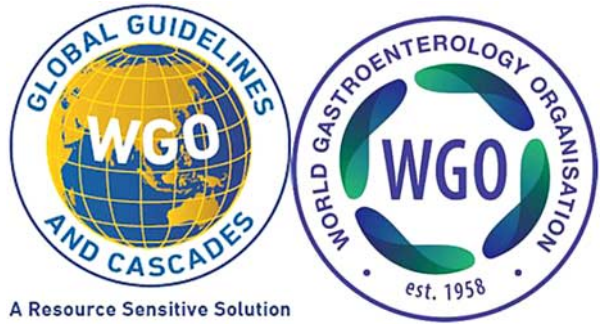
WGO Guideline—Endoscope Disinfection Update



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The WGO Guideline "Endoscope Disinfection" is intended for use by health providers and professionals who are involved in the use, cleaning, and maintenance of endoscopes and aims to support national societies, official bodies and individual endoscopy departments in developing local standards and protocols for reprocessing endoscopes.

This updated Endoscope Disinfection Guideline addresses the recent outbreaks of multi-drug resistant organisms after endoscopy and proposes measures to reduce the risks of these outbreaks occurring. The recommendations are based on the consensus findings of an international multidisciplinary working group with expertise in microbiology, including biofilms, endoscope reprocessing, nursing, and gastroenterology, and with broad experience in developing national and international reprocessing guidelines.

Received for publication February 11, 2022; accepted June 23, 2022.

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D.J.: No payment for work on these or any other guidelines; have participated in focus group meetings with several AFER manufacturers; have been a speaker at symposia/conferences supported by disinfectant and AFER manufacturers, all of which have been nonpaid; have shares in an Australian company involved in reprocessing technologies (not currently for endoscopy). M.A.: Consultant for 3M, Olympus, J&J ASP, Novaflux, Ofstead & Associates; royalties related to patent licenced to Healthmark through University of Manitoba; honoraria from Olympus and J&J ASP for invited presentations. H.G.: Speaker at education workshops sponsored by Cantel medical and Intercept medical. K.V.: Received no payment; have been a nonpaid, invited symposia speaker sponsored by Whiteley Corporation, a manufacturer of detergents and disinfectants. A.L.: Acting as guideline development consultant for WGO. R.S. declares no conflict of interest.

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DOI: 10.1097/MCG.0000000000001759

GUIDELINES OR STANDARDS

Reprocessing instructions are often called guidelines but are, in fact, a technical standard that sets out the minimum acceptable practice for reprocessing to deliver high-level disinfection of endoscopes. The distinction between the 2 terms is important. Medical guidelines usually address a narrow clinical question using population-based data, often results of randomized trials in a specific population, to guide the care of an individual patient.[1]

Standards are broader in the application and set out specifications and procedures designed to ensure products, services, and systems are safe, reliable, and consistently perform the way they were intended. The supporting evidence for a standard is based on science, technology, and experience rather than clinical trials. The standards governing reprocessing are based on the science of cleaning, disinfection, drying, and microbiology, and recommendations are supported by measurements of efficacy in models with artificial soils and/or a known inoculum of bacteria.

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The implementation of the appropriate standards for reprocessing should follow the general principles of good manufacturing practice (GMP). GMP is a set of regulations, codes, and guidelines for a manufacturing process, in this case reprocessing an endoscope to produce a high-level disinfected endoscope. These regulations cover both performances of reprocessing and quality control of the process. GMP is recognized worldwide for the control and management of manufacturing and quality control testing of pharmaceutical products and has evolved over the last 60 years in response to multiple well-publicized problems in the pharmaceutical industry.[2]

While the terms guidelines and standards are both used to describe instructions for endoscope reprocessing[3,4] these instructions are best considered as a technical standard.

General Principles in Endoscope Reprocessing

The most important step in endoscope reprocessing is scrupulous manual cleaning before disinfection. Disinfection will fail if the cleaning has been inadequate.[5–7]

Manual cleaning must be undertaken by a person familiar with the structure of the endoscope and trained in cleaning techniques. Cleaning should begin immediately after the endoscope is used so that biological material does not dry and harden. Appropriate detergents and cleaning equipment should be used; in particular appropriate diameter brushes should be used for each channel. Cleaning should be followed by thorough rinsing to ensure all debris and detergents are removed before disinfection.

