Research Article

Compliance with the recommended bronchoscope decontamination and bacterial status of reprocessed equipment at the bronchoscopy unit, National Hospital, Sri Lanka in 2017-2018

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Abstract

Introduction: Insufficient cleaning and disinfection of bronchoscopes have been associated with transmission of infections among patients undergoing bronchoscopy.

Methods: A descriptive, cross-sectional study was conducted at the bronchoscopy unit of National Hospital, Sri Lanka from 4th December 2017 to 31st March 2018. We observed 93 bronchoscopy reproducing cycles. Sample collection and processing followed the European Society of Gastrointestinal Endoscopy guideline for quality assurance and reprocessing (Microbiological surveillance testing in endoscopy).[1]

A washout sample from the bronchoscopy channel and two swabs from the tip of the bronchoscope before and after reprocessing were collected. Washout samples were processed to estimate the total microbial count. Washout and swabs were cultured aerobically to detect indicator organisms i.e. *Escherichia coli*, other Enterobacteriaceae, Enterococci, *Pseudomonas aeruginosa*, other non-fermenters, *Staphylococcus aureus*, *Staphylococcus epidermidis*, mycobacteria and *Legionella* sp. Washouts having colony counts of ≥ 20/channel and/or having indicator organism/s were considered 'contaminated'. Swabs were considered 'contaminated' if indicator organisms were present.

Results: Adherence to guidelines was 100% for cleaning valves and tips, 54% for fresh use of detergent, 50% for decontamination of trays and 50% for using sterile water. Sixty-seven (72%) samples were 'contaminated'. Organisms found in washouts were *P. aeruginosa* (98%) and *M. tuberculosis* (2%). Swabs collected from the tip after reprocessing were contaminated in 16% of cycles, with *P. aeruginosa* (93%) being the prominent organism.

Conclusion: Deficiencies were noted in adherence to steps recommended by the Infection Prevention and Control Unit for reprocessing of bronchoscopes. Contamination was identified in the working lumen and bronchoscope tips after reprocessing, predominantly with *P. aeruginosa and M. tuberculosis*.

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Introduction

Bronchoscopes are reusable endoscopes used in respiratory medicine to visualize the airways for diagnostic and therapeutic purposes. Safe reprocessing of reusable medical devices through decontamination is necessary for the prevention of healthcare associated infections. Endoscopes are semi critical medical devices used on patients for diagnostic and interventional purposes.[2] Since semi critical medical devices touch the compromised skin and mucosa of the body, they should be devoid of all microorganisms, except for few bacterial spores. 'High level disinfection' is the recommended method for decontamination of heat-sensitive semi critical instruments.[3,4]

Flexible endoscopes are difficult to clean due to their complex structure and narrow lumen. Each step of disinfection can be a challenge, with the potential for reduced efficacy.[5] Poor cleaning and disinfection of endoscopes raise the risk of transmission of infection to patients.[6]

The bronchoscopy unit of National Hospital Sri Lanka (NHSL) carried out 10-12 bronchoscopy procedures per week using two bronchoscopes and one thoracoscope. Bronchoscopies are performed on patients with various respiratory pathologies. Most patients who undergo bronchoscopy procedures are in-patients whose commensal respiratory tract flora may consist of hospital acquired resistant organisms. A person who is already suffering from a disease, becoming a victim of a device transmitted infection with a multi resistant organism , is an unfortunate situation. It adds an unwanted, additional burden as well as a marred reputation to the health care facility.

The organisms commonly transmitted due to inadequate bronchoscopy reprocessing include *Pseudomonas aeruginosa, Klebsiella pneumoniae, Serratia marcescens*, and *Mycobacterium tuberculosis*.[7] *Pseudomonas* sp. and *Klebsiella* sp. colonising hospitalised patients can be resistant to antibiotics including carbapenems. It is therefore crucial to evaluate the effectiveness of bronchoscope decontamination before using it on a new patient after prior use. Many gastrointestinal societies recommend microbiological monitoring of endoscopes periodically. The best available guideline for ensuring quality in reprocessing and microbiological testing of endoscopes was produced by the European Society of Gastrointestinal Endoscopy (ESGE) and the European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA). It is a comprehensive guideline, prepared jointly by endoscopists and endoscopy nurses, microbiologists and representatives from the industry. It provides a comprehensive account of practical aspects of microbial surveillance, including interpretation cut offs, to assess contamination in both manual and automated reprocessing systems.[1] The process of cleaning and disinfecting bronchoscopes and assessment of adequacy of bronchoscopy reprocessing is the same as for gastrointestinal endoscopes except for cover provided for rapid-growing mycobacteria in reprocessing of bronchoscopes.

