Corona viruses are a group of medium-sized positive-sense single-stranded RNA viruses with crown-like structure due to projections noted over the surface of the virus. The infection has been declared as a pandemic by the world health organization (WHO) in March 2020. Health care professionals in endoscopy are at high risk of infection by novel corona virus disease 2019 (COVID-19) from inhalation of droplets, conjunctival contact, feces, and touch contamination. Upper gastrointestinal (GI) endoscopy is considered to be a high-risk aerosol-generating procedures (AGPs) and the live virus has been found in patient stool. Flexible endoscopes when contaminated have been considered as the vector for transmission of infections. Infections related to the side viewing endoscopes and endoscopic ultrasound scopes are more frequent than upper GI scope and colonoscopes. Stratifying patients needing endoscopy and deferral of elective procedures will help to decrease the virus spread. Planning and revision of workflows is necessary for safety of patient and staff and to successfully provide infection prevention and control measures, for this a “three zones and two passages” concept should be followed. Manual cleaning followed by high-level disinfection (HLD), effectively eliminates nearly all microorganisms from endoscopes during reprocessing. Transmission of viral infections during endoscopy is quite rare and, it is usually the result of noncompliance from the essential steps of reprocessing. Reuse of any disposable GI endoscopic device is strongly discouraged. Environmental decontamination is essential to reduce the risk of fomite transmission. Noncritical environmental surfaces frequently touched by hands (e.g., bedside tables and bed rails) and endoscopy furniture and floor should be considered heavily contaminated in patients with intermediate or high risk of COVID-19 and should be thoroughly disinfected at the end of each procedure. If available, negative pressure rooms are preferred for endoscopy, as has been advised by Centers for Disease Control and Prevention (CDC). Staff involved in reprocessing and the cleaning of endoscopy rooms should utilize personal protective equipment (PPE) including N95 mask. Reprocessing staff should undergo necessary training and ongoing annual assessment of competency.
The infection has been declared as a pandemic by the
world health organization (WHO) in March 2020. There
have been 2,074,529 confirmed cases of COVID-19, with
139,378 deaths affecting 213 countries as on April 17, 2020.3

The virus is transmitted from human to human primarily
through respiratory secretions, in the form of droplets,
while other modes include aerosols, feces, and contami-
nated environmental surfaces.4–5 Studies have shown that
the virus particles can be detected in aerosols for up to
3 hours after aerosolization and up to 3 days on surfaces.6
Moreover, undocumented infections have been found to
be the source of a significant majority of documented
cases.7 Transmission can occur from both symptomatic
and asymptomatic individuals

Health care professionals in endoscopy are at high risk
of infection by COVID-19 from inhalation of droplets,
conjunctival contact, feces, and touch contamination.5,8
Upper gastrointestinal (GI) endoscopy is considered to be a
high-risk aerosol-generating procedures (AGPs) and the virus
has been found in patient stool alive.5,8,9 Moreover, the infected
health workers may transmit the infection to their patients.
Infection prevention and control has been shown to be dra-
matically effective in assuring the safety of both health care
professionals and patients.

Gastrointestinal Endoscopy and Viral Transmission

Flexible endoscopes when contaminated have been con-
sidered as the vector for transmission of infections.10
The exact burden of this problem is, however, unknown,
possibly due to asymptomatic infections and incomplete
surveillance. Health care-associated infection outbreaks
have been reported and hence comprehensive endoscope
checking strategies with high-level disinfection (HLD) and
reprocessing has been recommended.11 Infections related
to the side viewing endoscopes and endoscopic ultrasound
scopes are more frequent than upper GI scope and colon-
oreoscopes. The majority of these infections are bacterial;
however, the transmission of other microbial organisms
have also been reported.12

Viral transmission through endoscopes has been reported
with hepatitis B and C viruses.13 Though COVID-19 is pre-
dominantly spread by respiratory droplets, the virus is also
present in infected stools and, hence can result in viral trans-
mision via aerosolization and fecal–oral route of contamina-
tion. Since the endoscopes are affected by gut flora, it poses
a risk not only to the endoscopists, nurses, and other endo-
scopy staff but also could be a source of infection transmis-
sion to other patients.10 Till date, there is no reported case
of endoscope-related COVID-19 transmission; however, the
risk remains, especially with prior experiences with hepatitis
B and C viruses. It is reassuring that post cleaning samples of
SARS-CoV-2 became negative, indicating that current endo-
scope disinfection techniques are sufficient.14

Disinfection, Handling, and Endoscope Storage

Endoscope

Gastrointestinal endoscopes are semi critical devices (devices
that contact the mucous membranes), and these devices
require HLD to destroy microorganisms and prevent trans-
mision of endoscopy related infection. Standard manual
cleaning followed by HLD should be effective at eradicating
SARS-CoV-2.14 Hence, no changes to the reprocessing of GI
endoscopes are recommended.15,16 The reprocessing work-
flow as suggested by European Society of Gastrointestinal
Endoscopy (ESGE) is shown in – Fig. 1.15

Endoscope reprocessing is a multistage process includ-
ing manual initial cleaning, HLD, rinsing, drying, and stor-
age. The salient points of each step are highlighted and
holds true for prevention of COVID-19 as well.