Manual Cleaning

Pre-Cleaning—Immediately after each procedure, with the endoscope still attached to the light source, the insertion tube should be wiped with a lint-free disposable cloth and the distal tip placed in a low foaming medical grade detergent solution and detergent aspirated through all channels, including the suction/biopsy channel. The air/water channels should be flushed with detergent, and then all channels flushed, including the jet channel if present, with water, then air, as per the manufacturer's instructions. A specific valve may be required to flush the air/water channels with detergent.

The endoscope should be removed from the light source and transported to the cleaning area in a closed container that avoids environmental contamination from drip or spill, and that clearly indicates that the endoscope within is contaminated.

It is essential that the endoscope is not allowed to dry before further cleaning as this will make the removal of organic matter difficult or impossible. Endoscopes should be processed without delay within 30 minutes.

Leak testing should be performed to check the integrity of all channels before further processing. All the valves and buttons should be removed and leak testing performed as per the manufacturer's instructions.

Buttons and valves should be brushed and disinfected, paying particular attention to internal surfaces and high-level disinfection or sterilization according to the original equipment manufacturer's instructions.

The endoscope should be placed in a detergent solution in a sink in the "dirty" section of the decontamination area and the outer surface washed. A low foaming medical grade detergent should be used at the appropriate dilution according to the manufacturer's instructions. All accessible sections of the suction biopsy channel should be brushed according to the manufacturer's instructions for use, and each channel should be brushed until all debris is removed. The tip and handles and clean valve seats should be brushed and then cleaning adapters fitted and channels flushed with fresh detergent for the product specified time.

The endoscope should be rinsed by draining the detergent from the sink, rinsing the outer surface with cold running tap water, then filling the sink with tap water and purging the channels with tap water using the cleaning adapters following the manufacturer's instructions. The channels should be purged with air to remove rinse water.

Disinfection

High-level disinfection is performed in an Automatic Flexible Endoscope Reprocessor (AFER) that should comply with the relevant national standard or be approved by the Food and Drug Administration (FDA). The AFER may or may not have an automated cleaning and disinfection cycle. All connectors should be specifically designed for each endoscope model. All channels should be connected at the start and end of a cycle. The detachable components, including the air/water and suction valves, can be steam sterilized or reprocessed with the endoscope if the ability of the AFER to clean and/or disinfect these detachable components is validated by the AFER manufacturer.

After high-level disinfection, the endoscope is rinsed in the AFER with bacteria-free water produced by sub-micron filters. Water quality should be checked regularly.

Manual high-level disinfection is another option that is effective when performed by well-trained, dedicated reprocessing staff supplied with appropriate personal protective equipment. The endoscope should be immersed in disinfectant, and all channels are filled with disinfectant solution, and the buttons and valves should be immersed in the disinfectant. The instrument should be soaked for the required time at the required temperature and concentration as specified by the disinfectant manufacturer.

All channels should be purged with air to remove the disinfectant, the exterior of the endoscope rinsed and the channels flushed with bacteria-free water, with the volume required for the specific disinfectant used, to remove any traces of disinfectant.

Drying

Endoscopes should be dried after each procedure by purging the water from the channels with compressed air, then flushing the channels with alcohol, followed by forced air drying. Alcohol flush facilitates drying and is a useful adjunct to disinfection because of its bactericidal effects.[8]

The use of alcohol may not be permitted in some countries (France, UK) because of concerns about variant Creutzfeldt-Jakob disease.

The endoscope should be stored in a forced air-drying cabinet to supplement drying.

If an endoscope is used infrequently, it is reasonable to store it separately hanging vertically in a purpose-built cabinet as opposed to a forced air storage/drying cabinet, and then reprocess the endoscope before the next patient use. Endoscopes should be dried completely before hanging.

