





Drying of Flexible Endoscopes

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LEARNING OBJECTIVES

1. Understand the current standards and professional society recommendations for drying of flexible endoscopes
2. Discuss best practices for internal and external drying of endoscopes
3. Outline the types of procedures that can be implemented to achieve drying of flexible endoscopes

Effective drying of endoscopes reduces the risk of microbial contamination following high-level disinfection (HLD). In fact, improper or inadequate drying of flexible endoscopes has been cited as a potential cause of failure of the disinfection process.¹ If moisture remains in the channel of the endoscope and these endoscopes are stored wet while exposed to the environment, there is a possibility for recontamination of the device by the environment and replication of any remaining bacteria. Thus, recent endoscope instructions for use (IFU), published studies, national standards and professional society guidelines have begun to require complete drying, both internally and externally, of flexible endoscopes.

Previously, it was believed that an alcohol flush and air purge in an automated endoscope reprocessor (AER) or an alcohol flush and syringe air flush for manual reprocessing were sufficient to result in a dry endoscope. Multiple recent studies, however, have found that endoscopes are not being

dried adequately prior to storage when processed manually or even after an AER cycle. Until recently, facilities did not have the ability to inspect internal channels of endoscopes to verify that their drying process was working, and they did not have the ability to test if an endoscope was dry. Now that industry is aware that endoscopes are not being dried adequately, even when following the IFU of the endoscope manufacturer and AER manufacturer, it is no longer acceptable to ignore this critical step to prepare endoscopes for storage. Endoscopes must be dried completely prior to storage.

Objective 1: Understand the current standards and professional society recommendations for drying of flexible endoscopes

According to Society of Gastroenterology Nurses and Associates (SGNA) guidelines², there are nine separate steps for endoscope processing. Step #8 is the drying step, which requires an alcohol flush, followed by forced-air drying with instrument-quality compressed



air. The Association of periOperative Registered Nurses (AORN) guideline³ for flexible endoscope reprocessing states that “the collective evidence shows that effectively drying the internal and external surfaces of the endoscope is as important as effective cleaning and disinfection or sterilization.” The International Association of Healthcare Central Service Materiel Management’s (IAHCSMM’s) Endoscope Reprocessing Manual⁴ states that “once an endoscope has been properly cleaned and subjected to the HLD process, it must be dried thoroughly. Moisture that remains in an endoscope provides an opportunity for bacteria to grow.”

Current standards and guidelines, however, are inconsistent and vague about specific drying recommendations. This may be because we are only recently learning that endoscopes are not getting dry by following the endoscope IFU alone. Syringe flushing does not result in a dry endoscope, but neither does the air purge in an AER; therefore, following the cycle with compressed air is necessary before storage. Figures 1 and 2 show fluid remaining in endoscopes after several days of hanging in storage.

Inadequate drying before storage and lack of quality control measures to

detect problems or lapses in reprocessing are two characteristics that can impede proper reprocessing². Although SGNA recommends compressed air drying of the endoscope prior to storage, additional information on the type of air and how to perform the process is limited². The AORN guideline, however, does contain more information³ on this topic. This guidance states the following: Flush with instrument-quality air, which should be available in the endoscopy processing room. Clean, filtered air of instrument quality is required to dry lumens and small channels without introducing contaminants into the clean device. Drying the external surfaces of the endoscopes is also a necessary step in the process after both manual and automated HLD. SGNA guidelines² state that an endoscope that is not dry must be reprocessed before use.