There is a lack of proper local studies done on the reprocessing of bronchoscopes and the few studies done internationally do not adequately cover the local context. Routine microbial monitoring is currently not practised at the bronchoscopy unit of NHSL but is essential to ensure patient safety and a safe environment for medical staff.

The main objective of this study was to assess compliance with the recommended procedure of decontaminating bronchoscopes and evaluation of the bacterial status of the cleaned equipment used at the main bronchoscopy unit of NHSL

Methods

A descriptive, cross-sectional study was carried out from 4th December 2017 to 31st March 2018 at the main bronchoscopy unit of NHSL. The samples were processed in the bacteriology laboratory of NHSL and the National Tuberculosis Reference Laboratory (NTRL), Welisara.

The study used a convenient sampling method, including all cycles of bronchoscopy reprocessing performed following the completion of a bronchoscopy procedure on patients during these 4 months. Bronchoscopes were decontaminated with the protocol recommended in the Hospital Infection Control Manual (2005 Sri Lanka College of Microbiologists).[8] An observer-based check list was filled to assess compliance to recommended steps of decontamination. A hundred percent compliance with each step of decontamination was expected in all cycles.

Sample collection

The following three samples were collected in a single reprocessing cycle :

1. Washout sample from the bronchoscope channel - once the reprocessing cycle was over and the bronchoscope was washed with sterile water, the working channel was flushed with 20 ml of normal saline and the fluid was collected in a sterile container.
2. A swab from the outer surface of the bronchoscope - sterile swabs were used to swab the tip of the bronchoscope. One swab was taken from the tip of the reprocessed bronchoscope at the end of the reprocessing procedure.
3. Water supply - a water sample from a sterile water can was collected once during the study period and sent to the 'Food and Water Microbiology' Department at the Medical Research Institute, Colombo 8 by the infection control unit of the hospital.

Sample processing was carried out at the microbiology laboratory of National Hospital as follows

1. Wash out sample from the bronchoscope working channel

Estimation of total microbial count: From the sample of 20 ml, 0.5 ml was plated on a blood agar plate and incubated at 37 °C for 48 hours. The number of visible colonies were counted, to calculate the number of organisms per 1 ml of sample.

Detection of special (indicator) microorganisms: *E. coli* and other Enterobacteriaceae, Enterococci, *P. aeruginosa* and other Gram negative non fermenters, *S. aureus*, *Staphylococcus epidermidis*, mycobacteria, *Legionella* spp. were considered indicator organisms.

To detect indicator organisms other than mycobacteria, 10 ml of tryptic soy broth was mixed with 10 ml of the sample and incubated for 48 hours at 37 °C. Broth was centrifuged for 10 minutes and the sediment streaked using a 10µl wire loop on selective agar plates (i-v below) prepared according to manufacturer guidelines.

i. Blood agar plate as enriched media
ii. Violet Red Bile agar with 4-methylumbelliferyl-β-D-glucuronide (MUG) agar medium - a selective medium for isolation of Enterobacteriaceae

iii. Cetrimide agar to detect *P. aeruginosa*
iv. Baird-Parker agar to detect *Staphylococcus* sp
v. Buffered charcoal yeast extract agar (BCYE) medium for *Legionella* sp

The plates were incubated for appropriate times and temperature according to manufacturers' guidelines. Organism identification was done using growth and colony appearance in enriched and selective media, biochemical methods and where necessary the BD Phoenix™ Automated Microbiology System.

Nine ml from each wash out sample was sent to be processed at NTRL according to methods recommended by the Global Laboratory Initiative to detect the presence of mycobacteria. Ziehl-Neelsen staining was performed on the centrifuged deposit of each sample for the detection of acid-fast bacilli and cultured with the automated liquid culture method using Mycobacterial Growth Indicator Tube (MGITTM-BD BACTEC).

2. Swabs

The swabs received in the laboratory were each inoculated into a tube containing10 ml of tryptic soy broth and vortexed. These tubes were then incubated at 37 ºC for 48 hours. They were streaked on the above mentioned enriched and selective agar media and incubated, complying with manufacturer instructions.

