



Consensus-based Clinical Guideline
for the Provision of Oral Care for the
Critically Ill Adult

NSWHealth Statewide Guidelines for Intensive Care



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Disclaimer	<p>This clinical practice guideline (CPG) is aimed at providing the clinicians of NSW intensive care units (ICU) with recommendations to frame the development of policies and procedures related to 'Provision of Oral Care for the Critically Ill Adult'.</p> <p>This CPG is a distillation of several processes: an integrative review of the literature (available up to December 2006); an evaluation of how this literature applies to the NSW intensive care context; the extensive clinical knowledge of the guideline development network members (GDN); and a guideline development process based on research evidence and consensus development process.</p> <p>The CPG is not intended to replace the critical evaluation processes that underpin the development of local policy and procedure nor a clinician's judgment in an individual case.</p> <p>Users of this CPG must critically evaluate this CPG as it relates to local circumstances and any changes in the literature that may have occurred since the dates of the literature review. In addition NSWHealth clinicians must review NSW government policy documents to identify any directives that may relate to this clinical practice.</p> <p>These guidelines will be updated every 3 years.</p> <p>These guidelines are intended for use in adults only.</p> <p>NSW Health holds copyright of this CPG. No permission is given to redistribute, publish or commercialise this material in any way. The user agrees that in the event that part of the material in this CPG is reproduced or quoted, either in whole or in part, that the copyright owners name and interest in the matter will be acknowledged.</p> <p>Permission MUST be granted to publish this CPG as a stand-alone document on a website other than those of NSWHealth. This permission may be obtained by contacting NSW Intensive Care Coordination and Monitoring Unit (ICCMU).</p> <p>Phone: 61 2 4734 1585 - FAX : 61 2 4734 1586 – Email: iccmu@wahs.nsw.gov.au</p>	

Index

Glossary	4
Executive Summary	5
Clinical Practice Guideline	7
1 Introduction	7
2 Scope	7
3 Purpose	7
4 Target Clinicians	7
5 How the guideline was developed	7
6 How to use guideline	7
7 Level of Evidence taxonomy and how consensus opinion was developed	8
8 Infection Control	8
9 Occupational Health and Safety	9
10 Academic Facilitators	9
Methods of Guideline Development	11
External Validation Process	13
Recommendations for Practice	15
Appendix 1 – Data Extraction Tools	24
References	28

Tables

Table 1: Grading of Recommendations	5
Table 2: Recommendations for Practice	6
Table 3: NHMRC Grading of Recommendations	8
Table 4: Literature Identified	12
Table 5: Oral Care External Validation Panel Members	14
Table 6: Results of External Validation Process	14
Table 7: Summary Table of Prospective Controlled Trials	18
Table 8: Summary Table of Observational Studies	20
Table 9: Summary Table of Descriptive Studies	23

Glossary

CFU	Colony forming units
CHX	Chlorhexidine
COL	Colistin
CPI	Clinical Practice Improvement
CPIS	Clinical Pulmonary Infection Score
CV	Cardiovascular
ETT	Endotracheal Tube
GDN	Guideline Development Network
GOR	Grade of Recommendation
HAP	Hospital acquired pneumonia
ICC	Intensive Care Collaborative
ICC-CDC	Intensive Care Collaborative – Consensus Development Conference
ICCMU	NSW Intensive Care Coordination and Monitoring Unit
LOS	Length of Stay
NP	Nosocomial pneumonia
OAS	Oral Assessment Score
OPC	Oropharyngeal colonisation
PBAL	Protected bronchial Alveolar Lavage
PCT	Prospective Control Trial
PRCT	Prospective Randomised Control Trial
VAP	Ventilator Associated Pneumonia
WP	Weaning protocol