Furthermore, ANSI/AAMI ST91, *Comprehensive guide to flexible and semi-rigid endoscope processing in health care facilities*, states that for all endoscopes “all channels should be purged with filtered medical-grade air at the correct psi (outlined in the manufacturer’s written IFU for that specific scope)” and that “before storage, the channel of the high-level disinfected endoscope should be dry

to help prevent bacterial growth and the formation of biofilm.”⁵ Even as far back as 2008, the Centers for Disease Control and Prevention’s (CDC’s) Healthcare Infection Control Practices Advisory Committee (HICPAC) guideline stated that an endoscope rinsed with tap or filtered water should be followed by an alcohol rinse and forced-air drying because forced-air drying markedly reduces bacterial contamination of stored endoscopes.⁶

Objective 2: Discuss best practices for internal and external drying of endoscopes

Drying practices apply to both the internal and external surfaces of the entire endoscope. All external surfaces, internal channels, channel openings, valve housings, forceps elevator recesses, control knobs and distal dip should be dried in accordance with the endoscope manufacturer’s IFU. A cloth or sponge should be used to dry the external surfaces of the endoscope and should be soft and low linting or non-linting. Figure 3 shows an example of a non-linting cloth used to dry an endoscope. Valves and other reusable parts must also be completely dry prior to storage, in accordance with their IFU. The same risk of recontamination and microbial proliferation applies to those stored items.

Internal endoscope channels must also be dried completely prior to storage. As discussed, this is accomplished by flushing with compressed air after disinfection either manually or in an AER. Endoscopes should be flushed until completely dry. Recent studies using lighted, flexible borescopes have highlighted that drying is often overlooked and that endoscopes are wet when removed from standard storage cabinets. Ofstead et al⁷ conducted a study to evaluate procedures, employee perceptions and occupational health



Figure 1 and 2: Drops of Moisture inside Endoscope Channel upon Inspection



Figure 3: Example of Non-linting Wipes Used to Dry External Surfaces

issues related to processing flexible endoscopes. One of the steps commonly omitted during manual processing included forced-air drying and flushing with 70% isopropyl alcohol. The only step routinely omitted during mechanical processing was the final external drying of the endoscope after removal from the processor. Even when reprocessing steps are performed meticulously, a few microorganisms may survive HLD. If any moisture remains in the endoscope channels or on its surface⁸, those few microorganisms can multiply to over a million colony-forming units in just a few hours. In another study, Ofstead and associates found residual fluid upon inspection with a borescope inside 19 of 20 endoscopes.⁹ Figures 4 and 5 show fluid and remaining moisture inside the endoscope channel.

The length of time for air flushing an endoscope to achieve complete dryness has not been well established. There are

a few limited studies on the topic that support flushing with compressed air for 10 minutes; however, this time frame may be dependent upon the type of endoscope being dried.

One study by Alfa and Sitter¹⁰ evaluated the effect of drying on the bacterial load in duodenoscopes.

There was visible moisture remaining in the suction channel, even though processing personnel had followed the AER manufacturer's IFU. By adding 10 minutes of drying time to the reprocessed duodenoscopes, either by purging the lumens of the endoscopes with instrument air or by adding 10 minutes of drying time in the mechanical processor, the endoscopes were then shown to be dry. Additionally, with the 10 minutes of added air drying, there were no microorganisms detected. It was concluded that the additional 10 minutes of drying time prevented bacterial growth in the endoscopes and eliminated the need for an alcohol flush. Another article by Barakat, et. al., showed that 10 minutes of mechanical drying resulted in virtually no water droplets in the channel upon observation with a borescope.¹¹

The pressure of the compressed air must be a consideration prior to implementing a drying process. ANSI/AAMI ST91⁵ states that "forced air with an upper limit of pressure as described in the endoscope manufacturer's written IFU should be provided at the sink for flushing lumened devices." Within the endoscope's instruction manual or in customer letters there are specifications listed for pressure limits when flushing



Figure 4 and 5: Unknown Fluid and Remaining Moisture Inside Channel



Figure 6: Example of an Air Gun for Drying Endoscope and Accessories

with air. Refer to those instructions to find the correct pressure settings for flushing. For example, in Olympus customer letters^{12,13}, it states, “when injecting the compressed filtered air or medical grade compressed air into the endoscope channels, the air pressure must not exceed 0.5 MPa (71 psig) for gastrointestinal endoscopes or 0.2 MPa (29 psig) for surgical flexible endoscopes (e.g., bronchoscopes and cystoscopes). Exceeding the recommended pressure limits may cause damage to the endoscope.” Facilities personnel should test the pressure output on the compressed air lines to be sure these pressure ratings are not exceeded. A pressure regulator on the air line may be necessary to avoid damage to the endoscope internal channels.