Accessories

The water bottle should be changed after each endoscopy session and steam sterilized. The water bottle should be filled with sterile water immediately before use.

Documentation

All essential steps of endoscope reprocessing should be documented for quality assurance and for patient tracing if necessary.

OUTBREAKS

The recent reports of outbreaks of multi-drug resistant organisms (MDROs) after endoscopy, particularly carbapenem-producing Enterobacteriacae (CPE), have focused critical attention on the efficacy and safety of reprocessing protocols.

CPE has become established in the hospital environment and may cause clinical infections with substantial morbidity and mortality because of their antibiotic resistance. Outbreaks of CPE after endoscopy have been reported in several countries often after ERCP[9] but also following bronchoscopy,[10] gastroscopy,[11–13,] and flexible cystoscopy.[14,15] Often, microbiological surveillance identifies a single source for an outbreak of MDROs that can be traced to a culprit endoscope that has transmitted genetically similar bacteria on multiple occasions despite reprocessing.

MDROs may also be transmitted sporadically by endoscopes without a single source being identified by genetic studies. In case-control studies of hospital inpatients, a recent endoscopy, including gastroscopy, bronchoscopy, and ERCP, was a significant risk factor for acquiring MDRO colonization/infection.[13,16–18].

The risk of transmitting infection at endoscopy is underestimated; a risk of 1 in 1.8 million is often quoted.[19] The correlation of an infection with a previous endoscopy is difficult to establish confidently, and if established, is not always reported to authorities and is seldom published.[20,21] The paucity of reports from less developed countries is likely to be due to failure of detection and reporting rather than a true absence. Cultures of patient-ready endoscopes provide a better estimate of the problem.[22] Cultures of endoscopes performed immediately before a procedure and for routine microbiological surveillance suggest that at least 2-4% of endoscopes, including gastroscopes, colonoscopes, and duodenoscopes are transmitting bacteria.[23–26] Transmission of antibiotic-sensitive enteric bacteria at gastroscopy and colonoscopy rarely causes clinical illness; however, transmitted bacteria may colonize the patient.[27,28]

The recent outbreaks were only identified because of the distinctive features of the CPE, the antibiotic resistance.[29] CPE is acting as a marker of transmission, and the emergence of CPE has exposed long-standing flaws in endoscope reprocessing.[30]

Many of the problems associated with recent outbreaks are well recognized problems from the past, including breaches of cleaning and disinfection protocols, often failure to dry before storage, and occult endoscope defects that compromise cleanability. However, there are also outbreaks where cleaning and disinfection were performed according to guidelines, and the manufacturer can find no fault in the endoscope.

Recent publications have found that current reprocessing standards do not provide a reasonable level of safety and effectiveness.[31–34]

In response to outbreaks, the FDA's May 2015 Advisory Panel[35] encouraged facilities to consider supplemental measures, including double reprocessing between patients, ethylene oxide sterilization, or the use of a liquid sterilant processing system. About 15 months after these recommendations were made, a survey of providers performing ERCP in the USA found 63% of centers performed double disinfection and 12% ethylene oxide sterilization.[36] However, these additional measures are expensive and time-consuming, and ethylene oxide sterilization is not readily available.[33]

Subsequent to this advice, a randomized trial comparing the 3 reprocessing protocols, standard high-level disinfection, double high-level disinfection, and ethylene oxide sterilization, concluded that these enhanced disinfection methods did not provide additional protection against contamination.[33] Another randomized trial found double high-level disinfection was no better than standard high-level disinfection.[37]

It is increasingly recognized that biofilms on endoscopes compromise cleaning and disinfection.[34,38,39] The conditions reported as causes of outbreaks facilitate biofilm formation and growth; these include inadequate cleaning, inadequate drying, occult endoscope defects, including channel damage and breaches of reprocessing protocols.

