and out of the procedure room. We limit all non-essential personnel for all procedures, with no more than five individuals in the endoscopy suite at a time. We recommend use of a negative pressure room, rather than a positive pressure room, for all endoscopic procedures (FIGURE 2). A neutral pressure room with the door closed may be used if all personnel in the room don a powered air-purifying respirator (PAPR) in lieu of hair covering, N95 respirator, and eye protection, as well as using a water-resistant gown and double layer of gloves. This room would need to remain closed for one hour after the procedure is complete to allow enough air exchange to evacuate suspended infectious particles. Appropriate signage should be placed outside the procedure room, indicating to others that an AGP is occurring (FIGURE 3).

Scheduling of Endoscopic Procedures

In an effort to support patient-centered care, we plan to perform all previously scheduled and new outpatient endoscopic procedures that are deemed "essential" for as long as adequate PPE resources described in these recommendations will allow. We define "essential" endoscopic procedures as those that, if delayed more than 8 to 12 weeks, would predispose a

child to harm or injury. Should the status of available PPE or provider workforce change, we anticipate limiting our procedures only to “emergent” procedures (e.g., foreign body removal, gastrointestinal bleeding, diagnostic procedures in hospitalized patients). We will also review the risks and benefits of endoscopy with our patients’ families in advance of procedure, as well as the potential risks of exposure to SARS-CoV-2 associated with non-adherence to the public health recommendations to “shelter in place”. Many patients’ families may choose to reschedule procedures until after current social distancing restrictions have been lifted. If a patient’s endoscopic procedure is delayed, we will regularly assess the patient’s clinical status to ensure safety and provide necessary supportive measures in the interim. We have created a registry to enable monitoring of affected patients via telemedicine evaluation and to facilitate future procedure rescheduling.

Summary of Recommendations:

1. If viral testing for SARS-CoV-2 infection is not available, patient risk stratification prior to endoscopy may be accomplished based on symptoms and sick contacts.
2. Emergent procedures, including but not limited to foreign body retrieval, diagnostic and therapeutic evaluation of gastrointestinal bleeding, and procedures in hospitalized patients should be prioritized.
3. We suggest limiting outpatient procedures only to “essential” procedures (defined as procedures that, if delayed more than 8 to 12 weeks, would lead to harm or injury).
Ultimately, final decisions regarding the scheduling and timing of endoscopy will be made through shared decision making between the individual gastroenterologist, patient, and the patient’s family.

4. At minimum, those in the pediatric endoscopy suite will require use of gloves, water-resistant gowns, surgical face masks, eye protection, and hair coverings for all endoscopic procedures.
5. For low-risk and high-risk patients requiring upper endoscopy and high-risk patients requiring colonoscopy, endoscopists will utilize N95 respirators (in lieu of surgical face masks) or equivalent in addition to the PPE listed above.
6. PAPR may take the place of surgical face masks/N95 respirators, eye protection, and hair coverings.

ACCEPTED

References

1. Del Rio C, Malani PN. COVID-19-New Insights on a Rapidly Changing Epidemic. *JAMA*. 2020.
2. Xiao F, Tang M, Zheng X, Liu Y, Li X, Shan H. Evidence for gastrointestinal infection of SARS-CoV-2. *Gastroenterology*. 2020.
3. Bai Y, Yao L, Wei T, et al. Presumed Asymptomatic Carrier Transmission of COVID-19. *JAMA*. 2020.
4. Li R, Pei S, Chen B, et al. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV2). *Science*. 2020.
5. Repici A, Maselli R, Colombo M, et al. Coronavirus (COVID-19) outbreak: what the department of endoscopy should know. *Gastrointest Endosc*. 2020.
6. Cui Y, Tian M, Huang D, et al. A 55-Day-Old Female Infant infected with COVID 19: presenting with pneumonia, liver injury, and heart damage. *J Infect Dis*. 2020.
7. Johnston ER, Habib-Bein N, Dueker JM, et al. Risk of bacterial exposure to the endoscopist's face during endoscopy. *Gastrointest Endosc*. 2019;89(4):818-824.
8. Wu Y, Guo C, Tang L, et al. Prolonged presence of SARS-CoV-2 viral RNA in faecal samples. *Lancet Gastroenterol Hepatol*. 2020.
9. Organization WH. *Rational Use of Personal Protective Equipment for Coronavirus Disease (COVID-19): Interim Guidance*. Geneva: World Health Organization;2020.

FIGURE LEGENDS

TABLE 1. SARS-CoV-2 infection risk in pediatric patients requiring endoscopy.

Classification of potential COVID-19 infection risk in pediatric patients undergoing endoscopic evaluation	
Low risk	<ul style="list-style-type: none">• No symptoms (e.g., cough, fever, shortness of breath) in the past 14 days <p>AND</p>
High risk	<ul style="list-style-type: none">• No known contact with confirmed COVID-19 case• At least one symptom (e.g., cough, fever, shortness of breath) in the past 14 days, with:<ul style="list-style-type: none">- Contact with confirmed COVID-19 case <p>OR</p> <ul style="list-style-type: none">• At least one symptom (e.g., cough, fever, shortness of breath) in the past 14 days, with:<ul style="list-style-type: none">- No known contact with confirmed COVID-19 case <p>OR</p> <ul style="list-style-type: none">• No symptoms (e.g., cough, fever, shortness of breath) in the past 14 days, but:<ul style="list-style-type: none">- Contact with confirmed COVID-19 case
Unknown risk	<ul style="list-style-type: none">• In an emergency setting, all procedures should be considered high risk if patient history cannot be properly assessed

FIGURE 1. PPE Utilization Algorithm for Endoscopists.

