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Sterility Status of Reusable Medical Instruments at Public Hospital in Bandung

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Abstract

Hospital-acquired infection has become serious issue during previous decades. In Indonesia, the prevalence of nosocomial infection reached almost 10% of total patients encounter. The objective of this study was to investigate the sterility status of 160 sets of re-used instruments in three intermediate care rooms, including High Care Cardiac Unit (HCCU), Neosurgical Critical Care Unit (NCCU) and Burn Care Unit (BCU) of Dr. Hasan Sadikin General Hospital. All tested instruments were sterilized in Central Sterile Supply Department (CSSD) of the hospital and distributed to those intermediate care rooms. Observations and microbiology assays were carried out for four weeks. We found that 0.625% of the sample was contaminated by bacteria in week IV at CSSD, bacterial infection at HCCU reached 1.875% in week II and III while fungal infection was 1.875% in week I and IV. Contamination of bacteria in NCCU was 1.25% in week I; 1.875% of the samples were contaminated by fungi in week II, III, and IV. The worst contamination was found in BCU room with 2.50% bacterial infection in week I, II and III, and 4.375% of fungal infection in week I, II and IV. The best sterility status of re-used instruments was found in CSSD, followed by NCCU, HCCU and BCU, respectively. The highest contamination was found in BCU room. The finding of this study can be used to enhance patients safety and improve health care quality.

Keywords: hospital-acquired infections, hospital, nosocomial, sterility

Introduction

Hospital-acquired infections (HAI) is a major safety concern for both health care providers and the patients. Considering morbidity, mortality, increased length of stay and the cost, efforts should be made to make the hospitals as safe as possible by preventing such infections.[1] One of the indicators of the hospital health care quality is the low prevalence of hospital-acquired infection. Surveillance and control of infections in hospital should be conducted to protect patients safety and prevent unnecesary medical burden.[3]

One of the infection control activities is the sterilization of reusable medical instruments. The aim of the sterilization of the instrument is to prevent infections particularly for patients which have to undergo a medical procedure which use reusable sterile instrument such as surgical patients. Sterilization is the

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process to eliminate all the forms of living microorganism, including fungi and spora[4]. Every microorganism has different survival resistance in unfavorable living conditions. Several types of microorganisms survive in high temperature, the others capture energy from sunlight or chemicals. Even within same species, several individuals can survive in adverse conditions.[5]

This complexity poses a challenge in the sterilization process of medical instruments. The sterilization should create the condition which can eliminate the most resistant microorganism and maintain such condition until all areas are penetrated and all microbes are eliminated.[6,7] Sterilization requires high cost, therefore the number of instrument that should be sterilized must be counted carefully.[8] In order to decide which instruments that should be sterilized, E.H Spaulding classified the instruments into three categories, namely critical, semi-critical, and non-critical instruments.[9]

Critical instruments are the instruments that directly contact with internal organ, such as intravascular devices. This type of instrument has particularly high risk to spread the contamination, so those instruments absolutely have to undergo sterilization procedure. Semicritical insruments are the instruments that contacts with membrane mucus. Sterilization should be a priority, but high-level disinfection still can be performed for this type of instrument. Non-critical instruments are the instruments that contacts with outer part of the body. For this type of instrument, low-level disinfection procedure is allowed.[10,11]

Central Sterile Supply Department (CSSD) is a unit in the hospital that perform sterilization procedure. Responsibilites of this unit includes sterilization, evaluation, packaging, and distribution of reusable instruments.

One of the factors that affect sterility of the instruments was the storage time after distribution to care units in the hospital[12,13] The aim of this study was to investigate the effect of storage time to the sterility of reusable instruments in CSSD and three different intermediate care units, including High Care Cardiac Unit (HCCU), Neosurgical Critical Care Unit (NCCU) and Burn Care Unit (BCU).

Methods

Research design

This was an experimental research with randomized block design. The sterilility test was conducted to investigate the contamination of both bacteria and fungi in the instruments. The unit of observation was each different units, including CSSD, HCCU, NCCU and BCU. Normality test was conducted to investigate whether the residues distributed normally. The storage time, including week-1, week-2, week-3, and week-4, acted as the block. Ten samples were randomly collected each week from each unit.