Interpretation of results:

In washout samples the maximum total count of ≥20 colony forming units (cfu) /channel were considered to be contaminated as indicator organisms should not be present in the washout.[1]

In the swabs, presence of indicator organisms was detected. The colony count was not quantified.[1]

The steps of quality control were followed in pre analytical, analytical, and post analytical stages of the laboratory investigations.[1,9]

Results

Description of the study population

A total of 93 bronchoscopy reprocessing procedures were observed in the study from 4th December 2017 to 31st March 2018.

Adherence to recommended steps of decontamination of flexible bronchoscopes

Decontamination of used bronchoscope

Table 1 describes the frequency of bronchoscopy reprocessing cycles in which the recommended steps of decontamination were followed/not followed.

Table 1 - the frequency of adherence to steps of decontamination and disinfection in reprocessing of bronchoscopes

	Yes		No	
	Frequency	%	Frequency	%
Trays are decontaminated before use	50	53.8	43	46.2
Leak test is performed before manual cleaning	0	0	93	100
All channels are flushed and external surfaces wiped with a detergent solution immediately after use	91	97.8	02	2.2
All valves and detachable tips are subjected to manual cleaning	93	100	0	0
Bronchoscope is totally immersed in the detergent	92	98.9	01	1.1
Correct concentration of the detergent is used	93	100	0	0
Detergent is freshly used	51	54.8	42	45.2
Disinfectant is freshly used	17	18.3	76	81.7
Bronchoscope is entirely immersed in disinfectant	93	100	0	0
Bronchoscope is immersed in the disinfectant for correct duration of time	88	94.6	5	5.4

The leak test was not performed in any of the reprocessing cycles. While compliance in removing and cleaning the valves and detachable tips was 100%, compliance with decontamination of trays was 50% and fresh detergent use 54%. Bronchoscope immersion in the disinfectant for the correct duration of time was observed in 88 procedures (94%).

Bacteriological analysis

Washout samples

Table 2: Colony count per channel in washout samples

	Frequency	**%**
< 20 colony forming units per channel	44	47
≥ 20 colony forming units per channel	49	53
Total	**93**	**100**

The washout samples could be categorised into samples with <20 cfu/channel and ≥20 cfu/channel.[2] According to the interpretive criteria, < 20 cfu/channel in one bronchoscopy washout indicated that the instrument was properly cleaned and disinfected.[1] A total of 44 samples (47%) gave a colony count of <20 per channel.

Organisms in washout samples

Table 3- Organisms in washout sample

	Number of washout samples	%
No growth	39	42
P. aeruginosa	53	57
M. tuberculosis	01	1
Total	**93**	**100**

P. aeruginosa and *M. tuberculosis* were indicator organisms. Indicator organisms were found in 54 (58%) washout samples (Table 3).

Considering the colony count and the presence of indicator organisms in the washout sample, the number of washout samples considered contaminated was 67 of 93 samples (72%). The remaining 26 washout samples were considered not contaminated.

Swabs collected from the tip of the bronchoscope after reprocessing

Table 4: Organisms isolated from swabs collected after reprocessing of bronchoscopes

Organism	Swabs	%
P. aeruginosa	14	64
K. pneumoniae	01	4.5
Bacillus sp.	06	27
Micrococcus sp.	01	4.5
Total	**22**	**100**

A total of 93 swabs were collected from the tip of the bronchoscopes after 93 reprocessing cycles. Of the 93 swabs, 22 swabs had a bacterial growth. *P. aeruginosa* was grown from 14 of these 22 swabs (64%). *Bacilllus* sp. and *Micrococcus* sp. found in swabs were not considered as indicator organisms (Table 4).

Discussion

Reprocessing bronchoscope is a procedure done to ensure that a bronchoscope used in one person is safe enough to be used in another person. Even though a lot of reprocessing cycles take place daily in a bronchoscopy unit, routine or random checks on the reliability of the procedure are lacking Therefore, investigating the reprocessing procedure and its outcomes by detecting any residual contamination was both timely and valuable.