Executive Summary

Critically ill patients are cared for in a complex and highly technological environment and nursing staff are constantly faced with competing priorities when delivering this care. Within this context providing basic hygiene for patients may be seen as less important however this notion is now being challenged. Oropharyngeal colonisation has been identified as a factor contributing to ventilator associated pneumonia in the Intensive Care Unit (ICU). In spite of the importance ascribed to oral hygiene, best practice guidelines are not readily available to guide practice. This clinical practice guideline (CPG) for the provision of oral hygiene was developed through the process of a prospectively derived consensus method undertaken under the umbrella of the Intensive Care Coordination and Monitoring Unit (ICCMU) of New South Wales (NSW) Health in Australia. Following a systematic literature review a consensus conference and validation process was undertaken. This process generated 11 recommendations for: tools and solutions; frequency and duration of cleaning; oral assessment tools and oral hygiene protocols. In light of a sparse high-level evidence to inform guidelines, further research is needed inform clinical practice.

Table 1: Grading of Recommendations

Grade of recommendation	Description
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution
Consensus Opinion	Where no evidence could be applied consensus opinion developed by: <ol style="list-style-type: none"> 1. Formulation of recommendation through discussion 2. Assignment of agreement by individual participants (Likert 1-9) 3. Consensus set at median of 7

Table 2: Recommendations for Practice

Recommendations		
Recommendation Number	Recommendation statement	Grade of Recommendation
1	The provision of effective oral care is an important strategy in reducing nosocomial pneumonia.	C
2	The use of a designated oral care protocol can increase compliance and assessment of mouth care.	D
3	Systematic clinical assessment of the oral cavity using standardized methods is important in the planning and evaluation of oral care in the critically ill. Assessment should include the condition of the teeth, gums, tongue, mucous membranes and lips and barriers to mouth care delivery eg oropharyngeal tubes.	D
4	The use of a soft bristled brush can remove debris and subsequent plaque to assist in decreasing microbial colonization.	C
5	Mouth swabs (foam and cotton) should be used where there is a contraindication to brushing (eg bleeding gums in the presence of thrombocytopenia).	Consensus
6	At the present time there is no evidence to support the use of one oral rinse over another in mouth care. The exception is the use of chlorhexidine gluconate 0.12% in the cardiac surgical patient.	A
7	Tap water should not be used for oral hygiene in the critically ill.	C
8	Subglottic suction is recommended to decrease the risk of VAP in the critically ill and should be part of the mouth care regimen.	A
9	At present there is no evidence to support an optimal frequency for oral hygiene however the guideline committee recommend brushing at least twice a day.	Consensus
10	In the absence of strong evidence based on quality trials the recommended duration of brushing should be 3-4 minutes using a brush which allows access to all areas of the mouth.	Consensus
11	At present there is no evidence to support an optimal method of storing oral hygiene tools e.g. tooth brush. However the guideline committee recommend storing these tools in an individual clean container separate from other personal hygiene products.	Consensus

Clinical Practice Guideline

1 Introduction

Oral care is an often undervalued clinical practice in intensive care, yet there is an increasing body of evidence linking the colonisation of dental plaque and the oropharyngeal cavity with ventilator associated pneumonia (De Riso et al. 1996, Houston 2002 and Tablan et al. 2003). Additionally providing regular oral care is an important part of providing comfort for the critically patient. Optimising oral health for the intubated patient is often made difficult due to the presence of endotracheal tubes and orogastric tubes.

2 Scope

The recommendations in this guideline have been developed for the adult intensive care patient and are provided for intensive care clinicians to guide the development of local policy and procedure. This guideline does not address issues, which may relate to patients with specific oropharyngeal pathology such as neoplasm, trauma or invasive oral infections (for example oral candidiasis). Guidance should be sought from an appropriate medical or dental specialist when patients have specific pathology. In addition issues related to patient autonomy such as patient consent and explanation of procedure, although considered important, are beyond the scope of this guideline

3 Purpose

This guideline has been developed to provide intensive care clinicians with recommendations to guide the development of local policy/procedures related to oral care for the critically ill adult.

4 Target Clinicians

This guideline is for the use of all intensive care clinicians. This guideline will also be useful for any clinician who is responsible for the care of any patient with an artificial airway. It is assumed that users of this guideline have knowledge of respiratory anatomy and physiology and the purpose of artificial airways including endotracheal tubes and tracheostomy tubes.

