

## Oral care practice for the ventilated patients in intensive care units: a pilot survey

Kim Lam Soh<sup>1</sup>, Sazlina Shariff Ghazali<sup>2</sup>, Kim Geok Soh<sup>3</sup>, Rosna Abdul Raman<sup>1</sup> Sharifah Shafinaz Sharif Abdullah<sup>4</sup>, Swee Leong Ong<sup>5</sup>

<sup>1</sup>Department of Medicine, <sup>2</sup>Department of Family Medicine, Faculty of Medicines and Health Sciences, University Putra Malaysia, 43400 Serdang, Selangor, Malaysia

<sup>3</sup>Department of Sport Studies, Faculty of Education, University Putra Malaysia, 43400 Serdang, Selangor, Malaysia

<sup>4</sup>Department of Nursing, Faculty of Health Sciences, University Teknologi Mara, Selangor, Malaysia

<sup>5</sup>Department of Nursing, Faculty of Medicine and Health Sciences, University Sultan Zainal Abidin, Terengganu, Malaysia

### Abstract

**Introduction:** Ventilator-associated pneumonia (VAP) is the most common nosocomial infection in intensive care units (ICUs). One factor causing VAP is aspiration of oral colonisation, which may result from poor oral care practice. Oral care using tooth brushing can prevent formulation of dental plaque that can be a reservoir for microbes causing VAP.

**Methodology:** A cross-sectional survey was conducted among 124 nurses, using a self-administered questionnaire, to determine methods used, frequency, and attitude of nurses toward oral care provided to mechanically ventilated patients in Malaysian ICUs.

**Results:** Methods for oral care and their frequency of use varied between nurses even in the same unit. Cotton with forceps was used by 73.4% of the nurses. Some nurses used forceps and gauze (65%) or spatulas and gauze (36%). Toothbrushes were used by 50.8% of the nurses. Nurses in this hospital reported to have positive attitude toward providing oral care.

**Conclusions:** The survey showed the need to have standardised oral care protocols in ICUs to improve quality of oral care provided to ventilated patients.

**Key words:** ventilator-associated pneumonia; nursing practice; attitude; oral hygiene; oral care

*J Infect Dev Ctries* 2012; 6(4):333-339.

(Received 06 October 2010 – Accepted 01 April 2011)

Copyright © 2012 Soh *et al.* This is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

### Introduction

Ventilator-associated pneumonia (VAP) is the most common complication in intensive care units (ICUs). This complication contributes to delayed recovery and increases patients' mortality rates yet it is preventable. VAP extends patient's length of stay and leads to increased health care costs and mortality [1-3]. The VAP incidence rate was reported to be 26.5% for three ICUs in Malaysia [4]. A number of quality improvement initiatives, involving the implementation of ventilator care bundle interventions are required to reduce mortality due to VAP [5,6]. These interventions include head-of-bed elevation, daily interruption of sedation to reduce time on mechanical ventilation, prevention of deep vein thrombosis, as well as peptic ulcer disease prophylaxis and achieve significantly better outcomes than when they are implemented separately [5-7].

Currently, there is limited data on the incidence of VAP in relation to oral care. Aspiration of oral colonisation has been identified as one of the common causes of VAP in the ICU, as a result of poor oral care [8]. Effective oral care can prevent the formation of dental plaque, which often provides a reservoir for the microbes causing VAP [1]. The oral antiseptic chlorhexidine gluconate and subglottic suctioning have also been identified as effective strategies for preventing VAP [9]. Tooth brushing has been suggested every 12 hours in a revised oral care policy [7]. Suctioning of oropharyngeal secretions and tooth brushing, together with a ventilator care bundle, may improve prevention of VAP [10]. Blamoun *et al.* [11] indicated that implementation of a ventilator care bundle, oral care policy and subglottic suctioning for 12 months significantly reduced the rate of VAP.

Traditionally oral care in the ICU has been focused on patient comfort rather than plaque removal [12,13]. Cotton swabs are commonly used for cleaning patient's teeth, gum and tongue. Although cotton swabs are able to stimulate the mucosal tissues effectively, they are ineffective for removing plaque in between the teeth [14,15]. Nurses prefer to use cotton swabs because they are convenient, require little set-up, and clean faster than tooth brushing [16,17]. In the high-pressure and highly technological critical care environment, oral care is considered a low priority [12, 18]. A study found that 9 out of 10 nurses favoured foam sticks to toothbrushes for cleaning the oral cavity of intubated patients [16]. Similarly, Jones *et al.*[19] also found foam sticks to be highly preferred for oral care, as used by 88.5% of the nurses in the ICU. An observational study found that nurses varied the type and technique of the oral care they employed, possibly as a result of the vast array of cleaning tools provided [20]. The reason for this finding could be that the nurses were not aware of the importance of tooth brushing for critically ill patients, so they chose their preferred method even when toothbrushes were available [16]. Another barrier to oral care by tooth brushing is the endotracheal tube, [13,20] mainly because dislodging the endotracheal tube is life-threatening [12,21].