Biofilm prevention and control are core problems in reprocessing that are addressed in these guidelines

The changes proposed can be broadly summarized as follows:

- Cleaning—carefully follow the manufacturers' updated reprocessing instructions specific for each model of endoscope.
- Drying—improved drying with an alcohol flush and 10 minutes of forced air after each procedure. Endoscopes should be stored in a forced-air drying cabinet.
- Occult endoscope defects—routine endoscope maintenance to identify and repair defects. Routine channel replacement to reduce the prevalence of occult defects and maintain a smooth cleanable channel surface.
- Breaches of reprocessing protocols—Establish a multidisciplinary committee to develop and implement reprocessing protocols and to perform quality control of training, the process and outcomes.

NEW RECOMMENDATIONS

Recommended Changes to Reprocessing and Storage

Prompt attention to cleaning, disinfection, and complete drying reduces the growth of established biofilm and prevents bacteria from forming new biofilm (Table 1).

Recommended Changes for Duodenoscopes

Table 2

Endoscope Drying

It is critical that drying is performed following manual or AFER reprocessing—regardless of AFER manufacturer claims

- Initial Drying—All endoscopes should have a preliminary alcohol flush and forced-air channel drying for 10 minutes.
- Storing/Drying Cabinet—After initial drying endoscopes should be promptly transferred to an approved endoscope forced air storage/drying cabinet, and channel-purge air drying commenced.

  This should continue until the endoscope is used again or the safe storage period has elapsed.

  Storage/Drying cabinets should comply with the relevant National Standard or with the European Standard EN 16442 Controlled Environmental Storage Cabinet for Processed Thermolabile Endoscopes

TABLE 1. Specific Recommendations for Reprocessing and Storage

Activity	Recommendations
Precleaning	Precleaning must be carried out IMMEDIATELY after use.
Cleaning	Cleaning (manual or using an AFER with an FDA or National approved cleaning cycle) must be carried out PROMPTLY* within 30 minutes after precleaning.
	Always follow the most up to date manufacturer's specific instructions for cleaning for each model of endoscope.
Disinfection	After manual cleaning of the endoscope, machine or manual high-level disinfection must be undertaken promptly.
	Endoscopes should be thoroughly rinsed with bacteria-free water after disinfection.
Alcohol flush and forced-air drying	After disinfection by any means the endoscope must have prompt initial alcohol flush and forced-air drying† for 10 minutes and storage in an approved forced air storage/drying cabinet‡.
Drying cabinet storage	Endoscopes must remain in approved forced air-drying cabinets until next patient use.
Bacteriological surveillance	Perform regular bacteriological surveillance of endoscopes and AFERs at intervals appropriate to local conditions and resources.
Maintenance	Send endoscopes for regular yearly maintenance and consider replacing the instrument channel every 2 years or according to workload (or more frequently as recommended by the endoscope manufacturer.)

Notes:
Duodenoscopes are considered separately.
* = "Promptly" in these Guidelines means within 30 minutes.
† = The endoscope may be used on another patient after the initial forced-air drying but it must be placed into the storage cabinet if not immediately used for another patient procedure.
‡ = See section on Drying Cabinets.
AFER indicates automatic flexible endoscope reprocessor.

Note: If needed, the duodenoscope can be used for another patient procedure after the initial forced air drying or before the drying cycle in the cabinet is completed.

Interventions to Control CPE Transmission in the Facility

CPE is spread through the fecal-oral route; the mode of transmission is often through contaminated hands of healthcare workers or contaminated fomites. Carbapenemase-producing bacteria are commonly found in hospital wastewater and also found in sinks and faucets.[41] Investigations during an outbreak of an MDRO after ERCP found the culprit MDRO in sinks and in the water used to rinse the duodenoscope before disinfection.[42] Guidelines for prevention and control of CPE emphasize hand hygiene, active surveillance and contact precautions, and environmental cleaning. Endoscopy units should implement national and local infection control multi-drug resistant organism guidelines. Training that improves compliance with hand hygiene reduces transmission of infection.[43] (Table 3).

AFER Maintenance

- Water quality should be appropriate for the AFER.
- External water filters should be replaced according to an established schedule, and the internal sub-micron filters replaced as per the manufacturer's instructions for use.

