



# Decontamination Process and Factors Related to Contamination of Laryngoscope Blades and Handles

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## Abstract

**Objective:** To investigate bacterial and proteinaceous material contamination of 'ready to use' laryngoscope blades/handles and the factors related to its contamination at HRH Princess Maha Chakri Sirindhorn Medical Center, Nakhon Nayok.

**Methods:** Hospital survey on decontamination of laryngoscope blades and handles were observed and 70 participants of healthcare workers (HCWs) were asked to fill up self-answered questionnaires regarding experience on decontamination during their routine work. The effectiveness of laryngoscope decontamination was determined by total bacterial count and proteinaceous materials deposit with 6% erythrosin B solution from 326 swab samples of 'ready to use' laryngoscope blades (214), handles (106) and boxes (6) from September 2010 to May 2011.

**Results:** Various processes of laryngoscopes decontamination were practiced among 70 HCWs. Appropriate decontamination of blades and handles were observed in 50% and 2.9% of the participants, respectively. Bacterial contamination were found in 50.5% of laryngoscope blades, 46.2% of handles and 83.3% of boxes. Bacterial contamination levels of individual sample ranged from  $3 \times 10^4$  to  $3.6 \times 10^4$  CFU/sample. Approximately 56% of 162 positive samples were contaminated with bacteria less than  $10^2$  CFU/sample. Predominate bacteria was coagulase-negative staphylococci (82.7%). Other nosocomial pathogens were also isolated such as *Acinetobacter baumannii* (4.9%), *Pseudomonas aeruginosa* (3.7%), and methicillin-resistant *Staphylococcus aureus* (2.48%). Proteinaceous contamination rates were 60.9% on blades and 72.9% on handles. Bacterial contamination rates on blades and handles were significantly different ( $p=0.001$  and  $0.02$ , respectively) among departments and time intervals from the last decontamination. Inappropriate blade cleaning was significantly associated with bacterial contamination 5.92 times of those with appropriate cleaning ( $p=0.0001$ ).

**Conclusion:** Based on high bacterial contamination of the present study, we recommend the pre-use and on-site disinfection of the 'ready to use' laryngoscope blade and handle with 70% alcohol before each use. The guidelines and training on laryngoscope decontamination was necessary for a hospital-wide practice.

**Keywords:** laryngoscope, bacterial contamination, proteinaceous material



# การทำความสะอาดและปัจจัยที่เกี่ยวข้องกับการปนเปื้อนเบลดและ ด้ามจับของเครื่องส่องตรวจกล่องเสียง

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## บทคัดย่อ

**วัตถุประสงค์:** เพื่อศึกษาการปนเปื้อนแบคทีเรียและคราบโปรตีนของเครื่องส่องตรวจกล่องเสียงชนิดพร้อมใช้งาน และปัจจัยที่เกี่ยวข้องกับการปนเปื้อน ณ ศูนย์การแพทย์สมเด็จพระเทพรัตนราชสุดาฯ สยามบรมราชกุมารี จังหวัดนครนายก

**วิธีดำเนินการวิจัย:** การวิจัยเชิงสำรวจกระบวนการทำลายเชื้อของเครื่องส่องตรวจกล่องเสียงและประสิทธิภาพของการทำความสะอาดของเจ้าหน้าที่โรงพยาบาลจำนวน 70 ราย โดยการสังเกตขณะปฏิบัติงาน ตอบแบบสอบถามเกี่ยวกับประสิทธิภาพในการทำความสะอาดอุปกรณ์ และป้ายกวาดตัวอย่างจากเบลด (214 ตัวอย่าง), ด้ามจับ (106 ตัวอย่าง) และกล่องเก็บ (6 ตัวอย่าง) ของเครื่องส่องตรวจกล่องเสียงชนิดพร้อมใช้งาน รวมทั้งสิ้น 326 ตัวอย่าง นำมาตรวจหาการปนเปื้อนของเชื้อแบคทีเรียและคราบโปรตีนโดยวิธีย้อมคราบโปรตีนด้วยน้ำยาอิริโทรซิน บี ความเข้มข้น 6% ระหว่างเดือนกันยายน 2553 ถึงเดือนพฤษภาคม 2554