5 How the guideline was developed

This guideline was developed by a panel of senior nursing clinicians and academics who were assembled for the Oral Care Guideline Development Network (GDN) an ICCMU Intensive Care Collaborative project. The GDN was informed by a systematic literature review and process of expert consultation.

6 How to use guideline

This guideline is provided as a tool to inform the development of local practice policies in NSW intensive care units. It should be used in conjunction with other processes normally used to develop practice guidelines that can include: local audit of practice and outcomes; review of relevant literature and reference to other practice guidelines. Whilst a concerted effort was made to include relevant

literature, other studies may have been published since this guideline was written and these should be identified, reviewed and considered for inclusion. Therefore the guideline, should be critically evaluated prior to its implementation and during the ongoing process of review and quality assurance.

7 Level of Evidence taxonomy and how consensus opinion was developed

The NHMRC taxonomy (NHMRC 2005), on the basis of its useability and application to the Australian health care context was chosen by the Academic facilitators panel as the most appropriate framework to grade the levels of evidence and recommendations.. Where evidence was limited or not available the GDN members discussed the issue and developed a recommendation statement using their own clinical experience. Consensus was achieved by using a Likert scale with a median of at least 7 set as agreement.

Table 3: NHMRC Grading of Recommendations

Component	A	B	C	D
	Excellent	Good	Satisfactory	Poor
Volume of evidence	Several level I or II studies with low risk of bias.	One or two level II studies with low risk of bias or a SR/multiple level III studies with low risk of bias.	Level III studies with low risk of bias, or level I or II studies with moderate risk of bias.	Level IV studies, or level I to III studies with high risk of bias.
Consistency	All studies consistent.	Most studies consistent and inconsistency may be explained.	Some inconsistency reflecting genuine uncertainty around clinical question.	Evidence is inconsistent.
Clinical impact	Very large	Substantial	Moderate	Slight or restricted
Generalisability	Population/s studied in body of evidence are the same as the target population for the guideline.	Population/s studied in the body of evidence are similar to the target population for the guideline.	Population/s studied in body of evidence different to target population for guideline but it is clinically sensible to apply this evidence to target population	Population/s studied in body of evidence different to target population and hard to judge whether it is sensible to generalise to target population.
Applicability	Directly applicable to Australian healthcare context.	Applicable to Australian healthcare context with few caveats	Probably applicable to Australian healthcare context with some caveats	Not applicable to Australian healthcare context.

8 Infection Control

Prevention of infection is an important aspect of any clinical practice and guideline users are directed to NSWHealth Policy directive PD2007_036 and local policy to identify the infection control elements of this clinical practice. This includes but is not limited to: hand hygiene, disposal of equipment and medical waste and isolation of infectious patients. Additionally personal protective equipment including goggles, gloves and masks should be worn as there is a risk of exposure to patient fluids when completing this procedure.

9 *Occupational Health and Safety*

Guideline users are directed to local policy and procedures related to occupational health and safety to ensure operator safety whilst completing procedures.

10 *Academic Facilitators*

The Academic facilitators were identified through professional networks and were not paid to participate in the ICC project, however ICCMU paid the costs of travel and accommodation for the ICC-CDC. Apart from Professor Elliott the other academic facilitators did not join the ICC project until June 2006. Five meetings were held, four by teleconference and one the day prior to the ICC-CDC.