The study found deficiencies in adherence to the recommended reprocessing steps which included decontamination of trays before use, lack of use of freshly prepared detergent, incomplete immersion of bronchoscope in detergent/disinfectant, and lack of use of sterile water for the final rinsing of bronchoscopes. The single sample of sterile water used in the bronchoscopy unit tested at the Food and Water Microbiology Laboratory MRI,[10] did not have any indicator organisms.

High contamination rates were detected in the working channel as well as the tip of reprocessed bronchoscopes. *P. aeruginosa* was the predominant organism identified from the working channel. *M. tuberculosis* was present in one sample. *P. aeruginosa* was the predominant organism in tips followed by *K. pneumoniae*.

This study was limited to only one bronchoscopy unit due to time constraints. Recruiting additional bronchoscopy units from various hospitals along with a larger sample size, would

have been ideal. A larger sample size would have allowed for identifying associations between decontamination steps and contaminated washout/tips.

Ongoing surveillance of bronchoscope decontamination and disinfection is essential to ensure adherence to established protocols and to detect both lapses and improvements in practice. Compliance to set protocols should be monitored by regular and random internal and external audits. The sterile water supply should be enhanced to use fresh sterile water for each reprocessing cycle. Regular and random checks on bacterial status of reprocessed instruments should also be performed.

Declarations

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Author contributions:
MANM: contributed in developing the research proposal, sorting permission and ethical clearance from relevant bodies, data collection, sample processing, data entry, analysis, research writing and presentation.
DSV: contributed in developing the research proposal, sorting permission and ethical clearance from relevant bodies, sorting funds, sample processing in the National Tuberculosis Reference Laboratory, guiding on report writing and presentation.
CGUA: contributed in developing the research proposal, sorting permission and ethical clearance from relevant bodies , sorting funds, sample processing in the bacteriology laboratory at NHSL, guiding on report writing and presentation.

References

1. Beilenhoff U, Neumann C.S, Rey J.F, Biering H. *et al.* ESGE-ESGENA guideline for quality assurance in reprocessing: Microbiological surveillance testing in endoscopy. *Endoscopy* 2007;39(2):175-181. *doi http://dx.doi.org/10.1055/s-2006-945181*
2. Global Guidelines for the Prevention of Surgical Site Infection. Geneva: World Health Organization; 2018. Table 3.3.3, Spaulding classification of equipment decontamination. Available from: *https://www.ncbi.nlm.nih.gov/books/NBK536426/table/ch3.tab7/*. Accessed on 09.03.2025
3. Chiu K.W, Lu L.S & Chiou S.S. High-level disinfection of gastrointestinal endoscope reprocessing. *World J Exp Med* 2015;5(1):33-39 *doi: http://dx.doi.org/10.5493/wjem.v5.i1.33*
4. Mughal M.M, Minai O.A, Culver D.A. & Mehta A.C. Reprocessing the bronchoscope: the challenges. 2004;25(4):443–449. *doi: http://dx.doi.org/10.1055/s-2004-832717*
5. Aumeran C, Thibert E, Chapelle *et al.* Assessment on Experimental Bacterial Biofilms and in Clinical Practice of the Efficacy of Sampling Solutions for Microbiological Testing of Endoscopes. *J Clin Microbiol* 2012;50(3):938–942. *doi: http://dx.doi.org/10.1128/JCM.06221-11*
6. Hansen D, Benner D, Hilgenhöner M. *et al.* ATP measurement as method to monitor the quality of reprocessing flexible endoscopes. *Ger Med Sci* 2004(2): No doi PMID: 19675687

7. Kenters N, Huijskens E.G.W, Meier C. *et al*. Infectious diseases linked to cross-contamination of flexible endoscopes. *Endosc Int Open* 2015;3(4):E259–E265. *doi: http://dx.doi.org/10.1055/s-0034-1392099*
8. Sri Lanka College of Microbiologists *Hospital infection control manual*. Colombo 2015(1);86-88- Available at: : *https://slmicrobiology.lk/hospital-infection-prevention-and-control-manual-2/*.Accessed on 09.03.2025
9. Oxoid Manual: *The Manual of Culture Media, Ingredients and Other Laboratory Services* 9th ed. Basingstoke, UK: Oxoid Limited 2006; Available from: *https://www.analisisavanzados.com/modules/mod_tecdata/manuales/oxoid-manual-9th-edition.pdf*. Accessed on 09.03.2025
10. Microbiological test methods for water 1461 part 1 section 3:2013.