**ผลการวิจัย:** กระบวนการทำความสะอาดพบความหลากหลายรูปแบบของการล้าง เจ้าหน้าที่ทำความสะอาดเบลดและมือจับ อย่างเหมาะสมร้อยละ 50 และร้อยละ 2.9 ตามลำดับ พบการปนเปื้อนแบคทีเรียบนเบลดร้อยละ 50.5, ด้ามจับร้อยละ 46.2 และกล่องเก็บร้อยละ 83.3 ปริมาณแบคทีเรียทั้งหมดอยู่ระหว่าง  $3 \times 10^4$  -  $3.6 \times 10^4$  โคโลนีต่อตัวอย่าง โดยร้อยละ 56.2 ของตัวอย่างที่ปนเปื้อนเชื้อ (162 ตัวอย่าง) มีแบคทีเรียทั้งหมดต่ำกว่า  $10^2$  โคโลนีต่อตัวอย่าง แบคทีเรียที่พบมากที่สุดคือ coagulase-negative staphylococci ร้อยละ 82.7 ของตัวอย่างที่ปนเปื้อน นอกจากนี้ยังพบ *Acinetobacter baumannii*, *Pseudomonas aeruginosa* และ *Staphylococcus aureus* ที่ดื้อยาเมธิซิลลิน(MRSA) ร้อยละ 4.9, 3.7 และ 2.48 ตามลำดับ การปนเปื้อนคราบโปรตีนบนเบลดพบร้อยละ 60.9 และบนด้ามจับร้อยละ 72.9 อัตราการปนเปื้อนแบคทีเรียบนเบลดและด้ามจับพบว่าแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ( $p=0.001$  และ  $0.02$  ตามลำดับ) ตามหน่วยงานและระยะเวลาหลังจากการล้างกล่องส่องตรวจครั้งสุดท้าย การล้างที่ไม่เหมาะสมสัมพันธ์กับการปนเปื้อนแบคทีเรียบนเบลด 5.9 เท่าเมื่อเปรียบเทียบกับกลุ่มที่มีการล้างอย่างเหมาะสม

**สรุป:** การศึกษานี้พบว่าเครื่องส่องตรวจกล่องเสียงปนเปื้อนแบคทีเรียทั้งหมดในอัตราที่สูง จึงแนะนำให้ทำความสะอาดเบลดและด้ามจับด้วยแอลกอฮอล์ ความเข้มข้น 70% ก่อนการใช้ ณ จุดปฏิบัติงาน ควรจัดทำคู่มือและฝึกอบรมเจ้าหน้าที่ผู้เกี่ยวข้องให้มีแนวทางปฏิบัติเหมือนกันทั้งโรงพยาบาล

## Introduction

Hospital-associated infections (HAI) and nosocomial outbreaks have been reported to arise from common source vehicles such as laryngoscope, bronchoscope, and endoscope.<sup>1-3</sup> Inadequate decontamination of laryngoscope has been linked to nosocomial outbreaks.<sup>4,5</sup> *Serratia marcescens*, methicillin-resistant *Staphylococcus aureus* (MRSA), and *Enterobacter cloacae* were reported as causes of outbreaks that linked to the contaminated laryngoscope blades<sup>5-7</sup> and handles.<sup>8</sup>

Laryngoscope blade and handle are classified as semi-critical and non-critical medical instruments, respectively on the basis of risk of nosocomial infection. Guidelines for cleaning and disinfection of them are then recommended according to this Spaulding classification.<sup>9</sup> However, the tip of the blade may contact with the handle when the blade is folded along the handle before and after its use. Hence, both blade and handle of rigid laryngoscopes are considered as one instrument and classified as semi-critical item that required high-level disinfection.<sup>10</sup>

Practically, substantial differences in decontamination procedures of laryngoscope were reported among hospitals or even within the same hospital. The hospital survey conducted in the Netherlands found that decontamination by cleaning machines as a standard procedure was used in only 30 of 139 hospitals (22%), and manual cleaning and disinfection were inadequate in 22.9%.<sup>11</sup> Moreover, decontamination and disinfection of laryngoscopes between patients during the surgery were frequently ineffective, leaving residual contamination that has been implicated as a source of cross-infection.<sup>12</sup>

At HRH Princess Maha Chakri Sirindhorn Medical center (MSMC), laryngoscopes were currently available and used at many units. Daily use of the laryngoscopes was found in operating rooms (OR) and Ear Nose Throat (ENT) department. Decontamination method between the units was different and was not evaluated in the hospital. This study was aimed to evaluate laryngoscopes decontamination process currently practiced at

MSMC and effectiveness of decontamination by detection of bacterial and proteinaceous materials presented on the blades and handles of 'ready to use' laryngoscopes. This study was approved by the Ethical committees, Faculty of Medicine, Srinakharinwirot University (SWUEC/EX4-2/2010).