Tasks completed during these meetings included:

1. Assignment of academics to a particular GDN
2. Discussion regarding the most appropriate levels of evidence and recommendation taxonomy
3. Format of the consensus conference (ICC-CDC)
4. Process of developing recommendations and reaching consensus
5. Process for writing guidelines and peer reviewed publications

Convenor, Academic Facilitators	Professor Doug Elliott Director of Research, Faculty of Nursing, Midwifery and Health University of Technology Sydney
Oral Care GDN	Professor Patricia Davidson Professor of Cardiovascular and Chronic Care, School of Nursing and Midwifery, Curtin University of Technology. Previously School of Nursing, College of Health and Science University of Western Sydney, Sydney West Area Health Service
Eye Care GDN	Ms Andrea Marshall Sesqui Senior Lecturer in Critical Care Faculty of Nursing and Midwifery The University of Sydney
Suction of a Tracheal Tube GDN	Dr Bridie Kent Director of Clinical Nursing Research School of Nursing - Faculty of Medical and Health Sciences University of Auckland Professor Wendy Chaboyer Director, Research Centre for Practice Innovation Griffith University Queensland
Stabilisation of an Endotracheal Tube GDN	Associate Professor Anne Gardner Professor, School of Nursing, Midwifery and Nutrition, James Cook University Professor Sandy Middleton School of Nursing Australian Catholic University, National - North Sydney Campus

Arterial Line GDN (Nursing Management) Dr Tina Jones
Manager, Australian Centre for Evidence Based Clinical Practice,
Flinders Medical Centre
Senior Lecturer, Faculty of Health Sciences, Flinders University

CVC GDN (Nursing Management) Dr Judy Currey
Senior Lecturer, School of Nursing
Deakin University Melbourne

Methods of Guideline Development

The consensus development process attempts to integrate clinical practice with scientific evidence. The process follows sequential steps of: (1) defining specific questions for the panel based on a disparity between practice and available research evidence; (2) facilitating a discussion following appraisal of the best available evidence within the context of the agreed questions and (3) developing recommendations for clinical practice guidelines (Black et al. 1999).

The oral care guideline development network (Oral GDN) was established in June 2005 at the start-up seminar for the Intensive Care Collaborative (ICC). At this meeting senior nursing clinicians, representing most of NSW intensive care units, attended sessions including the purposes of the project, systematic review methodology, identification of the six practices and self-selection into a guideline development network (GDN). The members of the Oral GDN were experienced critical care nurses and academics and met in August 2005 to augment the previously formulated systematic review that informed the development of the clinical guideline. Using a comprehensive approach, including a wide-ranging search of the literature together with consultation with experts in oral health and critical care, resulting in the following review questions:

1. Overarching review question:

What clinical practices are effective in maintaining oral health in the critically ill?

2. Specific questions were:

1. *What are the potential consequences of inadequate mouth care in the critically ill patient?*
2. *What assessment strategies are effective in providing optimal mouth care?*
3. *What methods are effective in providing optimal mouth care?*
4. *What solutions are effective in providing optimal mouth care?*
5. *What is the optimal frequency for the provision of oral hygiene?*
6. *What is the optimal duration of an intervention eg brushing?*

The literature review upon which these guidelines are based identified a limited number of adequately powered randomised controlled trials, for the provision of oral hygiene in the critical care setting. Due to the heterogeneity of the patient population, solutions and techniques used in the prospective, randomized control trials identified, meta-analysis could not be undertaken. Therefore using the classification system developed by the NHMRC (NHMRC 2005), (Table 4) eleven prospective control trials, twenty observational studies, and twenty-four descriptive papers were reviewed.

Table 4: Literature Identified

NHMRC Designations of Levels of Evidence		
Level	Intervention	Numbers of studies identified
I	A systematic review of level II studies	1
II	A randomised controlled trial	4
III-1	A pseudorandomised controlled trial (i.e. alternate allocation or some other method)	3
III-2	A comparative study with concurrent controls: <ul style="list-style-type: none"> • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group 	1
III-3	A comparative study without concurrent controls: <ul style="list-style-type: none"> • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group 	8
IV	Case series with either post-test or pre-test/post-test outcomes	15
Expert opinion	Literature reviews	11

These articles were distributed to the oral care guideline development collaborative group, together with the summary tables. In December 2006 the ICC Consensus Development Conference (ICC-CDC) was held where an experienced facilitator developed the debate and discussion around the negotiated questions to inform guideline development. Discussion was conducted around the quality and applicability of research findings to critical care nursing practice as well as current practices being undertaken in units. A voting procedure using a Likert scale (1 disagree – 9 agree) with consensus agreement set as a median of equal to or greater than seven. Following the ICC-CDC, twelve recommendations for practice were developed and circulated to GDN members for clarification. The guideline was written by the principal authors and sent to GDN members for comment, with revisions included as appropriate. An external validation process was conducted using a modified Delphi panel.