A small head toothbrush is preferred for intubated patients [21,22]. Studies also have recommended brushing with a child's toothbrush at least twice a day for more effective dental plaque prevention in mechanically ventilated patients [14,15,23]. Although there is limited data associating dental plaque removal with reduced incidence of VAP [24], colonization of dental plaque with respiratory pathogens was found to be correlated with occurrence of pneumonia and nosocomial infections [25]. There are a number of studies addressing the methods for oral care in ICUs worldwide. There are a number of studies addressing the methods for oral care in ICUs worldwide [1,12]; however, there is limited data available for Malaysia. This survey therefore describes the methods used for the oral care of the mechanically ventilated patients in Malaysian ICUs and the corresponding frequencies as well as the nurses' attitude toward providing oral care. The results of this survey can be used as baseline data to develop guidelines for providing oral care in our ICUs.

## Methodology

### *Study design*

This was a cross-sectional survey elaborated at a tertiary government referral hospital in Kuala Lumpur, Malaysia, with 2,375 beds distributed in 82 wards of 22 disciplines. All adult ICUs in the hospital, namely medical surgical, neurology, urology, and post-infarction care, involving a total of 39 beds and 180 nurses were included in the survey. The ratio of nurses to patients was about 1:1 per shift in all ICUs.

### *Participants*

A sample size of 82 participants was estimated based on Snecdecor & Cochran sample size calculation [26]. Our survey included all registered ICU nurses or ward managers who were caring for ventilated patients. Student nurses and registered nurses posted to the unit for their post-basic critical care course were not included in the survey.

### *Survey instrument*

A self-administered questionnaire was adapted from an American study by Binkley *et al.* [27] The researchers modified the questionnaire to adapt to the Malaysian context and practice. The questionnaire was peer reviewed by seven experts, namely two anaesthesiologists, one surgeon, one nurse manager, and three nurses with Post-Basic Critical Care qualification. The expert panel agreed on the survey items and supported the number, format and validity of the questions posed. Only one question in the demographic profile (the nurses' highest qualification) was rephrased for greater clarity. Experts also agreed that the sampling of the questions was adequate and reflected the nurses' practice of oral care and supported the face validity. Cronbach alpha for eight attitude items was 0.66. Cronbach alpha values are quite sensitive to the number of items in a scale and values lower than 0.7 are common with less than 10 items [28].

The questionnaire consisted of five sections. Section one focused on the protocol in the unit, while section two concerned the knowledge of VAP's mode of transmission. Findings from section two will be reported in another paper. Section three was related to the nurses' practice on oral care. In this section, nurses were asked about the frequency of oral care and the equipment used, such as cotton and forceps, gauze and forceps, gauze and spatula and moisture agents. Nurses were also asked whether they used manual toothbrushes for patients while the use of a

paediatric toothbrush was not specifically mentioned. Additionally, nurses were asked to identify the type of mouthwash used for oral care. Section three also included questions on the support provided by the hospital; *i.e.*, nurses were asked to respond to questions regarding hospital supplies, equipment and time, using a five point Likert scale of strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, and strongly agree. Section four consisted of eight items related to nurses' attitude on providing oral care. Questions regarding attitudes were also answered using the five-point Likert scale. In the last section, participants were asked to provide demographical data such as age, level of qualification, type of ICU where they work presently, and length of service.

The questionnaire was pretested on November 14, 2005 in a group of 38 nurses working in an ICU in one of the Ministry of Health hospitals in Kuala Lumpur. The reliability test was not conducted because the main purpose of the trial was to assess the clarity of the questions. Ten nurses completed the questionnaires. There were no further alterations made after the trial.

#### *Ethical considerations*

Ethical approval for this survey was granted by the University of Putra Malaysia Medical Ethics Committee. Participation in this survey was voluntary and anonymous. No written consent was taken because participants were considered to have consented if they completed the questionnaire.