## Methods

Hospital survey on laryngoscopes decontamination was carried out at MSMC from September 2010 to May 2011. Hospital staff responsible for laryngoscope decontamination in all departments/units were asked to voluntarily participate in the survey and to provide informed consent. Laryngoscope decontamination procedure was observed during the routine work at OR, ENT, emergency room (ER), in-patient wards and special units. The questionnaires on general characteristics and decontamination experience were given and collected later. Appropriate cleaning included immediate cleaning with running water using brush /scrub sponge with detergent and wipe dry. Appropriate disinfection included applying disinfectant with appropriate method according to the used disinfectant.<sup>3</sup>

Sample sizes of laryngoscope blades and handles were determined by using bacterial contamination rate of blades 58%<sup>13</sup> and handle 86%<sup>8</sup>, margin of error (d) 0.07 with 95% confidence interval. Six boxes of swab samples were later collected upon the subsequent finding of high contamination at ER. A total of 326 swab samples of 'ready to use' laryngoscopes (214 laryngoscope blades, 106 handles and 6 boxes) were randomly sampling to determine total bacterial count and identify common nosocomial pathogens. Antimicrobial susceptibility of nosocomial pathogens were determined by discs diffusion method in accordance with Clinical and Laboratory Standards Institute.<sup>14</sup>

Proteinaceous materials deposited on laryngoscope samples were determined by using 6% erythrosin B solution (Faculty of Dentistry, Mahidol University), which adhered to the proteinaceous materials remaining on the blade/

handle and stained red.<sup>15</sup> Red staining and site were observed after applying erythrosin B and rinsing with tap water. Bacterial and proteinaceous material contamination rates of laryngoscope blades and handles were calculated in percentage. The data on variables associated with bacterial contamination rates were analyzed with SPSS version 18.0. Pearson's chi-squared test was used to test differences of contamination rates and statistical significance at  $p < 0.05$ .

## Results

### Participants' profile

A total of 70 hospital staff, 63 female (90%) and 7 male (10%) participated in the study. Their ages were ranged from 19 to 49 years and 57.1% of them were between 21–30 years old. Majority of them (85.7%) were nurse assistants. They had been working at MSMC with an average of 4.5 years in various departments including inpatient wards (65.7%), anesthesiology (10%), ICUs (10%), OPD/other units (8.6%), and ER (5.7%).

All participants had been working on laryngoscopes decontamination since the beginning of the job. Approximately 25.7% of participants had decontamination experience less than 3 years, 42.9% had laryngoscope decontamination experience between 3 to 5 years and 31.4% had been working on decontamination for more than 6 years (Table 1). Only 5 persons (7.1%) reported that they had guidelines for laryngoscope decontamination and 67.1% had never been formally trained in decontamination process but one-on-one training by personnel in the same department who was previously assigned on laryngoscope decontamination procedure.

Regarding wearing personal protective equipment (PPE) during the cleaning procedure, 80% of participants wore gloves and mask. 17.1 % wore only gloves and two persons (2.9%) did not use any PPE. None of them wore apron during the cleaning. All participants carried out the decontamination process at their department. Only one nursing assistant did not clean but rinsed the blade with water and sent it to central sterile

supply department (CSSD) for sterilization, in known case of infection. Approximately 67% of them did the work within 30 minutes and 30% immediately after usage.

### Laryngoscope decontamination process

Approximately 93% of the rigid laryngoscopes used in MSMC were Macintosh type. It was found that various patterns of decontamination process were carried out among 70 HCWs. Half of the participants appropriately decontaminated blades by disinfection after proper cleaning yet only 2.9% decontaminated handles appropriately. Laryngoscope decontamination was divided into 4 steps i.e. preparation before cleaning, cleaning, disinfecting/sterilization and storage.

*Preparation before cleaning:* the blade was removed before cleaning 98.6 % and only one person did not. Battery removal from the laryngoscope handle was found only 24.3%. Soaking blade in water was not observed in this study.

*Blade cleaning:* proper blade cleaning with running water, detergent and scrub/brush action was found in 51.4% (36/70). Cleaning with detergent but no scrubbing was observed in 21.4% (15/70). 18.6% (13/70) cleaned only with running water without detergent. Six persons did not clean the blade but wiped blades with wet clothes (3/70, 4.3%) and another 3 persons (4.3%) disinfected blades without cleaning step. After cleaning, blades were wiped with gauze or clean cloth in 58.6% and air dry was observed in 22 persons (31.4%).

