Literature Review

Risk and Prevention of Infections in the Bronchoscopy Room

Wahju Aniwidyaningsih,*[1] Indah Puspita Sari,[2] Anis Karuniawati,[3] Fathiyah Isbaniah,[1] Mia Elhidsi,[1] Ni Putu Laksmi Ananda Martini[4]

[1]Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, Universitas Indonesia, Persahabatan Hospital, Jakarta
[2]Clinical Microbiology Specialist Study Program, Faculty of Medicine, Universitas Indonesia, Dr. Cipto Mangunkusumo National General Hospital, Jakarta
[3]Department of Microbiology, Faculty of Medicine, Universitas Indonesia, Dr. Cipto Mangunkusumo National General Hospital, Jakarta
[4]General Practitioner, Abdi Waluyo Hospital, Jakarta

Corresponding Author:
Wahju Aniwidyaningsih | Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, Universitas Indonesia, Persahabatan Hospital, Jakarta | dr.wahjuani.spp@gmail.com

Submitted: December 28th, 2025
Accepted: April 28th, 2026
Published: June 30th, 2026

Respir Sci. 2026; 6(3): 199-211
https://doi.org/10.36497/respirsci.v6i3.217

Abstract

Bronchoscopy is a widely used diagnostic and therapeutic procedure in pulmonary medicine, with increasing utilization as technology advances. However, it is also associated with a risk of infection, which may negatively impact patient outcomes, particularly in individuals with underlying lung disease or immunocompromised conditions. The Centers for Disease Control and Prevention (CDC) has reported that endoscopic procedures, including bronchoscopy, are among the most frequently implicated medical devices in healthcare-associated outbreaks. Post-bronchoscopy infections, although relatively uncommon (0.2–5.2%), may lead to serious complications such as pneumonia, lung abscess, and empyema. These infections can originate from endogenous respiratory flora or from exogenous contamination related to inadequate bronchoscope reprocessing. This narrative review aims to summarize current evidence on infection risks, sources of transmission, and preventive strategies in the bronchoscopy setting, including occupational risks to healthcare workers. Strengthening infection control practices is essential to improve patient safety and reduce the risk of transmission in bronchoscopy units.

Keywords: bronchoscopy, infection prevention, infection risk

INTRODUCTION

Bronchoscopy is one type of endoscopy used as an important diagnostic tool in patients with respiratory tract diseases. The combined use of flexible and rigid bronchoscopy has been increasingly applied as a method for managing pulmonary diseases. In cases of thoracic cavity malignancies, bronchoscopy can be used for both palliative and curative purposes.[1]

As stated in the Centers for Disease Control and Prevention (CDC) Guideline for Disinfection and Sterilization in Healthcare Facilities of the United States, more healthcare-associated outbreaks are related to endoscopy than to other medical

devices. In the United States, over half a million bronchoscopy procedures are carried out each year. However, many bronchoscopists are not familiar with the reprocessing and disinfection procedures for bronchoscopy.[2]

During bronchoscopy procedures, there is a risk of infection when the bronchoscope comes into contact with mucosa and blood vessels. Post-bronchoscopy infection rarely occurs, but there have been reports of complications ranging from 0.2–5.2%, such as pneumonia, lung abscess, and empyema, which may affect patient survival.[3]

Given the crucial role of bronchoscopy in the care and management of patients with pulmonary diseases, this literature review was prepared to discuss the risks of infection during bronchoscopy procedures as well as efforts to prevent infection. This review aims to provide a comprehensive overview of infection risks and prevention strategies in bronchoscopy and to support improved infection control practices in clinical settings.

METHODS

This study is a narrative literature review conducted to summarize current evidence regarding infection risks and prevention strategies in bronchoscopy procedures. A comprehensive search was performed using electronic databases including PubMed, Scopus, and Google Scholar. The search keywords included combinations of "bronchoscopy," "infection," "cross-contamination," "endoscope reprocessing," and "infection control."