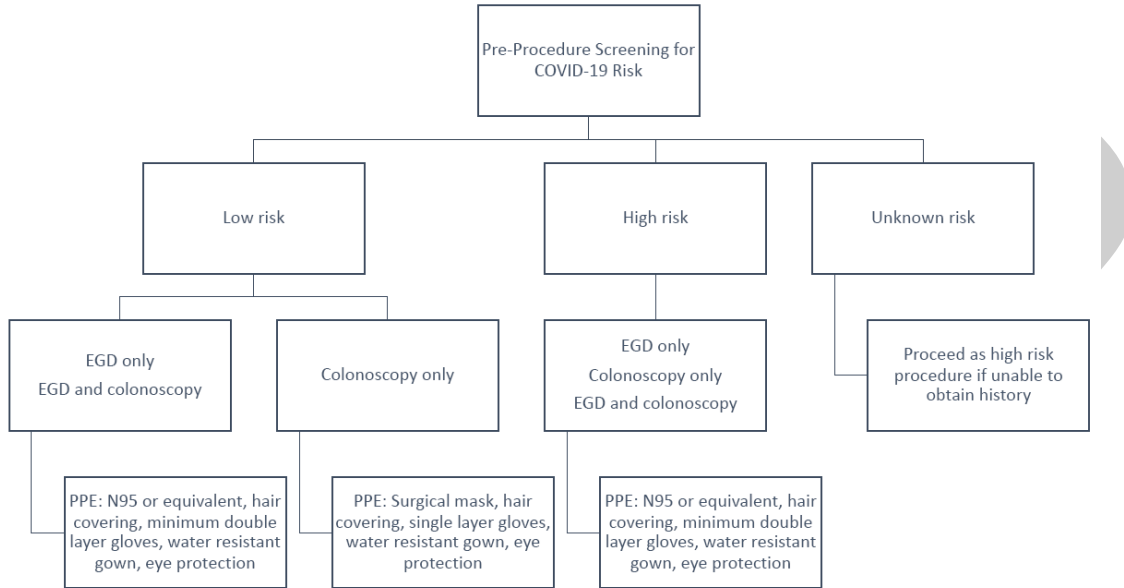


FIGURE 2. PPE Utilization in the Endoscopy Suite.

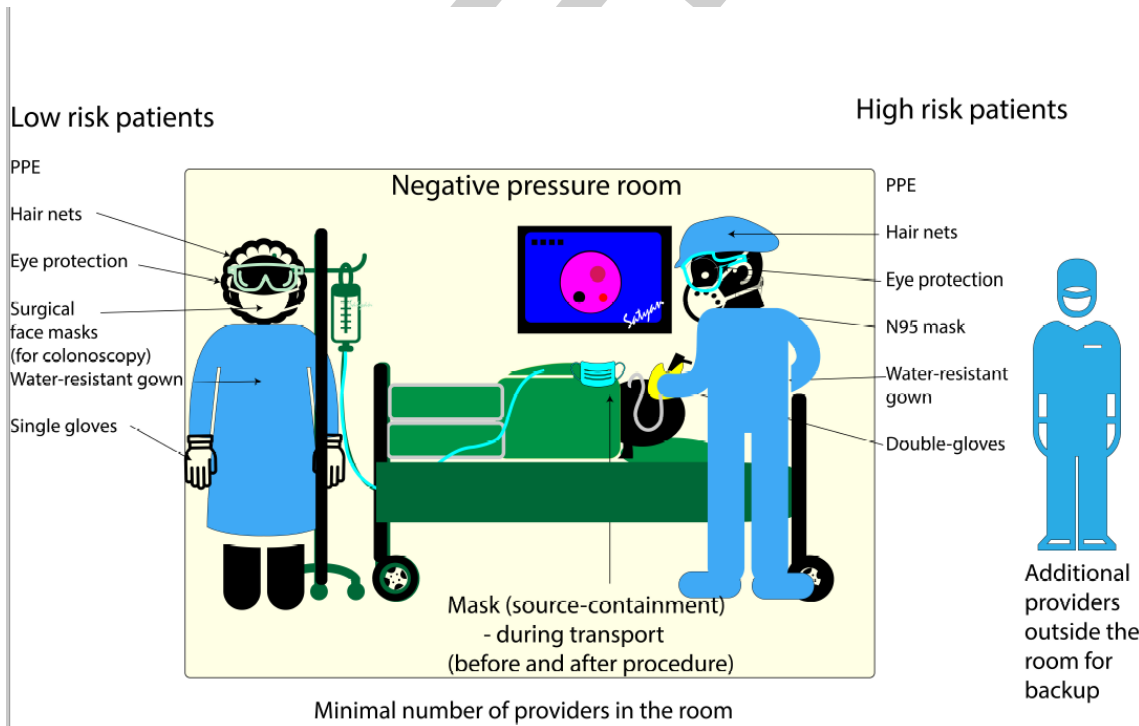


FIGURE 3. Aerosol Generating Procedure (AGP) Notification.