*Blade disinfection:* 61 participants (81.1%) disinfected the blades and 83.6% of them (51/61) disinfected by wiping the blade with 70% alcohol and air dry. A few used other disinfectants such as 4% chlorhexidine, glutaraldehyde.

*Handle cleaning and disinfection:* handle cleaning was not done in 82.9% of the participants but 70% alcohol soaked on cotton ball or gauze was directly wiped on the handle. Among 12 participants (17.1%) who cleaned the handles, 2 persons (2.9%) appropriately cleaned and

**Table 1:**

General characteristics of HCW assigned for laryngoscope decontamination at MSMC hospital (n= 70)

General Characteristics	Number (%)
Sex	
Female	63 (90)
Male	7 (10)
Age (years)	
≤ 20	4 (5.7)
21-30	40 (57.1)
31-40	24 (34.3)
> 40	2 (2.9)
Work status	
Nurse	1 (1.4)
Nursing assistant	60 (85.7)
Anesthetic nurse	7 (10.0)
House keeper	2 (2.8)
Departments	
In-patient wards	46 (65.7)
Anesthesiology	7 (10.0)
ICUs*	7 (10.0)
OPD and other units**	6 (8.6)
ER	4 (5.7)
Time of employment (years)	
< 3	18 (25.7)
3-5	30 (42.9)
6-10	22 (31.4)

\* Medical, surgical, pediatrics ICUs \*\* Hemodialysis unit, radiology, and labor room

disinfected the handles, 10 persons cleaned or disinfected inappropriately. Laryngoscope handles were air dried after alcohol disinfection (87.1%). The most commonly used disinfectant (98.5%) was 70% alcohol.

*Storage:* after the decontamination process, 90% of the laryngoscopes were stored in the laryngoscope boxes which had not been cleaned on regular basis. Six laryngoscopes (8.6%) were placed on the tray or shelf after decontamination. One was wrapped in the sterile cloth after EO sterilization.

### Bacterial contamination

Approximately half of laryngoscope samples (162/326) were contaminated with bacteria (Table 2). 50.5% (108/214) and 46.2% (49/106) of laryngoscope blades and handles, respectively, were contaminated with bacteria. Five of 6 box samples (83.3%) were contaminated with bacteria similar to those found on the laryngoscope blades and handles.

Bacterial contamination levels of individual samples were ranging from  $3 \times 10^4$  -  $3.6 \times 10^4$  CFU/sample. Greater than half (91/162, 56.2%) of 162 positive samples were contaminated with bacteria at low level ( $< 1 \times 10^2$  CFU/sample), followed by

Table 2:

Bacterial contamination of laryngoscopes and box samples

Level of contamination (CFU/sample)	Number (%)			
	Total (n=326)	Blade (n=214)	Handle (n=106)	Box (n=6)
Total positive samples	162 (49.7)	108 (50.5)	49 (46.2)	5 (83.3)
Low ( $< 1 \times 10^2$ )	91 (56.2)	58 (53.7)	30 (61.2)	3 (60.0)
Low to medium ( $1 \times 10^2 - 4.9 \times 10^2$ )	40 (24.7)	27 (25.0)	12 (24.5)	1 (20.0)
Medium ( $5.0 \times 10^2 - 9.9 \times 10^2$ )	8 (4.9)	6 (5.6)	2 (4.1)	0 (0.0)
Heavy ( $> 1 \times 10^3$ )	23 (14.2)	17 (15.7)	5 (10.2)	1 (20.0)

24.7% of low to medium contamination level, ranging from  $1 \times 10^2$  to  $4.9 \times 10^2$  CFU/sample. Heavy bacterial contamination ( $> 1 \times 10^3$  CFU/sample) was found only 14.2% of the samples. Among the heavy bacterial contamination, only 4 samples had total bacterial counts greater than  $1 \times 10^4$  CFU/sample.

Predominant bacterial contamination were gram positive, namely coagulase negative staphylococci (CNS) found in 82.7%, *Bacillus* spp. (38.3%), *Streptococcus* spp. (18.5%), and *Staphylococcus aureus* (3.1%), of which 4 of 5 of isolates were MRSA. Among gram negative bacteria, *Acinetobacter baumannii* and *Pseudomonas aeruginosa* were found 4.9% and 3.7% of the samples, respectively. Thirteen (54.2%) of 24 *A. baumannii* isolates were MDR strains.