Articles published in English between 2000 and 2025 were considered. Inclusion criteria comprised original studies, review articles, and clinical guidelines addressing infection risk, transmission mechanisms, and preventive measures related to bronchoscopy. Studies not directly related to bronchoscopy or infection control, as well as duplicate publications, were excluded.

Relevant articles were screened based on titles and abstracts, followed by full-text evaluation. Data were then synthesized narratively to provide a comprehensive overview of infection sources, risk factors, and preventive strategies in the bronchoscopy setting.

INDICATIONS AND CONTRAINDICATIONS OF BRONCHOSCOPY

Bronchoscopy has various diagnostic and therapeutic indications, with its scope expanding in line with technological advancements. The first bronchoscope was rigid, while the fiberoptic bronchoscope, developed in 1968, presented a lower risk of cross-infection. The capability of fiberoptic bronchoscopes to access the distal airways and lung parenchyma with only local anesthesia and/or light sedation renders them appropriate for bedside evaluation.[4]

Disposable bronchoscopes are now increasingly available and easy to obtain. The indications for fiberoptic bronchoscopy in intensive care units include the evaluation of bleeding, assistance in placing definitive airway devices, clearance of airway

secretions, and sampling in cases of lower respiratory tract infection or pneumonia.[4] Clinicians should be familiar with the contraindications of bronchoscopy to reduce the risk of serious complications, including hemodynamic instability, bronchospasm, significant hypoxemia, and bleeding. Bronchoscopy requires special care in the intensive care setting, particularly for patients receiving mechanical ventilation.[5]

Bronchoscopy is recommended for cases of pneumonia that do not resolve or show delayed improvement in immunocompetent patients suspected of infection, especially those who are current or former smokers over the age of 50. In 42.4% of patients in a study conducted by Costa et al, bronchoscopy was performed due to indications of infection or secretion, with positive bacterial cultures found in 36.3% and 53.9% of cases, respectively.[5]

Bronchoscopy-associated infections remain a significant clinical concern in pulmonology, as it has the potential to worsen patient conditions, particularly in individuals with compromised immune systems or a history of pulmonary disease. It can occur due to pathogenic microbes in the lower respiratory tract or be transmitted through inadequate bronchoscope reprocessing, which may lead to outbreaks.[3]

Galdys et al reported an outbreak in the intensive care unit caused by multidrug-resistant bacterial infections, 70% of which were due to *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*, originating from reprocessed bronchoscopes.[6]

POST-BRONCHOSCOPY INFECTION

Infections associated with bronchoscopy have been reported sporadically since this procedure was first introduced into clinical practice. Several studies have demonstrated that bronchoscopes can act as vectors in the transmission of infections. From a clinical standpoint, infections associated with bronchoscopy are categorized into true infections and pseudo-infections.[7]

A true infection develops when microorganisms are transferred during the bronchoscopy procedure and subsequently lead to a new illness in the patient. The majority of these true infections are attributed to pathogenic microbes outlined in Table 1.[7]

Table 1. Microorganisms Associated with Bronchoscopy-Related Infections[3]

Bacteria	Mycobacteria	Fungi
1. *Pseudomonas aeruginosa*	1. *Mycobacterium tuberculosis*	1. *Rhodotorula rubra*
2. *Serratia marcescens*	2. *M. chelonae*	2. *Aureobasidium spp.*
3. *Klebsiella pneumoniae*	3. *M. avium-intercellulare*	3. *Blastomyces dermatitidis*
4. *Legionella pneumophila*	4. *M. xenopi*	4. *Trichosporon cutaneum*
5. *Burkholderia pseudomallei*	5. *M. fortuitum*	5. *Penicillium spp.*
6. *Proteus*	6. *M. gordonae*	6. *Cladosporium spp.*
7. *Bacillus*	7. *M. abscessus*	7. *Phialospora sp.*
8. *Methylobacterium mesophilicum*		
9. *Morganella morganii*		
10. *Enterobacter cloacae*		
11. *Stenotrophomonas maltophilia*		

Individuals with compromised immune systems are particularly susceptible to developing true infections associated with bronchoscopy procedures. These infections can be associated with considerable morbidity and mortality.[7]