External Validation Process

In May 2007 external validation of the guideline was conducted using a limited Delphi round. This additional process of validation was considered necessary in light of the paucity of published data, the strong emphasis on interpretation and expert opinion, and the recognised limitations of the consensus method (Halcomb et al. 2007). The purpose of validation of a guideline by an external group of experts is threefold. Firstly, this group reviews the purpose and scope of the guideline to ensure the relevant clinical aspects have been addressed. Secondly, the panel reviews the process to ensure rigour of guideline development. Lastly, the panel reviews the clinical practice recommendations for suitability in terms of both the available scientific evidence and current clinical practice. Furthermore a panel should include experienced clinicians and academics (AGREE 2001; Alderson 2006). The process of consensus development within the EVP was formalised using a single Delphi round and a Likert scale (Rycroft-Malone 2001). A Delphi round was used to promote the involvement of clinicians and academics from across Australia thus ensuring consultation with a broad range of intensive care clinical and academic expertise.

Formation of External Validation Panels

Panel members (n=46) for all guidelines were identified using professional networks and associations and were allocated to a specific guideline using two processes. Firstly there were nine panel members who were approached directly because of their acknowledged expertise with a particular practice (including research or professional role). The other panel members' names were randomly allocated to a specific guideline until names and panel positions were exhausted. Panel members completed a conflict of interest form which included demographic data. Table 3 lists panel members. One nursing academic was a member of two panels.

Method of validation

Panel members received the draft guideline and the literature review (which included the data extraction tools completed by the GDN members) along with a recommendation agreement form. They were then asked to assign their level of agreement (Likert 1-9) with the recommendation statement. A median score of at least 7 was set for consensus to be reached. Table 5 sets out the results of the EVP process for this guideline.

Table 5: Oral Care External Validation Panel Members

EVP Role	Name qualifications and position
Nursing Academic	Dr Gavin Leslie RN, PhD, ICU Cert, BAppSc, Post Grad Dip (Clin Nurs), FRCNA Associate Professor School of Nursing and Midwifery, Curtin University of Technology Western Australia
Clinical Nurse	Tanya Douglas RN Post Grad Cert Clin Nurs (Intensive Care) Staff Development Nurse ICU Royal Perth Hospital Western Australia
Clinical Nurse	Alison Kingsbury RN, BAS, CCC, Post Grad Cert Health Ed (Nursing) CNC ICU, The Canberra Hospital, University of Canberra, Charles Sturt University
Dental Specialist and Clinical Nurse	Benjamin Robinson RN, Grad Dip IC Nurs, Dip Health Sc(UNE), Bachelor of Dentistry
Medical Specialist	Dr Priya Nair MBBS, MD, FJFICM, Grad Dip(Clin Epi), Post Grad Dip(Perioperative Echocardiography) Staff Specialist St Vincents Hospital, Sydney, NSW
Medical Specialist	Dr Martin Rowley MBBS, FJFICM, FRACP Senior Specialist ICU, John Hunter Hospital, Newcastle, NSW

Table 6: Results of External Validation Process

Recommendation Number	25 th	Median	75 th	Range	
				Minimum	Maximum
1	7	7.5	8.75	7	9
2	7	7.5	8	5	8
3	7.25	8	8	6	8
4	8	8	8	7	9
5	6.25	7	7.75	5	9
6	7	7.5	8	7	8
7	3.5	6	7	2	8
8	8	8.5	9	7	9
9	7	7.5	8	3	9
10	7.25	8	8.75	7	9
11	7.25	8	8	7	9
12	7	7	8	7	9

Recommendations for Practice

Recommendation 1

The provision of effective oral care is an important strategy in reducing nosocomial pneumonia.