#### Factors related to bacterial contamination

Bacterial contamination rates on blades and handles were significantly different among departments ( $p=0.001$ ,  $0.02$ , respectively). Highest contamination rates were 77.6 % on blades and 80% on handles found at emergency room (ER). Laryngoscopes were inappropriately cleaned and disinfected by all ER participants who had average working experience for 2 years. Moreover, they kept 'ready to use' laryngoscopes in the boxes that were rarely cleaned. Samplings of 4 contaminated boxes at ER were found all positive

for CNS, *Bacillus* spp., *Streptococcus* spp. and *Pseudomonas* spp., similar to those on blades and handles. Bacterial contamination rates were also found significantly different among time intervals between usages. The shorter the duration, the higher was the bacterial contamination rates. In addition, inappropriate cleaning and disinfection procedure at ER were associated with blade contamination 5.92 times higher (95% CI 2.51-13.99) compared to ICUs; storing blade for 1 day and 2-7 days were associated with blade contamination 4.34 and 2.56 times higher than storing for longer than 7 days. Bacterial contamination of handles was only significantly associated with 1 day time interval (OR 4.23, 95% CI 1.53-11.66) (Table 3).

#### Proteinaceous material contamination

Assay on proteinaceous material after decontamination of laryngoscopes were carried out to observe the effectiveness of cleaning. Blades and handles were stained positive for proteinaceous material in 60.9% and 72.9%, respectively. Tip of the blades were mostly contaminated with proteinaceous material (56.8%) and less in the front surface (8.3%). Handles were contaminated with proteinaceous materials all over in no particular area. Decontamination process was inappropriate in 48.6% for blade and 97.1% for handles. Cleaning steps were not taken but most wiped the handles with 70% alcohol.



Table 3:

Factors related to bacterial contamination of laryngoscopes

	No. (%) of contaminated samples			
	Blade <sup>d</sup>	OR (95%CI)	Handle <sup>e</sup>	OR (95%CI)
Departments				
ICUs <sup>a</sup>	21/57 (36.8)	1	9/19 (47.4)	1
Emergency room	38/49 (77.6)	5.92 (2.51-13.99)*	12/15 (80.0)	4.44 (0.9-21.0)
Anesthesiology	26/39 (66.7)	3.43 (1.46-8.07)*	18/38 (47.4)	1 (0.33-3.01)
Wards <sup>b</sup>	20/60 (33.3)	0.86 (0.40-1.83)	9/27 (33.3)	0.56 (0.17-1.85)
Others <sup>c</sup>	3/9 (33.3)	0.86 (0.19-3.79)	1/7 (14.3)	0.18 (0.02-1.84)
Total	108/214 (50.5)		49/106 (46.2)	
Time intervals				
1 day	66/105 (62.9)	4.34 (2.15-8.73)*	31/53 (58.5)	4.23 (1.53-11.66)*
2-7 days	26/52 (50.0)	2.56 (1.16-5.66)*	11/25 (44.0)	2.36 (0.73-7.55)
>7 days (8-30+days)	16/57 (28.1)	1	7/28 (25.0)	1
Cleaning and disinfection <sup>f</sup>				
Appropriate (ICU)	21/57 (36.8)	1	9/19 (47.4)	1
Inappropriate (ER)	38/49 (77.6)	5.92 (2.51-13.99)*	12/15 (80.0)	4.44 (0.94-21.0)

<sup>a</sup> Medical ICU, Surgical ICU, Pediatric ICU, and Neonatal ICU<sup>b</sup> Ten wards in different departments were included in the study.<sup>c</sup> Labor room, hemodialysis unit, and radiation department<sup>d</sup> Blade contamination rates were significantly different among departments ( $p=0.001$ ) and time intervals ( $p=0.001$ ).<sup>e</sup> Handle contamination rates were significantly different among departments ( $p=0.02$ ) and time intervals ( $p=0.02$ ).<sup>f</sup> Bacterial contamination of blade was significantly associated with inappropriate cleaning (OR 5.92, 95% CI 2.51-13.99,  $p=0.001$ ).\*  $p < 0.05$ 

## Discussion

Not only microorganisms but also proteinaceous materials contamination of medical devices has been concerned since the outbreaks of variant Creutzfeldt-Jakob disease in 1966.<sup>15</sup> The joint commission of the association of perioperative registered nurses (AORN) released a new standard of processing and storing of laryngoscope blades.<sup>16</sup> The new standard includes the use of steam sterilization or high-level disinfection wherever possible and implied that laryngoscope blades should be reprocessed at CSSD. However, decontamination of laryngoscopes at CSSD in resource-limited hospitals as in Thailand may not be practical for time consuming and supply management. Decontamination process in our study was almost all carried at the site of use and varied widely from department to department.