Pseudo-infection results from the growth of microorganisms in specimens obtained through bronchoscopy without clinical evidence in the form of signs and symptoms of infection. Most pseudo-infections occur when specimens, such as bronchoalveolar lavage samples, become contaminated due to inadequate bronchoscope disinfection.[7]

Although patients do not show clinical signs of infection, pseudo-infections pose several indirect dangers, including misdiagnosis, inappropriate treatment, or diagnostic delay that may have serious consequences. For instance, the detection of acid-fast bacilli in bronchoscopy samples may lead to a missed early diagnosis of lung cancer.[7]

In addition, diagnostic errors may lead to the administration of unwarranted antibiotic or antituberculosis treatment, thereby increasing the risk of patients experiencing adverse drug reactions. Finally, pseudo-infections in bronchoscopy facilities represent a critical failure in the reprocessing protocol, and their cause must be identified and corrected to ensure that all patients undergoing bronchoscopy remain free from infection after the procedure.[7]

A respiratory infection occurring within 24 hours after bronchoscopy is classified as a bronchoscopy-associated respiratory infection. It is typically manifested by clinical features such as fever, elevated inflammatory markers, and the detection of microorganisms in suspected infectious specimens.[8]

Radiological findings, including chest X-ray or computed tomography, may demonstrate new or worsening infiltrates.[8] The risk of developing such infections is influenced by several factors, including advanced age (≥75 years), abnormalities within the airway lumen, smoking history, and the presence of centrally located tumors.[9]

In addition, since fiberoptic bronchoscopes are constructed from specialized materials that cannot withstand high temperatures or pressure, so the cleaning and disinfection process after use becomes difficult. Inadequate cleaning and disinfection of these instruments can lead to healthcare-associated infections.[10]

Multiple studies across the globe have demonstrated that improper cleaning or disinfection of fiberoptic bronchoscopes can result in cross-contamination, leading to infections caused by single or mixed bacterial species, including multidrug-resistant *Acinetobacter baumannii*, multidrug-resistant *Pseudomonas aeruginosa*, carbapenem-resistant *Klebsiella pneumoniae*, and cases of hospital-acquired pneumonia.[10]

Findings from a study by Wang et al also revealed that fiberoptic bronchoscopy is highly correlated with healthcare-associated infections or colonization by carbapenem-resistant Enterobacteriaceae. Moreover, the study demonstrated that the higher the number of fiberoptic

bronchoscopy procedures performed, the greater the likelihood of healthcare-associated infection or colonization by carbapenem-resistant *Enterobacteriaceae*.[10]

It is also known that aerosols produced throughout bronchoscopy procedures may facilitate the transmission of severe respiratory infections, including tuberculosis, varicella, measles, and various respiratory viruses, to healthcare workers (HCWs) involved in the procedure.[9] Catanzaro et al estimated that during intubation and bronchoscopy, more than 200 infectious mycobacterial units are released from a patient per hour.[11]

The use of a bronchoscope during intubation can trigger the patient's cough reflex, resulting in the release of droplets of varying sizes, many of which are inhalable and capable of reaching the lower regions of the lungs. Since these particles originate from deeper areas of the respiratory tract, droplets expelled during coughing may be more infectious than those produced during sneezing. A large proportion of these particles are sufficiently small to stay airborne for prolonged durations.[8]

SOURCES OF MICROORGANISMS CAUSING INFECTION

Endogenous Microbes

Endogenous infections after flexible endoscopic procedures arise when the patient's normal flora penetrate the bloodstream or other normally sterile areas due to mucosal injury, independent of any shortcomings in the instrument reprocessing procedure.[12]

Examples include pneumonia resulting from aspiration of oral secretions in anesthetized individuals or bacteremia caused by tissue trauma during the insertion or withdrawal of the endoscope. Normal flora are generally absent from and do not persist within the lung parenchyma but are present on the mucosal surfaces of the upper respiratory tract (~10^6 cfu/gm), which may be carried into the lower respiratory tract during bronchoscopy.[12]