Precleaning

- Precleaning should commence in the procedure room and
  should be done by the staff already in the room.
- Manual cleaning of the endoscope is done with detergent
  solution and brushes after procedure completion to pre-
  vent drying of debris on or within the endoscope.16
- The insertion tube of the endoscope is wiped, and the
  channels are flushed with detergent according to the
  manufacturer’s instructions.
- After this, a properly labeled and enclosed container is
  stored. The salient points of each step are highlighted and
  holds true for prevention of COVID-19 as well.

Manual Cleaning

- Manual cleaning is performed before HLD.
- All debris is washed from its exterior by wiping and brush-
  ing after immersing the scope.
- A low-foaming medical grade detergent is used and is
diluted according to the manufacturer’s instructions. The
  scope remains immersed during the cleaning process.
- The suction and air/water valves, the biopsy channel cover,
  and all other removable parts are detached, while parts
  not intended for reuse are discarded. Brushing continues
  until there is no visible debris.
- For elevator channel endoscopes, it is important to
  ensure that the elevator mechanism located at the distal
tip of the duodenoscope is thoroughly cleaned and free
  of all visible debris.
- After manual cleaning, the endoscope and all removable
  parts are thoroughly rinsed with clean water to remove
  residual debris and detergent.
Forced air is used to purge water from the channels. After manual cleaning, endoscopes and reusable accessories are visually inspected prior to HLD.

### High-Level Disinfection
- HLD is the process of completely eliminating all microorganisms in or on a medical device, except for some of bacterial spores.
At most endoscopy centers, HLD is performed with a liquid chemical germicide solution by using an automated endoscope reprocessor that meets the standards of the Food and Drug Administration (FDA; or other government agency), while some centers use a manual process for HLD. Different disinfectants used for this purpose should be tested according to the European Standard, EN 14885. The product used must be bactericidal, mycobactericidal, fungicidal, and viricidal against enveloped and nonenveloped viruses. The germicidal chemical used for HLD must be compatible with the manufacturer’s instructions. Commonly used disinfectant is glutaraldehyde.

Rinsing: After HLD, the endoscope surface, channels, and removable parts must be rinsed with clean, bacteria-free water. Rinsing prevents exposing skin or mucous membranes to chemical residue.

Drying

- Compressed air is used to purge water from the channels, then flushing the channels with alcohol, followed by a second forced-air drying.
- Residual water in the channels after mixing with alcohol evaporates as air flows through the channels. If the channels and elevator mechanism are not completely dry, bacterial growth can occur resulting in persistent contamination.
- The exterior of the endoscope is dried with a soft, clean, lint-free cloth.

Storage and Reuse

- There isn’t any additional recommendation with regard to endoscope storage during the pandemic.
- A well-ventilated, dust-free, and forced-air drying cabinet is used to store the endoscopes. The endoscopes are stored in a vertical position with the tip hanging freely.
- Hence, although reuse within 21 days and perhaps even, 56 days appears to be safe, the data are insufficient to provide a maximal outer duration for use of appropriately cleaned, reprocessed, dried, and stored flexible endoscopes.

 Certain other points that need to be implemented seeing the COVID-19 pandemic are as follows:

- Limit the number of reprocessing staff.
- Reprocessing staff should be experienced with documented competency.
- All endoscopes should undergo full standard reprocessing prior to return to the endoscope manufacturer for maintenance.
- Reprocessing staff should have proper personal protective equipment (PPE).
- Clean gloves should be worn while transporting dry endoscopes to storage or drying cabinet.

Endoscopic Accessories

- Reprocessing of endoscopic accessories should be performed according to published guidelines. However, reuse of any disposable GI endoscopic device is strongly discouraged.
- Sterilization is required for reusable accessories (e.g., biopsy forceps, snares, and sphincterotomes) that breach the mucosal barrier.
- The water bottle and its connecting tube are typically changed at least daily, and the water bottle and tubing are sterilized after use (or discarded if it is single-use only).