#### *Procedures*

Data collection was conducted from 1 December 2005 until 22 December 2005. A researcher distributed a pack of envelopes that each contained the questionnaire, an information sheet, and a self-addressed envelope for participants to return the answered questionnaires.

All the nurses and nurse managers in the units were invited to participate in the survey. Nurses, besides the participant's information sheet they were given together with the questionnaire, were also verbally informed about the research by the researcher or the ward manager.

#### *Data analysis*

Collected data were processed using the Statistical Package of Social Sciences (SPSS) 13.0.1 standard version (IBM, Chicago, USA). Response

rates and sample characteristics were analyzed using descriptive statistics. In descriptive data analysis, proportions (percentages) were reported.

## **Results**

### *Response rate*

Among a total of 181 nurses working in the four ICUs during the survey period, only 124 nurses completed the questionnaire resulting in a response rate of 68.5%. The nurses' characteristics are shown in Table 1. In total, 46% of the nurses from the medical surgical, neurology and urology ICUs reported that their units had an oral care protocol. Post-infarction care nurses responded that there was no oral care protocol available. Other nurses stated that an oral care protocol was not available or they were not sure if any oral care protocol existed in the unit. More than 56% of the nurses reported that they have learned about oral care practice either in their basic nursing training or in continuous education programs.

### *Oral care practices*

Nurses responded that they used more than one method for practicing oral care (Table 2). However, the methods for oral care and the frequency of use varied between nurses in the same unit. Cotton with forceps was the primary material used by the majority (73.4%) of nurses. Some nurses practiced oral care using forceps and gauze or spatulas and gauze, at 65% and 36%, respectively. Approximately 50.8% of the nurses reported that they practiced oral care using toothbrushes at least once a day (Table 3). However, 86 (69%) nurses reported that the hospital did not supply the toothbrushes for the patients, while 38 (31%) agreed that the hospital had provided toothbrushes for the patients. Out of 124 nurses, only one indicated that she used chlorhexidine mouthwash, while 72% used glycerine thymol gargle, and 13% mixed glycerine thymol gargle and chlorhexidine.

### *Nurses' attitudes toward oral care*

Most nurses reported having a positive attitude toward providing oral care for the ventilated patients, with 85% agreeing that oral care is a high-priority procedure for such patients. However, approximately 16% of the nurses responded that the oral cavity is a difficult body area to clean and that this procedure is an unpleasant task (Table 4).

**Table 1.** Nurses' characteristics

Characteristics	n	%
<b>Working experience as a nurse (n = 124)</b>		
Less than one year	6	4.8
1-3 years	26	21.0
4 -6 years	35	28.1
7-9 years	20	16.1
>10 years	37	30.0
<b>Working in ICU (n = 124)</b>		
Less than one year	10	8.1
1-3 years	41	33.1
4-6 years	32	25.8
7-9 years	22	17.7
>10 years	19	15.3
<b>Position (n = 124)</b>		
Registered Nurse	121	97.6
Ward Manager	3	2.4
<b>First nursing qualification (n = 124)</b>		
Certificate program	22	17.7
Diploma program	101	81.5
Degree program	1	0.8
<b>Highest nursing qualification (n = 124)</b>		
Bachelor degree	1	0.8
Post basic critical care	62	50.0
Diploma in nursing	56	45.2
Certificate in nursing	5	4.0
<b>Shift (n = 121)</b>		
Office hours	6	5.0
Shift	113	93.4
Office hours & shift	2	1.6
<b>Discipline (n = 124)</b>		
Medical surgical	66	53.2
Neurology	17	13.7
Urology	21	17.0
Post-infarction care	20	16.1

**Table 2.** Oral care practices

Method (number of nurses)	Yes n (%)	No n (%)
Forceps and Cotton [n = 100]	91 (73.4)*	9 (7.2)
Forceps and Gauze [n = 95]	80 (64.5)*	15 (12.1)
Spatulas and Gauze [n = 93]	45 (36.3)	48 (38.7)
Cotton and Orange Sticks [n = 91]	31 (25.0)	60 (48.4)
Toothbrushes [n = 91]	63 (50.8)	28 (22.6)

\*Common methods of oral care practice based on nursing college protocols

**Table 3.** Frequency of using a toothbrush for oral care

	<b>More than Once a Day</b> n (%)	<b>Once a Day</b> n (%)	<b>Never</b> n (%)
Toothbrush [n = 91]	55 (44.3)	8 (6.5)	28 (22.6)

## Discussion

This survey described the type and frequency of oral care provided to ventilated patients in the ICUs in a government hospital in Malaysia. The results indicated that the frequency and method of oral care differed among nurses. Although this survey was only performed in four ICUs at one hospital, it has provided important insight into nurses' oral care practice and their attitude toward prevention of VAP in ventilated patients, and identified areas for future improvement.