Exogenous Microbes

Exogenous infections arise from microorganisms entering the patient's body through the flexible bronchoscope or accessories used during the procedure. These infections can be prevented by adhering to established reprocessing guidelines. Exogenously acquired microorganisms can originate from several sources, such as:[12]

1. Bronchoscopes that are not followed by appropriate reprocessing and cleaning techniques, leaving bacteria that form biofilms capable of withstanding hydrodynamic shear forces;
2. Environmental contamination of the bronchoscope, its accessories, or automated endoscope reprocessors during reprocessing—such as exposure to environmental microbes, skin flora, or water;
3. Contamination of bronchoscopes and accessories after reprocessing with water, environmental microorganisms, and/or skin flora during handling and/or final storage.

Reservoirs of exogenous microorganisms in flexible endoscopes can include suction/biopsy channels or inner channels (for example, the elevator wire channel in duodenoscopes, the air/water channel in colonoscopes, or any auxiliary channel present). Additionally, water bottles and tubing used in bronchoscopy procedures can serve as reservoirs if these accessories are not adequately reprocessed.[12]

Certain components used during the reprocessing cycle may also act as reservoirs for contamination—for instance, cleaning brushes that are not properly examined, washed, and subjected to high-level disinfection after each use; enzymatic detergent or rinse water that is reused rather than replaced; or water filtration systems that are poorly maintained.[12]

To prevent residual microorganisms from contaminating subsequent bronchoscopes, both the enzymatic detergent and rinse water used in manual cleaning must be renewed after every use. Diluted enzymatic detergent solutions should not be stored overnight because microorganisms from tap water can proliferate.[12]

Tap water used for final rinsing after disinfection or sterilization may leave waterborne microorganisms in the internal channels. Current guidelines recommend that final rinse water be sterilized, filtered, or made bacteria-free. If tap water is used for the final rinse, it is essential to follow it with a rinse using 70–90% alcohol, which not only accelerates drying but also helps eliminate any residual waterborne microorganisms that may have entered during the tap water rinse.[12]

During bronchoscopy, environmental surfaces and equipment, including video monitors, may contribute to hand contamination, while the procedure itself generates bioaerosols containing respiratory pathogens. As an aerosol-generating procedure, bronchoscopy exposes HCWs to airborne microorganisms, making transmission from patient to personnel a recognized occupational risk.[13]

Microbial Agents

Various bacteria, mycobacteria, and fungal agents can cause outbreaks associated with bronchoscopy procedures. *Pseudomonas aeruginosa* and *Serratia marcescens* have been reported to cause most pseudo- and true infections.[7]

Environmental mycobacteria can also cause numerous pseudo-infection outbreaks after bronchoscopy, with *Mycobacterium chelonae* being the most common. True infections due to environmental mycobacteria are extremely rare. Most fungal infection outbreaks reported in the literature are pseudo-infections caused by environmental fungi. *Rhodotorula rubra* is the most frequently reported fungus associated with outbreaks.[7]

Human immunodeficiency virus (HIV) ribonucleic acid (RNA) has been isolated from bronchoscopes used on HIV-infected patients. Adequate reprocessing is highly effective in removing viral traces, and to date, there have been no reports of

HIV transmission via bronchoscopy. Furthermore, no cases of hepatitis B or hepatitis C virus transmission have been reported following bronchoscopy procedures.[7]

THE ROLE OF BIOFILM IN INFECTIONS ASSOCIATED WITH BRONCHOSCOPY

Biofilm plays an important role in secondary infections resulting from contaminated medical and prosthetic equipment. A biofilm consists of a community of microorganisms embedded within a matrix composed of polysaccharides and hydrated bacterial proteins that exhibit several physiological characteristics distinct from those of planktonic (free-living) microorganisms.[7]

Bacteria within a biofilm possess different physiological properties compared to other bacterial cells and adhere tightly to surfaces, forming microcolonies with one another. Although bacteria residing within biofilms do not possess inherently greater virulence than their free-floating counterparts, the biofilm allows them to survive in unfavorable environments. Biofilm formation makes bacteria more resistant to antimicrobial agents and disinfectants.[7]