71% of anesthetic nurses appropriately decontaminated laryngoscopes and 50% of ER nurse aids did. These data coincided with bacterial contamination rates found the lowest in OR and highest in ER.

Decontamination should be done as soon as possible to prevent soiled materials become dried and hard to remove. Soaking at pre-cleaning step was required to prevent organic matter from drying on device and make it easy to clean yet soaking blade was not observed in our setting. Using brush and scrub sponge would help to remove debris more effectively but we found only 51.4% of participants used them in cleaning step. In addition, 18.6% of participants cleaned without detergent. These explained high proteinaceous material contamination rates of blades (60.9%) and handles (72.9%) in the present study. Tip of the blade that

came into contact with the handle (in folding position) was the site with the highest proteinaceous material contamination (56.8%). This contact point of the handle could be a potential route for patient-to-patient transmission of proteinaceous material and pathogens. Most manufacturers suggest at least a low-level surface disinfectant be utilized on the surface of the handle; however, there is increasing evidences of bacterial and viral contamination on the handles. Laryngoscope handle is therefore suggested to be decontaminated as same as blade with the use of high-level disinfectant.<sup>17</sup>

The bacterial contamination rate of laryngoscope blades and handles were 50.5% and 46.2%, respectively in the present study. Most of them were contaminated with coagulase-negative staphylococci (CNS) that was similar to other studies.<sup>18,19</sup> CNS is commonly found on skin, mucous membrane and hospital environment. They increasingly cause nosocomial infections particularly among immune-compromised patients, those retaining invasive devices, and injecting drug users.<sup>20,21</sup> *A. baumannii*, *P. aeruginosa* and *S. aureus* were also detected and some of them were MDR strains. They persistently survived in the hospital environment as long as 11 months for *A. baumannii*, 12 months for *P. aeruginosa* and 16 months for *S. aureus*.<sup>22,23</sup> Therefore, high bacterial contamination could be due to both inappropriate decontamination and storage, and recontamination after reprocessing laryngoscopes.

Reprocessing semi-critical items are recommended to be kept in peel-pack post steam sterilization for long-term storage or wrapped in a sterile towel for short-term storage.<sup>16</sup> At MSMC, laryngoscopes at in-patient wards and other units were used occasionally and kept unwrapped in the boxes, so they should be kept more appropriately for long-term storage. Another routine practice was a routine check for 'ready to use' laryngoscope in every nurse shift or in some department on daily basis. This practice also increased risk of bacterial re-contamination of 'ready to use' laryngoscopes. Analysis of factors related to bacterial contamination

was linked to various departments in which inappropriate decontamination process were observed and time intervals between usages. Increasing frequency of usage resulted in increasing contamination due to inappropriate decontamination process and thus increase risk to the patients.<sup>12</sup>

Therefore, decontamination of laryngoscopes would require guidelines and training in cleaning and disinfection for effective decontamination of laryngoscopes. These guidelines should be practical and appropriate for the hospitals, especially in the resource-limited hospitals. Sripore *et al* reported that bacterial contamination of laryngoscope blades was 2% after cleaning with 4% hibiscrub and wipe with 70% alcohol, and then kept in a plastic bag.<sup>18</sup> Similar evidence-based data would be required to support the establishing guidelines. Some limitations of the present study included an assumption of similar decontamination process would occur for the same HCWs during the study period. Bacterial and proteinaceous material sampling were not carried out at the same time or immediately after decontamination process to avoid interfering with routine works. High proteinaceous material contamination rates could be a result of old imbedded organic matter that was not previously removed due to inadequate cleaning. In the interim, based on high bacterial and proteinaceous material contamination rates, and inappropriate decontamination process of laryngoscopes of the study, we recommended that laryngoscope blade and handle must be repeatedly wiped with 70%-90% alcohol immediately prior to usage to minimize the cross infection after using laryngoscopes.

## Acknowledgement

We thank MSMC staff who participated in the study. This research was partially supported by grant of Department of Microbiology, Faculty of Public Health, Mahidol University.

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