The results show that most of the nurses prefer to use cotton and forceps rather than toothbrushes for cleaning patients' mouths. Approximately 73.4% of the 124 nurses used cotton and forceps for oral care

practice. Nurses may be hesitant to provide oral care or use toothbrushes for patients who are intubated because endotracheal tubes may limit access to the oral cavity [12]. Nurses may also fear dislodging or displacing the endotracheal tube [29]. Another reason for not using toothbrushes could be the nurses' lack of knowledge of up-to-date research findings; therefore, nurses were not applying the latest oral care practices [19] and providing a variety of oral care interventions designed for patients' comfort rather than plaque removal [30].

The frequency and method of oral care varied among the nurses. The various practices among nurses indicate that there is a need of having a standardized oral care protocol using toothbrushes in the units. A study found that approximately 93% of nurses practice oral care more than four times per shift after the implementation of a new oral care protocol [14,31]. Cutler and Davis [23] also found that there was an increase in the frequency and comprehensiveness of the oral care that was provided after the implementation of a standardized protocol and the provision of the recommended oral care tools.

The presence of protocols in the unit could affect

**Table 4.** Nurses' attitude towards oral care practices

<b>Question</b>	Strongly Disagree	Somewhat Disagree	Not Agree/ Disagree	Somewhat Agree	Strongly Agree
	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>
I have adequate time to provide oral care at least once a day [n = 124]	43 (34.7)	5 (4.0)	2 (1.6)	21 (16.9)	53 (42.7)
I have been given adequate training in providing oral care [n = 124]	4 (3.2)	20 (16.1)	11 (8.9)	30 (24.2)	59 (47.6)
Oral care is a very high priority for mechanically ventilated patients [n = 124]	3 (2.4)	Nil	1 (0.8)	15 (12.1)	105 (84.7)
Cleaning the oral cavity is an unpleasant task [n = 124]	39 (31.5)	9 (7.3)	32 (25.8)	25 (20.2)	19 (15.3)
The oral cavity is difficult to clean [n = 123]	33 (26.6)	20 (16.1)	9 (7.3)	41 (33.1)	20 (16.1)
The mouth of most of the ventilated patients gets worse no matter what I do [n = 123]	12 (9.7)	13 (10.5)	22 (17.7)	37 (29.8)	39 (31.5)
I need better supplies and equipment [n = 123]	6 (4.8)	6 (4.8)	6 (4.8)	27 (21.8)	78 (62.9)
I would prefer using a common oral toilet method to a toothbrush for cleaning patients' teeth [n = 124]	27 (21.8)	20 (16.1)	15 (12.1)	28 (22.6)	34 (27.4)

the oral care provided, as well as the attitude and knowledge of nurses. Only one nurse out of 124 indicated that she used chlorhexidine for oral care. No information was collected about the chlorhexidine supply in the unit; however, the lack of usage of chlorhexidine may indicate lack of awareness about current best practice recommendations [9,32].

This survey shows that nurses have a positive attitude towards providing oral care practice to mechanically ventilated patients. This finding is similar to the previous study performed by Binkley *et al.* [27]. Some nurses did not use toothbrushes in their practice; however, they still followed the oral care protocol learned during their basic nursing training, which shows that they have positive attitude in providing oral care. Other than following the oral care protocol, nurses also practiced oral care as a routine procedure. A study found that without a protocol for oral hygiene, oral care was performed infrequently [23]. They also found that 40% to 46% of the nurses in the study reported that oral care is an unpleasant and difficult task, and the mouth of the patient who needs prolonged ventilation deteriorates even if oral care is provided. In this survey 84.7% of the nurses regarded oral care as very important for the mechanically ventilated patients and had the training and time to provide it. These results are similar to those of a study by Binkley *et al.* [33]. Having sufficient time to provide oral care, as well as seeing it as priority and not unpleasant, is associated with providing better oral care for patients [34]. A survey on oral care interventions in the ICUs also found that oral care was accorded low priority while of greater importance was to stabilise the condition of the critically ill patients [32].