Structurally, the bronchoscope is a device highly conducive to biofilm formation. The device possesses a complex design featuring elongated and narrow internal channels, which can be readily contaminated with bacteria and organic debris during each use. Thorough mechanical cleaning before the disinfection process is the most effective method to prevent biofilm development.[7]

PROGNOSIS OF POST-BRONCHOSCOPY INFECTIONS

The prognosis of bronchoscopy-associated infections depends on patient characteristics, infection type, and overall clinical status. Despite their low incidence, these complications may lead to significant morbidity, particularly in vulnerable populations such as patients with malignancy or immunocompromised conditions.[14]

Farrokhpour et al reported an incidence of 2.56% following bronchoscopy. Additional risk factors, including poor nutritional status and smoking, have been associated with an increased risk of pneumonia, although evidence remains inconsistent.[15]

RISK OF INFECTION IN HEALTHCARE WORKERS

Healthcare workers involved in bronchoscopy are at risk of exposure to infectious agents through aerosol generation, contact with contaminated respiratory secretions, and handling of bronchoscopic equipment. Bronchoscopy is recognized as an aerosol-generating procedure, particularly during suctioning and bronchoalveolar lavage, which can release microorganisms into the surrounding environment.[13]

Studies have demonstrated increased microbial contamination in ambient air during bronchoscopy, supporting the

potential occupational risk to HCWs.[8] Therefore, strict adherence to infection prevention measures, including appropriate personal protective equipment (PPE), adequate ventilation, and standardized reprocessing protocols, is essential to minimize transmission risk.[12]

Bronchoscopy practitioners can implement various preventive measures to minimize the likelihood of tuberculosis transmission during the procedure. Whenever feasible, bronchoscopy should be avoided in patients known or suspected to have tuberculosis. A minimum of three suitable sputum specimens should be tested for acid-fast bacilli prior to proceeding with bronchoscopy.[7]

In specific cases, gastric lavage and urine samples may also be evaluated for acid-fast bacilli. If the diagnosis remains uncertain, the need for bronchoscopy must be carefully balanced against the potential risk of infection transmission to personnel in the bronchoscopy room. If bronchoscopy is unavoidable, the procedure should take place in a negative-pressure environment, ensuring that the air is either vented outdoors or passed through a high-efficiency particulate air (HEPA) filter before being recirculated.[7]

Patients should be encouraged to wear a mask throughout the procedure whenever feasible. Sufficient topical anesthetics and antitussive agents are recommended to lessen coughing episodes during bronchoscopy. All healthcare personnel involved in the procedure are advised to use powered air-purifying respirator hoods to minimize the risk of tuberculosis transmission. A particulate respirator such as N95 can be used as an alternative. The use of a standard surgical mask alone is insufficient for protection during this procedure.[7]

INFECTION CONTROL IN THE BRONCHOSCOPY ROOM

Flexible bronchoscopes are complex reusable devices with narrow internal channels that are difficult to clean effectively. Their intricate design and exposure to biological material increase the risk of biofilm formation and microbial contamination, especially exogenous infections, which are primarily associated with inadequate bronchoscope reprocessing.[2]

As heat-sensitive instruments, they require specialized reprocessing techniques rather than conventional sterilization methods. Bronchoscope reprocessing involves multiple critical steps, and failure at any stage—such as manual cleaning, disinfection, or drying—can result in residual contamination and subsequent infection transmission. In addition, improper handling or storage also increases the risk of outbreaks. Therefore, strict adherence to standardized reprocessing protocols and proper equipment handling is essential to prevent infection transmission in bronchoscopy settings.[2]

Based on the Spaulding classification, bronchoscopes are classified as semi-critical instruments, as they are designed to contact intact skin and mucosal surfaces.