APPLICATION OF GUIDELINES

Detailed recommendations for reprocessing are set out in international and national guidelines/standards. Recent guidelines from USA, Europe, China, Southeast Asia, and the Middle East have been updated to reflect the latest research and the manufacturer's recommendations.[3,4,32,44–47] These

TABLE 2. Specific Recommendations for Duodenoscopes

	Endoscopy Units Performing ERCP Should…
Volume of procedures	Consider whether the number of ERCP procedures performed is sufficient to continue offering this clinical service.
Dedicated staff and training	Have dedicated staff reprocessing duodenoscopes who are aware of and have undertaken specific training in the particular problems associated with cleaning, disinfecting, and obtaining endoscope samples for bacteriological surveillance.
Bacteriological surveillance	Perform MONTHLY bacteriological surveillance cultures of duodenoscopes utilizing sample collection protocols that include samples from the distal lever cavity.*
	Duodenoscopes with positive surveillance bacterial cultures with organisms of concern detected should be sent for service (unless there is an alternative explanation eg, staff error).
	Have appropriate risk notification of possible MDRO transmission in their Informed Consent information.
Maintenance	Regardless of culture results, send duodenoscopes for regular yearly maintenance.
	Have instrument channels and "O-rings" replaced at least on yearly basis (or more frequently as recommended by the endoscope manufacturer).

*Note:
Consideration should be given to using the recently published FDA/CDC/ASM duodenoscope sample collection and culture protocol that has been validated by duodenoscope manufacturers.[40]
MDRO indicates multi-drug resistant organisms.

TABLE 3. Recommendations to Control CPE Transmission

	Recommendations
CPE status	Be aware of the CPE status of your hospital.
CPE infected patients	Ensure that known CPE positive patients are notified to the endoscopy unit BEFORE arriving at the unit. CPE infected patients or those at high risk, who are yet to be cultured, should be examined last on the list and managed in isolation from other patients with use of a separate toilet or a commode. Clean and decontaminate procedure room after the endoscopy procedure as per specific protocols for terminal cleaning of contaminated areas.
Plumbing standards	Sinks, taps and plumbing should comply with the national standards to minimize the risks of spray from drains in sinks or overflow of wastewater from blocked pipes.
Infection control procedures	The emergence of CPE is another compelling reason to meticulously follow standard infection control procedures including hand hygiene and the use of appropriate personal protective equipment (i.e. gloves and impervious gowns for each procedure). Endoscopy units should provide regular education, and assessment of compliance with hand hygiene and environmental cleaning and decontamination.

CPE indicates carbapenem-producing Enterobacteriacae.

guidelines will inform the development of other national and regional guidelines.

In all countries, health resources are allocated according to cost/benefit analysis. Prioritizing resources in low and middle-income countries have increasingly focused on cost-effectiveness.[48] The cost-effectiveness of endoscopy can be estimated from the cost of delivering the services, the outcomes achieved, and the costs of complications.[49] The emergence of CPE has increased the risk of serious infections occurring after endoscopy and thus increased the costs of inadequate reprocessing. The costs of managing an infection with CPE are substantial in both developed and low and middle-income countries.[50,51]

The risk of transmitting CPE depends on the

- prevalence of CPE in patients referred for endoscopy
- quality of reprocessing
- age and state of repair of the endoscopes.

Each country and hospital should know the local prevalence of CPE to implement appropriate risk management.

Endoscopists must understand the principles of reprocessing and be aware of the risk to patients when there is failure of endoscope reprocessing.[52]

When purchasing second-hand equipment, hospitals should ask to see an endoscope's previous history of maintenance and repairs. Channels and O-rings that are old or have had a previous heavy workload should be replaced. Rawers reported that inadequate repairs to 2 duodenoscopes contributed to an outbreak and highlighted the importance of reliable endoscope repairs and maintenance.[29]

Endoscope reprocessing should be managed by a multidisciplinary committee

Successful reprocessing is dependent on many interrelated processes governed by overlapping standards. The delivery of endoscopic services is best managed by a multidisciplinary committee including nurses, endoscopists, infection control and engineering personnel, and most importantly management.[32,53,54]

- The committee should use a process approach to develop, implement, and improve the effectiveness of a quality management system for both the people and the process itself, as informed by the Standards ISO 9001 and ISO 13485:2016.[55–57]
- The recent position statement of the European Society of Gastrointestinal Endoscopy and European Society of Gastrointestinal Nurses and Associates lists quality criteria for endoscope reprocessing.[58]
- Policies, procedures, and strategies should be developed in consultation with relevant stakeholders.[53]
- The committee must be up to date with recent publications and undertake internal audits to ensure reprocessing complies with recent recommendations from manufacturers, guidance bodies, and regulatory departments.