Variable identification

The independent variables were the sterility of instruments in various care units in different times. The dependent variables were the factors affecting the sterility. General population of this study was the reusable instruments in all inpatient care units at Dr. Hasan Sadikin General Hospital Bandung. Accessible population was the reuseable instruments in the CSSD and three intermedicate care rooms including HCCU, NCCU, and BCU which were sterilized using steam sterilizators with two layers linen packing. 160 samples were sterilized in CSSD based on hospital procedures. Sterile samples were distributed into four units, each

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Table 1. Microbes and fungi contamination

		Unit							
		CSSD		HCCU		NCCU		BCU	
Week	Sample	FTM	TSB	FTM	TSB	FTM	TSB	FTM	TSB
Sterility Status of Re-usable Medical Instru-ments at Public Hospi-tal in Band-ung	1	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	2	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(+)
	3	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	4	(-)	(-)	(-)	(+)	(+)	(-)	(+)	(-)
	5	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	6	(-)	(-)	(-)	(-)	(+)	(-)	(-)	(-)
	7	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	8	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	9	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	10	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
II	1	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	2	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(+)
	3	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	4	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	5	(-)	(-)	(-)	(-)	(-)	(-)	(+)	(-)
	6	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	7	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	8	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	9	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(-)
	10	(-)	(-)	(+)	(-)	(-)	(-)	(-)	(-)
III	1	(-)	(-)	(-)	(-)	(-)	(+)	(+)	(-)
	2	(-)	(-)	(+)	(-)	(-)	(-)	(-)	(-)
	3	(-)	(-)	(-)	(-)	(-)	(-)	(+)	(-)
	4	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(+)
	5	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	6	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	7	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	8	(-)	(-)	(+)	(-)	(-)	(-)	(-)	(-)
	9	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	10	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
IV	1	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(+)
	2	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(+)
	3	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(+)
	4	(-)	(-)	(-)	(+)	(-)	(-)	(-)	(-)
	5	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(+)
	6	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	7	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
	8	(-)	(-)	(-)	(+)	(-)	(-)	(-)	(-)
	9	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(+)
	10	(+)	(-)	(-)	(-)	(-)	(-)	(-)	(-)

FTM : For contamination of bacteria
TSB : For contamination of fungi

Table 2. Sterility of re-used instruments at CSSD

No	Category	FTM		TSB	
		f	%	f	%
1	Sterile	39	97.5	40	100.0
2	Not sterile	1	2.5	0	0
	Total	40	100.0	40	100.0

Table 3. Sterility of re-used instruments at HCCU

No	Category	FTM		TSB	
		f	%	f	%
1	Sterile	37	92.5	37	92.5
2	Not sterile	3	7.5	5	7.5
	Total	40	100.0	40	100.0

40 samples. Ten samples were collected each week from every room during 4 weeks study period. Samples were selected using simple random sampling method.

Materials and instruments

Materials and instruments which were used for sterility test were sterile physiological sodium chloride, fluid thioglicolate medium (FTM), trypticase soy broth (TSB), tryticase soy agar (TSA), destilled water, cotton swab, petri dishes, glass tube, steam sterilizer, laminar air flow (LAF) room, and incubator.

Microbes contamination test in the LAF room

This test was conducted to evaluate the sterility in the LAF room. Desinfection process was performed using alcohol 70%, blower, and ultra violet for one hour. The sterility test was performed by placing a petri dish containing TSA in LAF room for 15 minutes. Then, it was incubated at 37ºC for 18-24 hours.