According to established guidelines and the manufacturer's recommendations, semi-critical devices are required to undergo high-level disinfection (HLD), which eliminates all microorganisms within the channels or on the instrument, except for a small number of spores. The definition of high-level disinfection by the Food and Drug Authority includes sterilant agents used with shorter contact times to achieve a 6-$\log_{10}$ reduction of Mycobacterium species.[2]

Sterilization provides a superior level of decontamination compared to HLD, as sterilized instruments are packaged at the end of the process and can be safely stored for future use, while those subjected only to HLD remain unwrapped and moist. The limitation of the Spaulding scheme arises when semi-critical instruments are used alongside critical ones (those that penetrate mucous membranes and contact the bloodstream or sterile body areas, e.g., biopsy forceps used with a bronchoscope).[2]

The CDC advises that semi-critical instruments, including bronchoscopes, should undergo, at minimum, high-level disinfection and specifies that only approved high-level disinfectants or sterilizing agents be utilized. Biofilm formation tends to occur when bronchoscopes are not adequately cleaned immediately after use. Biofilm typically develops in the narrow internal channels and on uneven surfaces, making removal difficult. Biofilms frequently harbor resistant pathogens, such as carbapenem-resistant Enterobacteriaceae and various other multidrug-resistant bacterial species.[2]

KEY STEPS IN BRONCHOSCOPE REPROCESSING

Several essential steps in bronchoscope reprocessing are summarized in Table 2.

Table 2. Summary of Reprocessing Procedures for Reusable[2]

Step	Method	Purpose
Pre-cleaning (performed at the bedside)	Suction enzymatic detergent through the internal channels and manually wipe the outer surface of the scope with a sponge or cloth moistened with detergent	To prevent biofilm formation
Leak testing	Pressurize the scope using a leak tester and immerse it in water to detect defects	To detect damage to the internal and external surfaces of the scope
Manual cleaning	Mechanically clean the internal and external surfaces of the bronchoscope using chemical or enzymatic cleaning agents	To achieve a microbial load reduction of 3 to 4.5 log
Visual inspection	Check for defects, damage, oily residues, or debris along the internal channels and external surfaces of the scope	If defects or residues are found, the scope must be sent for repair
Terminal reprocessing	Perform High-Level Disinfection (HLD) manually or using an Automated Endoscope Reprocessor (AER)	To achieve a microbial load reduction of 6 log
Rinsing	Rinse the bronchoscope channels with water	To remove traces of cleaning chemicals and prevent patient injury
Drying	Rinse the internal channels and insertion tube with alcohol, followed by forced-air drying.	To thoroughly dry the scope and prevent residual microbial replication during storage

Pre-cleaning

Cleaning flexible bronchoscopes presents a challenge because of their intricate structure and narrow internal channels. The pre-cleaning stage plays a vital role in preventing biofilm development by suctioning enzymatic detergent or sterile water through all internal pathways and promptly wiping the external surface with a lint-free cloth, sponge, or gauze soaked in enzymatic detergent immediately after the procedure.[2]

Before this step, all suction valves and biopsy attachments must be removed. This process is usually conducted at the patient's bedside to minimize delay and to prevent the drying of blood, secretions, or purulent material on the device's surface. Once completed, the bronchoscope is placed in a labeled container and transferred to a designated area for subsequent processing.[2]

Leak Testing

This step is essential to detect any damage to the bronchoscope's outer surface or internal channels that could lead to the accumulation of water, chemicals, or organic material and potentially cause microbial spread or chemical exposure to the respiratory mucosa. During this stage, the bronchoscope is pressurized and immersed in water to detect the formation of air bubbles. If leakage is detected, the device must be returned to the manufacturer for repair.[2]

Manual Cleaning

This step involves the mechanical cleaning of both internal and external bronchoscope surfaces. It includes rinsing each internal channel thoroughly with water and detergent or enzymatic cleaner and scrubbing the external surface. Flexible bronchoscopes have a high level of microbial contamination after use. The average microbial load before cleaning is approximately 6.4×10^4 CFU/mL. Cleaning reduces the microbial contamination level by 4–6 $\log_{10}$. Improper cleaning may result in outbreaks due to failure in the subsequent high-level disinfection/ sterilization process.[2,18]