The drying step is also necessary for an endoscope that is being sterilized instead of high-level disinfected. In this case, however, drying would be performed after manual cleaning and prior to sterilization instead of after the completion of the HLD process. Drying prior to sterilization is essential

prior to wrapping the endoscope to prepare the endoscope to be sterilized. Residual moisture can interfere with the sterilization process (rendering it ineffective), leave harmful residuals or even cause the cycle to abort; therefore, the endoscope must be “bone dry” prior to wrapping.

Objective 3: Outline the types of procedures that can be implemented to achieve drying of flexible endoscopes

Now that it is established that each endoscope processing cycle must be completed with a drying step prior, how can this be achieved? There are several options that a facility can implement to be compliant with this new drying requirement.

1. Flush the endoscope with compressed air using an air gun until the endoscope is completely dry. An example of an air gun used in drying of endoscopes is seen in Figure 6.
2. Utilize a pump-assisted drying unit for the endoscope. Flush the endoscope per the IFU of the drying pump to achieve drying prior to storage.

3. Utilize a drying cabinet that provides filtered or instrument-quality air hooked up directly to the endoscope channels. This completes the drying cycle while the endoscope is in the cabinet and eliminates the need for internal manual drying. External drying steps still need to be performed.

The IAHCSSM Endoscope Reprocessing Manual states that “in the past, processed endoscopes were stored in cabinets, often without proper drying prior to storage. While cabinets protected the endoscopes from damage and kept them dust free until use, they did little to reduce internal moisture.”⁴ At best, cabinets had holes in them to allow for air circulation or may have had a high-efficiency particulate air (HEPA) filter unit on the cabinet. According to AORN’s *Guideline for Processing Flexible Endoscopes*³, endoscopes should be stored in drying cabinet as this is the most robust process available and takes the manual steps out of the equation. If a drying cabinet is not available, then flexible endoscopes may be stored in a closed cabinet with HEPA-filtered air that provides positive pressure and allows air circulation around the flexible endoscopes.

In the past, it was difficult or impossible for personnel to determine if an endoscope was dry. Today, there are two options available to test for dryness in an endoscope prior to storage. The first is a simple drying test in the form of a card (See Figure 7). This card is used by blowing compressed air through the endoscope channels and placing the card at the outlets of the endoscope, such as the distal tip, at the suction connector and at the auxiliary water connector. If moisture is detected, white spots will appear on the card’s blue/purple background. The endoscope must then



Figure 7: Example of an Endoscope Drying Test – Side 1 is instructions, Side 2 is for detection. White dots on blue/purple background indicate moisture is detected.

be further dried and retested to see if any residual moisture is found.

A flexible video borescope is another method to detect residual moisture in endoscope channels (See Figure 8). Periodically inspecting endoscopes after the drying process or in storage provides immediate feedback to the facility on whether the drying practices are sufficient. *Note: Remember that the inspected endoscope must be reprocessed again before use.*

Conclusion

By implementing an additional drying cycle, each facility will have a quality drying process that is subjected to periodic inspection and feedback to ensure that the process is effective; this is an important part of a quality management system of checks and balances. According to SGNA, drying the endoscope after every reprocessing cycle, both between patient procedures and before storage, is crucial to the prevention of bacterial transmission and nosocomial infection. Since moisture promotes biofilm development¹, drying the endoscope after every reprocessing cycle, both between patient procedures and before storage, is a practice crucial to the prevention of bacterial transmission and nosocomial infection². Drying is as important to the prevention of disease transmission and nosocomial infection as cleaning and HLD¹. ©

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Figure 8: Example of a Flexible Video Borescope for Internal Inspection of Endoscope Channels