Bacteria and fungi contamination test

Bacteria and fungi contamination tests were performed for ten samples from each unit every week. The contamination test was

Table 4. Sterility of re-used instruments at NCCU

No	Category	FTM		TSB	
		f	%	f	%
1	Sterile	38	95.0	37	92.5
2	Not sterile	2	5.0	3	7.5
	Total	40	100.0	40	100.0

Table 5. Sterility of re-used instruments at BCU

No	Category	FTM		TSB	
		f	%	f	%
1	Sterile	36	90.0	32	80.0
2	Not sterile	4	10	8	20.0
	Total	40	100.0	40	100.0

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performed using swab method; sterile cotton was swabbed to the samples, then it was dissolved in physiological sodium chloride and was inoculated in tube containing FTM for bacteria contamination test and TSB for fungi contamination test. It was incubated during 7-14 days at 30-35ºC

Data Analysis

Descriptive analysis was performed to report the percentage of steril reusable instruments at CSSD, HCCU, NCCU, and BCU in different time. Analysis of variance (ANOVA) was performed to investigate the effect of storage time and storage condition/units towards the sterility of the instruments. Hypothesis used for testing the effect of storage time included; H0: storage time did not influence the sterility of the instruments and H1: storage time influenced the sterility of the instruments. Hypothesis used for testing the effect of storage condition/units were; i.) H0: there were no differences of sterility in every unit ii.) H1: there were differences of sterility in every unit. Normality test was also performed to determine the characteristic of data distribution. Significancy was set at $p<0.05$. If there was significant difference, student newman keuls test was then performed.

Results And Discussion

Overall, in CSSD unit, all (100%) reusable instruments were completely sterile from the growth of fungi and 97.5% of the instruments were sterile from the growth of bacteria. 92.5% of the instruments in HCCU were sterile from bacteria and fungi. In NCCU, 95% of the instruments were sterile from the growth of bacteria and 92.5% were sterile from the growth of fungi. 90% of the instruments in the BCU was sterile from the growth of bacteria and 80% were sterile from the growth of fungi.

The contamination occured in different time for each unit. In CSSD, the sample was contaminated by bacteria in week 4. In HCCU, 1.875% of the samples were contaminated by bacteria in week 2 and 3 while 1.875% of the samples were contaminated by fungi in week 1 and 4. Contamination of bacteria in NCCU was 1.25% in week 1 and 1.875% of fungi contamination occured in week 2, 3, and 4. The worst contamination was found in BCU unit. 2.50% of bacterial contamination occured in week 1, 2 and 3, while 4.375% of fungal contamination occured in week 1, 2 and 4.

Based on the statistical analysis, we found that there were no significant differences of the bacterial contamination in various units at different time, while for fungal contamination, different time and storage unit influenced its prevalence.

Several factors might affect such finding, including the differences in survival ability of microorganisms and differences in the characteristics of each unit supporting the contamination. For example, burn care unit is one of the unit with highest risk of infection. Burn wounds are a suitable site for multiplication of microorganisms and are more persistent richer sources of infection than surgical wounds, mainly because of the larger area involved and longer duration of patient stay in the hospital.[14]

Modern medical practices have increasingly utilized medical devices to improve therapeutic outcomes and enhance quality of life of the patients. However, these particular devices are easily colonized with bacteria and fungi. Health care professionals are becoming increasingly concerned with the infection associated with the use of medical devices. Crude mortality rates of nosocomial infections due to device-related infections vary from 12–80%, dependent on

the population studies and the definitions used.[15,16]

The most common nosocomial bacterial pathogen were *Staphylococcus aureus*, P*seudomonas aeruginosa,* and *Streptococcus pyogenes*. The dominant nosocomial fungal pathogens was *Candida spp*. Minimal immune suppression is needed to treat an individual with such infection. *Aspergillus* species are the second most common cause of nosocomial fungal infections, as they tend to occur in patients with severe immunosuppression and prolonged neutropenia. These infections are difficult to diagnose and cause high morbidity and mortality. Effective decontamination of medical instruments and the compliance to standard procedures to reduce trasnmission remain the cornerstones of the prevention of nosocomial infection.[14,17]

Conclusion

The storage condition and time influenced the nosocomial fungal contamination in medical instruments. The best sterility status was found in CSSD while the worst was found in wound care unit. The result of this study can be used to formulate the nosocomial prevention policy in health-care setting, particularly regarding the decontamination of medical instruments.

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Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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