There was also an interest in determining the effect of hospital-provided supplies on the provision of oral care. Inappropriate toothbrushes hindered nurses from providing oral care [16]. Approximately more than half agreed that the hospital did not supply toothbrushes. Availability of supplies and equipment for patient care can greatly affect the quality of care given by the nurses [13,16]. Availability of an oral care protocol with a child-size toothbrush is important so that it becomes part of the routine patient care in the unit. Child-size toothbrushes should be included in the existing oral care procedure since oral care and implementation of the ventilator care bundle interventions have been shown to decrease the rate of VAP [10].

### Limitations

A number of limitations within this survey are acknowledged. First, this survey records reported practices and attitudes, rather than evaluating the oral health and disease of the ICU patients by directly observing nurses' practices. Hence there might be a gap between the reported and actual practice and how the nurses answered the questionnaire [19,27]. Second, our results cannot be generalized to all hospitals in Malaysia since our survey was conducted at four ICUs in a single government hospital using a purposive sampling method. Third, the use of validated measures may improve the survey's findings. Finally, the type of toothbrush used by the nurses was not identified, which might influence the frequency and technique of the oral care provided since having improper equipment may discourage nurses from practising recommended oral care procedures.

### Conclusion

Oral care is a routine procedure in our hospital; however, the frequency and type of oral care practice varied among nurses in the units. The existence of various oral care practices indicates that there is a need of a standardized oral care protocol that includes tooth brushing and use of chlorhexidine mouthwash. Furthermore, having chlorhexidine mouthwash and proper toothbrushes available in the unit's stock may assist in implementing evidence-based practice and help to improve patients' outcome. This survey has offered important insight into nurses' oral care practice and their attitude toward prevention of VAP in ventilated patients and has identified areas for future improvement in our hospital.

### Acknowledgement

We wish to thank the General Director of Health, Malaysia, for the permission to publish this paper and the ICU nurses for their support in this study.

### References

1. Stonecypher K (2010) Ventilator-associated pneumonia: The importance of oral care in intubated adults. *Crit Care Nurs Q* 33: 339-347.
2. Graves N (2010) Economics and preventing hospital-acquired infection. *Emerg Infect Dis* 10: 561-566.
3. Graves N, Weinholt D, Tong E, Birrell FA, Doidge SR, Ramritu P, Halton KA, Lairson D, and Whitby M (2010) The effect of healthcare-acquired infection on length of hospital stay and cost. *Infect Control Hosp Epidemiol* 28: 280-292.
4. Katherason SG, Naing L, Jaalam K, Imran Musa K, Nik Mohamad NA, Aiyar S, Bhojani K, Harussani N, Abdul