Visual Inspection

The bronchoscope's internal channels are slender and lined with dark materials, which makes direct visual examination challenging. Ofstead et al reported that routine use of bronchoscopes often leads to internal defects, including retained fluids such as brown, red, or oily residues, scratches, damaged inner distal tubes, and fibrous debris. These defects may harbor pathogens responsible for many reported outbreaks. When visual examination identifies any damage or irregularities, the bronchoscope should be withdrawn from use and sent back to the manufacturer for necessary repairs.[2]

Terminal Processing

High-level disinfection is performed by circulating a high-level disinfectant/chemical sterilant through all bronchoscope channels until air bubbles are eliminated and contact between the germicide and the internal channel

surfaces is ensured. Chemicals used include ethylene oxide or peracetic acid, as well as appropriate high-level disinfectants such as 2% glutaraldehyde or 0.55% ortho-phthalaldehyde.[2]

This process may be carried out either manually or with the assistance of an automated endoscope reprocessing system. The exposure duration varies depending on the product type. Exposure times shorter than 20 minutes for glutaraldehyde are insufficient to inactivate mycobacteria effectively.[2]

Rinsing

In this stage, the bronchoscope, along with all of its internal channels, is rinsed using sterile water to eliminate any remaining chemical residues from the preceding process. Improper rinsing may leave toxic residues within the bronchoscope channels and cause patient injuries, including anaphylaxis.[2]

Drying

Drying both the internal and external bronchoscope channels can be achieved through an additional rinse with alcohol followed by air drying. Inadequate drying of the endoscope and its channels before storage can lead to outbreaks. Therefore, the drying step is critical to prevent the proliferation of remaining pathogens during storage.[2]

Storage

Reprocessed bronchoscopes should be stored in accordance with the manufacturer's guidelines or positioned in a vertical hanging orientation to minimize the risk of recontamination and to promote adequate drying. Storage practices may also follow the recommendations provided by the Healthcare Infection Control Practices Advisory Committee (HICPAC) or the Association for the Advancement of Medical Instrumentation (AAMI).[2]

Cabinets equipped with HEPA filtration are regarded as more effective than static-air enclosures in reducing the chance of recontamination. The storage duration of a reprocessed bronchoscope before it requires another reprocessing cycle typically ranges from 7 to 12 days.[2]

OTHER IMPORTANT FACTORS FOR SAFE REPROCESSING AND INFECTION PREVENTION

Water quality

According to the AAMI 34 report, two types of water are recommended for reprocessing: 1) clean water for the initial cleaning and rinsing steps; and 2) sterile water for the final rinsing stage.[2]

Rinsing time

It is important to follow the bronchoscope manufacturer's instructions for each step. For example, Olympus America recommends that pre-cleaning, leak testing, and manual cleaning be performed within 60 minutes after the removal of the scope to prevent biofilm formation. If manual cleaning cannot be initiated within 60 minutes after pre-cleaning, an additional step of soaking the bronchoscope in enzymatic detergent should be performed.[2]

Use of Personal Protective Equipment During Bronchoscopy

The 2020 consensus statement issued by the American Association for Bronchology and Interventional Pulmonology (AABIP) advises the use of gloves, gowns, head covers, face shields or eye protection, and N95 respirators (or their equivalents) for all bronchoscopy procedures, including those conducted on patients with COVID-19.[2]

CONCLUSION

Post-bronchoscopy infection remains a critical concern in pulmonology, particularly in patients with underlying lung disease or immunocompromised conditions, as it may worsen clinical outcomes. Although relatively uncommon, with reported complication rates ranging from 0.2% to 5.2%, infections such as pneumonia, lung abscess, and empyema can significantly impact patient prognosis. These infections may arise from endogenous pathogens in the lower respiratory tract or exogenous sources, particularly due to inadequate bronchoscope reprocessing, improper disinfectant use, or recontamination from automated washer–disinfector systems.

Therefore, strict adherence to standardized reprocessing protocols is essential in all bronchoscopy units, supported by comprehensive training of healthcare personnel. In addition, healthcare institutions should implement clear quality assurance systems to minimize reprocessing errors. Adequate resource allocation, including sufficient bronchoscope availability and updated reprocessing facilities, is also necessary to maintain high standards of infection control and ensure the safety of both patients and HCWs.