In low and middle-income countries, there may be a lack of infrastructure and a deficiency in trained personnel.[51]

- Local guidelines should be tailored to specific needs, and quality control should start with simple, cost-effective measures such as education programs. Surveillance of process and compliance with guidelines should be prioritized over outcome surveillance that is more expensive and time-consuming.[51]
  If resources are limited, a local multidisciplinary committee should review the options available and make a decision based on a risk assessment informed by local conditions.
- Options to consider include referral to a center with more resources and reassessing the need for endoscopy. Is a trial of treatment a safer option?

SCIENCE OF REPROCESSING

During outbreaks of MDROs after endoscopy, patients may become colonized and initially show no clinical symptoms only to develop serious systemic infections weeks to months later, with mortality reported as high as 40%.[42,59]

Often a single species of CPE is transmitted from 1 endoscope on multiple occasions despite reprocessing. This epidemiology is best explained by a biofilm on the endoscope protecting bacteria from cleaning and disinfection and acting as a reservoir for transmission of infection.

Biofilm

In the 1999 CDC report of an outbreak of a carbapenemase-producing *Pseudomonas aeruginosa* following bronchoscopy, it was considered that biofilm forming in difficult to clean, narrow, endoscopy channels contributed to this outbreak.[60] A subsequent research investigation examined the surfaces of endoscope channels with scanning electron microscopy and confirmed the presence of biofilm often lodged in surface defects.[38] Other studies have also found biofilm on endoscope channels[61–63] and on culprit endoscopes in reports of outbreaks.[64–66]

Biofilm is a community of bacteria attached to a surface and to each other by an extracellular polysaccharide matrix.

Bacteria living in a biofilm have different properties than free floating (planktonic) bacteria of the same species. Bacteria incorporated into biofilms are often resistant to disinfectants used at recommended reprocessing concentrations.[34,67] Planktonic CPE are killed in under 1 minute by recommended concentrations of standard disinfectants providing a wide safety margin for these planktonic bacteria.[68] However, biofilm matrix limits the diffusion of the disinfectant; multiple layers of cells and biofilm matrix are difficult for the disinfectant to penetrate.[69] Standard concentrations of disinfectants do not reliably kill the same bacteria within biofilms.[70] Bacteria in buildup biofilm that accumulates in defects on endoscope channel surfaces are also protected by organic debris and crosslinked protein, making them more difficult to kill with standard reprocessing.[34,62] Current reprocessing parameters based on data from models using artificial soils and planktonic bacteria need to be revised using models incorporating bacteria in biofilm or buildup biofilm.[34]

Biofilm attached to the surface of an endoscope channel acts as a reservoir of bacteria, and given favorable conditions, bacteria in biofilms can multiply, detach, resume their planktonic state, and be transmitted to patients during endoscopy.[34] Moisture and a supply of nutrients facilitate biofilm growth and release of planktonic bacteria.

The role of moisture facilitating biofilm growth during storage and the importance of complete drying after reprocessing has been underestimated in the past. Current evidence indicates 95% of endoscopes still had visible moisture in channels after AFER alcohol flush, a 3-minute drying cycle, and overnight storage in a regular cabinet.[71] Keeping the endoscope free of moisture, particularly the channels during storage, must be a priority.