Room Cleaning Process

- Environmental decontamination is essential to reduce the risk of fomite transmission.
- Meticulous cleaning of all high-touch and horizontal surfaces in procedure rooms after each procedure with an environment protection agency (EPA) approved surface disinfectant. Some of these disinfectants include hydrogen peroxide, sodium hypochlorite, chlorine dioxide, and others. The contact time ranges from 1 to 10 minutes.
- Noncritical environmental surfaces frequently touched by hands (e.g., bedside tables and bed rails) and endoscopy furniture and floor should be considered heavily contaminated in patients with intermediate or high risk of COVID-19 and should be thoroughly disinfected at the end of each procedure.
- The cleaning process should include cleaning of all surfaces in the procedure room to remove all soil and biofilm, followed by proper disinfection, as clearly reported in the ASGE (American Society of Gastrointestinal Endoscopy) guideline.
- Standard room disinfection policy should be kept in rooms where non-COVID-19 or low-risk patients undergo endoscopy. For surface and noncritical patient care equipment disinfection, 1:100 dilution of household bleach and water can be used.
- If available, negative pressure rooms are preferred, as has been advised by Centers for Disease Control and Prevention (CDC). In negative-pressure rooms, a delay of approximately 30 minutes is suggested before allowing a new patient to enter the room. Because small particles remain airborne for some period of time, in the absence of negative-pressure rooms, alternative measures such as diluting the air with cleaner air from the outdoors should be considered and the room kept empty for at least 1 hour.
- Staff involved in the cleaning of endoscopy rooms should utilize complete PPE.
- Each endoscopy unit should have a plan in place for the cleaning and disinfecting of the entire unit at the end of the day.

Quality Assurance

Quality assurance is essential for the effectiveness and safety of endoscope reprocessing protocols. Documenting the monitoring process typically includes the following:
• Procedure date and time.
• Patient’s name and medical record number.
• Endoscopist’s name.
• Endoscope model and serial number.
• Automatic endoscope reprocessor (if used) model and serial number.
• Names of technicians who reprocessed the endoscope.

Waste management: contaminated waste and endoscopic devices from high-risk patients, or with suspected or confirmed COVID-19 should be disposed of using the specific local regulations related to high-risk waste.23

Besides the disinfection in endoscopy, planning and revision of workflows is necessary for safety of patient and staff and to successfully provide infection prevention and control measures. “Three zones and two passages” concept should be followed: a contaminated zone, a potentially contaminated zone, and a clean zone should be clearly demarcated, with proper buffer areas in between.24 One-way passages for the transportation of contaminated equipment (such as endoscopes) are needed to avoid cross-contamination with clean equipment. Endoscopy unit layouts need to be adjusted to separate gown-up and gown-down areas to prevent cross-contamination. Separation in space and/or time between suspected and confirmed COVID-19 patients and other patients should be arranged.

GI endoscopes could pose a potential risk for transmission of viruses, and they could also theoretically transmit COVID-19, especially in patients with fecal shedding. Even asymptomatic individuals have shown to shed virus in feces, which can last many days after resolution of symptoms. Stratifying patients needing endoscopy and deferral of elective procedures will help to decrease the virus spread. Manual cleaning, followed by HLD, effectively eliminates nearly all microorganisms from endoscopes during reprocessing.25 Transmission of viral infections during endoscopy is quite rare and, it is usually the result of noncompliance from the essential steps of reprocessing.

Reprocessing of GI endoscopes has been outlined in several guidelines and should follow endoscope manufacturer instructions for use.27–29 Reprocessing staff should undergo necessary training and ongoing, annual assessment of competency. It would be prudent at this time for endoscopy unit leadership to reemphasize the importance of optimal reprocessing and ensure competency assessments are up to date.

Conflict of Interest
There is no conflict of interest.

References
9 Parodi SM, Lui VX. From containment to mitigation of COVID-19 in the US. JAMA 2020;323(15):1441–1442
17 Barakat MT, Huang RJ, Banerjee S. Comparison of automated and manual drying in the elimination of residual endoscope working channel fluid after reprocessing (with video) Gastrointest Endosc 2019;89(1):124–132.e2
18 Muscarella LF. Inconsistencies in endoscope-reprocessing and infection-control guidelines: the importance of endoscopy drying. Am J Gastroenterol 2006;101(9):2147–2154
19 SAGES webmaster: returning to operations after COVID-19. Available at: https://www.sages.org/author/sages-webmaster/ Accessed April 23, 2020
EPA Disinfectants for Use Against SARS-CoV-2. Available at: https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2.. Accessed March 30, 2020


Handbook of COVID-19 Prevention and Treatment. The First Affiliated Hospital, Zhejiang University School of Medicine, China