REFERENCES

1. Eberhardt R, Holland A, Petermann C, Bornitz F, Gesierich W. Interventionelle Bronchoskopie – ein Überblick. Pneumologe (Berl). 2021;18(6):405–18.
2. Chhabria MS, Maldonado F, Mehta AC. Infection control in the bronchoscopy suite: effective reprocessing and disinfection of reusable bronchoscopes. Curr Opin Pulm Med. 2023;29(1):21–8.
3. Permatasari TW, Karuniawati A. Post-Bronchoscopy Infections: A Literature Review. Journal of Clinical Microbiology and Infectious Diseases. 2024;4(2):41–9.
4. Röder M, Ng AYKC, Conway Morris A. Bronchoscopic Diagnosis of Severe Respiratory Infections. J Clin Med. 2024;13(19):6020.
5. Costa A da S, Scordamaglio PR, Suzuki I, Palomino ALM, Jacomelli M. Indications, clinical outcomes and complications of 1,949 flexible bronchoscopies. Einstein (São Paulo). 2018;16(4):eAO4380.
6. Galdys AL, Marsh JW, Delgado E, Pasculle AW, Pacey M, Ayres AM, et al. Bronchoscope-associated clusters of multidrug-resistant *Pseudomonas aeruginosa* and carbapenem-resistant

Klebsiella pneumoniae. Infect Control Hosp Epidemiol. 2019;40(1):40–6.

7. Jain P, Hadique S, Mehta AC. Infection Control and Radiation Safety in the Bronchoscopy Suite. In: Flexible Bronchoscopy. Wiley; 2020. p. 35–62.
8. Marchand G, Duchaine C, Lavoie J, Veillette M, Cloutier Y. Bacteria emitted in ambient air during bronchoscopy—a risk to health care workers? Am J Infect Control. 2016;44(12):1634–8.
9. Keshishyan S, DeLorenzo L, Hammoud K, Avagyan A, Assallum H, Harris K. Infections causing central airway obstruction: role of bronchoscopy in diagnosis and management. J Thorac Dis. 2017;9(6):1707–24.
10. Wang WH, Wu YH, Wang YM, Wang CL, Liu Y, Gao P, et al. Correlation Between the Number of Fiberoptic Bronchoscopies and Nosocomial Infection/Colonization of Carbapenem-Resistant Enterobacteriaceae. Infect Drug Resist. 2022;15:3205–11.
11. Catanzaro A. Nosocomial Tuberculosis. American Review of Respiratory Disease. 1982;125(5):559–62.
12. Humphreys H. Infection prevention and control considerations regarding ventilation in acute hospitals. Infection Prevention in Practice. 2021;3(4):100180.
13. Public Health Agency of Canada. Public Health Agency of Canada [Internet]. 2017 [cited 2025 Mar 10]. Infection Prevention and Control Guideline for Flexible Gastrointestinal Endoscopy and Flexible Bronchoscopy. Available from: https://www.canada.ca/en/public-health/services/infectious-diseases/nosocomial-occupational-infections/infection-prevention-control-guideline-flexible-gastrointestinal-endoscopy-flexible-bronchoscopy.html
14. Biondini D, Damin M, Bonifazi M, Cocconcelli E, Semenzato U, Spagnolo P, et al. The Role of Bronchoscopy in the Diagnosis and Management of Patients with SARS-Cov-2 Infection. Diagnostics. 2021;11(10):1938.
15. Farrokhpour M, Kiani A, Mortaz E, Taghavi K, Farahbod AM, Fakharian A, et al. Procalcitonin and Proinflammatory Cytokines in Early Diagnosis of Bacterial Infections after Bronchoscopy. Open Access Maced J Med Sci. 2019;7(6):913–9.
16. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention [Internet]. 2008 [cited 2025 Mar 10]. Disinfection of Healthcare Equipment. Available from: https://www.cdc.gov/infection-control/hcp/disinfection-sterilization/healthcare-equipment.html