Defects in endoscopes impair cleaning and provide a niche for biofilms to grow.[38,62] Some defects may be identified by close inspection, including defects in the cap and external layers and leaks behind the lens.[42,72] Occult defects that do not interfere with endoscope function are more difficult to identify without dismantling the endoscope or using specialized tools such as a bore scope. Bore scope examination of channels in working endoscopes has found longitudinal wear marks and other defects on the channel surfaces.[73–75] Scanning electron microscopy of channel surfaces shows biofilm in these wear marks.[38,62] Outbreak investigations that dismantled culprit endoscopes have found other occult defects, including micro-perforations and leaking O ring seals.[29,42,64,76] Timely routine inspections and preventative maintenance would reduce the use of endoscopes with defects that compromise cleanability.[22] Endoscope manufacturers and national guidelines now recommend annual routine maintenance.[22]

Duodenoscopes

Duodenoscopes are difficult to clean and disinfect. In addition to the complex design, factors such as the characteristics of patients referred for ERCP, and the interventions performed also contribute to the risk of colonization and subsequent infection from bacteria transmitted during the procedure.

The rate of contamination of duodenoscopes, as judged by positive surveillance cultures, is similar to the rates of contamination of gastroscopes and colonoscopes.[23–26] Thus, patient characteristics and the interventions performed are dominant factors in the higher incidence of outbreaks after ERCP.

The risks of outbreaks are best addressed by specific changes to improve cleaning and disinfection of duodenoscopes as well as improvements to reprocessing protocols for all endoscopes. The manufacturers' updated cleaning protocols are an important improvement in duodenoscope reprocessing. Review of a quality assurance database of 4307 duodenoscope cultures found that implementation of the new cleaning protocols significantly reduced the rate of positive cultures.[77] However, FDA-mandated manufacturers' surveillance culture studies have found persistently positive cultures with clinically important bacteria.[78]

Drying

The reprocessing step of drying has often been ignored or incompletely carried out and is prone to human error.[43] A survey in the United States of reprocessing in 249 endoscopy units performing ERCPs found that 52% of the centers did not comply with the Multisociety Guidelines and did not use forced air to dry endoscopes.[79] Guidelines are inconsistent with one another and do not always specify the parameters for adequate drying.[80] Recent studies have found residual fluid in up to 95% of endoscope channels after reprocessing and drying, suggesting drying guidelines need improvement.[62,71]

Biofilms need moisture to grow. Alfa and Sitter,[81] in a pivotal paper, demonstrated that if duodenoscopes were left damp after reprocessing there was rapid growth of *Pseudomonas* and *Acinetobacter* species. Drying for 10 minutes with forced air prevented this overgrowth in all duodenoscopes studied. Implementation of an alcohol flush followed by forced air drying ended outbreaks of *Pseudomonas* infections after ERCP in the 1980s.[82] More recent studies have confirmed that alcohol flush followed by 10 minutes of forced air drying was more effective than alcohol flush followed by a shorter variable time of forced air drying.[73,83]

AORN guidelines[84] recommend endoscopes should be stored in a drying cabinet and state, "The collective evidence shows that optimal storage of flexible endoscopes facilitates drying, decreases the potential for contamination, and provides protection from environmental contaminants."

This recommendation is supported by a review of surveillance cultures of patient-ready endoscopes, including duodenoscopes, gastroscopes, colonoscopes, and echoendoscopes, which found that the introduction of drying cabinets significantly reduced the risk of endoscope contamination.[85] In a direct comparison, a forced-air drying cabinet dried endoscopes more rapidly and significantly reduced microbial growth compared with a standard storage cabinet.[86]

CONCLUSION

The science of reprocessing is evolving. New research, including basic research, clinical research, and randomized trials undertaken in response to the publications of outbreaks of CPE, is now being published. Endoscope manufacturers continue to improve endoscope design and validate new reprocessing instructions. New drying and cleaning technologies are emerging in the marketplace. Professional societies are producing updated versions of reprocessing guidelines in response to the flood of information.

These and other recent guidelines recommend hospitals appoint a multidisciplinary committee with a diversity of interests and expertise to assess new information as it is published and develop, implement, and importantly regularly update reprocessing guidelines that are appropriate to the hospital's resources and patient mix.

Effective reprocessing is key to patient safety in endoscopy.

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