- Rahman A, and Ismail A (2009) Ventilator-associated nosocomial pneumonia in intensive care units in Malaysia. *J Infect Dev Ctries* 3: 704-710.
5. Institute for Healthcare Improvement.(2004) Implement the ventilator bundle. 2004 [cited 13 December 2011]; Available from: <http://www.ihl.org/IHI/Topics/CriticalCare/IntensiveCare/Changes/ImplementtheVentilatorBundle.htm>.
  6. Clinical Excellence Commission.(2006) Preventing ventilator associated complications. 2006 [cited 13 December 2011]; Available from: <http://www.cec.health.nsw.gov.au/toolkits/SSSL.html>.
  7. Institute for Healthcare Improvement.(2004) Ventilator bundle checklist. 2004 [cited 13 December 2011]; Available from: <http://www.ihl.org/IHI/Topics/CriticalCare/IntensiveCare/Tools/VentilatorBundleChecklist.htm>.
  8. Paju S and Scannapieco FA (2007) Oral biofilms, periodontitis, and pulmonary infections. *Oral Dis* 13: 508-512.
  9. Wip C and Napolitano L (2009) Bundles to prevent ventilator-associated pneumonia: how valuable are they? *Curr Opin Infect Dis* 22: 159-166.
  10. Institute for Healthcare Improvement.(2004) Improvement report: Reducing Ventilator-Associated Pneumonia. 2004 [cited 13 December 2011]; Available from: <http://www.ihl.org/IHI/Topics/CriticalCare/IntensiveCare/ImprovementStories/ReducingVentilatorAssociatedPneumoniaOwensboro.htm>.
  11. Blamoun J, Alfakir M, Rella ME, Wojcik JM, Solis RA, Khan AM, and DeBari VA (2009) Efficacy of an expanded ventilator bundle for the reduction of ventilator-associated pneumonia in the medical intensive care unit. *Am J Infect Control* 37: 172-175.
  12. Yeung KY and Chui YY (2010) An exploration of factors affecting Hong Kong ICU nurses in providing oral care. *J Clin Nurs* 19: 3063-3072.
  13. Munro CL, Grap MJ, and Kleinpell R (2004) Oral health and care in the intensive care unit: state of the science. *Am J Crit Care* 13: 25-34.
  14. Schleder BJ and Pinzon L (2004) You can make a difference in 5 minutes. *Evidence- Based Nursing* 7: 102-103.
  15. Pearson LS and Hutton JL (2002) A controlled trial to compare the ability of foam swabs and toothbrushes to remove dental plaque. *J Adv Nurs* 39: 480-489.
  16. Kite K (1995) Changing mouth care practice in intensive care: Implications of the clinical care setting context. *Intensive Crit Care Nurs* 11: 203-209.
  17. McCaughan D, Thompson C, Cullum N, Sheldon TAT, and Thompson DR (2002) Acute care nurses perceptions of barrier to using research information in clinical decision-making. *J Adv Nurs* 39: 46-64.
  18. Berry AM, Davidson PM, Masters J, and Rolls K (2007) Systematic literature review of oral hygiene practices for intensive care patients receiving mechanical ventilation. *Am J Crit Care* 16: 552-562.
  19. Jones H, Newton JT, and Bower EJ (2004) A survey of the oral care practices of intensive care nurses. *Intensive Crit Care Nurs* 20: 69-76.
  20. McNeill HE (2000) Biting back at poor oral hygiene. *Intensive Crit Care Nurs* 16: 367-372.
  21. Abidia RF (2007) Oral care in the intensive care unit: A review. *The Journal of Contemporary Dental Practice* 8: 76-82.
  22. Berry AM and Davidson PM (2006) Beyond comfort: Oral hygiene as a critical nursing activity in the intensive care unit. *Intensive Crit Care Nurs* 22: 318-328.
  23. Cutler CJ and Davis N (2005) Improving oral care in patients receiving mechanical ventilation. *Am J Crit Care* 14: 389-394.
  24. Munro C, Grap M, Elswick Jr R, McKinney J, Sessler C, and Hummel III R (2006) Oral health status and development of ventilator-associated pneumonia: A descriptive study. *Am J Crit Care* 15: 453-460.
  25. Fourrier F, Duvivier B, Boutigny H, Roussel-Delvallez M, and Chopin C (1998) Colonization of dental plaque: A source of nosocomial infections in intensive care unit patients. *Crit Care Med* 26: 301-308.
  26. Snedecor GW and Cochran WG (1989) *Statistical methods*, 8th edition. Danvers: Iowa State University Press.
  27. Binkley CJ, Furr LA, Carrico R, and McCurren C (2004) Survey of oral care practices in US intensive care units. *Am J Infect Control* 32: 161-169.
  28. Pallant J (2005) *SPSS survival manual*, 2nd edition. Sydney: Open University Press.
  29. Treloar D and Stechmiller J (1995) Use of a clinical assessment tool for orally intubated patients. *Am J Crit Care* 4: 355-360.
  30. Adam R (1996) Qualified nurses lack adequate knowledge related to oral health, resulting in inadequate oral care of patients on medical wards. *J Adv Nurs* 24: 552-560.
  31. Schleder B, Stott K, and Lloyd RC (2002) The effect of a comprehensive oral care protocol on patients at risk for ventilators-associated pneumonia. *Journal of Avocate Health Care* 4: 27-30.
  32. Grap MJ (2009) Not-so-trivial pursuit: Mechanical ventilation risk reduction. *Am J Crit Care* 18: 299-309.
  33. El-Solh AA, Pietrantonio C, Bhat A, Okada M, Zambon J, Aquilina A, and Berbary E (2004) Colonization of dental plaque. *Chest* 126: 1575-1582.
  34. Furr A, Binkley CJ, McCurren C, and Carrico R (2004) Factors affecting quality of oral care in intensive care units. *J Adv Nurs* 48: 454-462.

### Corresponding author

Kim Lam Soh  
 MHSc, RN  
 Department of Medicine  
 Faculty of Medicine and Health Sciences  
 University Putra Malaysia  
 43400, Serdang, Selangor  
 Malaysia  
 Telephone: +60 3 89472439  
 Fax: +60 3 89472585  
 Email: kim@medic.upm.edu.my

**Conflict of interests:** No conflict of interests is declared.