Grade C

Rationale: Based on Level III studies with strategies to minimize bias it would appear that effective oral care is an important strategy to reduce the risk of nosocomial pneumonia in the critically ill (Houston 2002, Mori et al. 2006). The EVP agreed with this recommendation.

Evidence Level – III

Recommendation 2

The use of a designated oral care protocol can increase compliance and assessment of mouth care.

Grade D

Rationale: Across a range of conditions an organizational commitment to guideline development and implementation has a favourable impact on patient outcomes (Fitch et al. 1999, Schleder et al. 2002). The EVP agreed with this recommendation.

Evidence Level – III-3

Recommendation 3

Systematic clinical assessment of the oral cavity using standardized methods is important in the planning and evaluation of oral care in the critically ill. Assessment should include the condition of the teeth, gums, tongue, mucous membranes and lips, and barriers to mouth care delivery eg oropharyngeal tubes.

Grade D

Rationale: A small number of studies with limited sample sizes infer that systematic assessment is an important factor in assessment of the critically ill (Fitch et al. 1999, Treloar and Stechmiller 1995b). However a standardized assessment tool that had been evaluated for reliability and validity in the critically ill could not be identified. The EVP agreed with this recommendation.

Evidence Level – III-3

Recommendation 4

The use of a soft bristled brush can remove debris and subsequent plaque to assist in decreasing microbial colonization.

Grade C

Rationale: Based upon a small number of studies (Fitch et al. 1999, Schleder et al. 2002, Taylor-Piliae R. et al. 2004, Harris 2004) the use of a soft-bristled brush can assist in reducing microbial colonization but larger studies are recommended. The EVP agreed with this recommendation.

Evidence Level – III-1

Recommendation 5

Mouth swabs (foam and cotton) should be used where there is a contraindication to brushing (eg bleeding gums in the context of thrombocytopenia).

Grade Consensus

Rationale: Based upon consensus the use of brushing is recommended in comparison to other methods, however in the ICU population brushing may predispose or exacerbate bleeding in a select group of patients (Ransier et al. 1995). The EVP agreed with this recommendation.

Recommendation 6

At the present time there is no evidence to support the use of one oral rinse over another in mouth care. The exception is the use of chlorhexidine gluconate 0.12% in the cardiac surgical patient.

Grade A

Rationale: In spite of a meta-analysis, the small number of trials and effect sizes make it difficult to totally discount the benefit of chlorhexidine gluconate 0.12% for the broader ICU population, as it has been demonstrated in smaller, non-randomised studies to be an effective agent (Houston 2002, De Riso et al. 1996, Genuit et al. 2001). The EVP agreed with this recommendation.

Evidence Level – II

Recommendation 7

Tap water should not be used for oral hygiene in the critically ill.

Grade C

Rationale: Due to colonization of microbial organisms in hospital pipes and taps, hospital tap water should not be routinely used for oral care in critically ill patients (Trautmann et al. 2001, Anaissie et al. 2002). The EVP did not achieve a median of greater than seven for this recommendation.

Evidence Level – III-2

Recommendation 8

Subglottic suction is recommended to decrease the risk of VAP in the critically ill and should be part of the mouth care regimen.

Grade A

Rationale: Subglottic suctioning is an important strategy in decreasing the risk of VAP (Tablan et al. 2003). The EVP agreed with this recommendation.

Evidence Level – I

Recommendation 9

At present there is no evidence to support an optimal frequency for oral hygiene however the guideline committee recommend brushing at least twice a day (American Dental Association 2005).

Grade Consensus

Rationale: Brushing is the best method for plaque removal from the tooth surfaces (American Dental Association 2005). The EVP agreed with this recommendation.

Recommendation 10

In the absence of strong evidence based on quality trials the recommended duration of an intervention eg brushing should be 3-4 minutes using a brush which allows access to all areas of the mouth.

Grade Consensus

Rationale: To ensure teeth are cleaned effectively it is important to undertake a thorough cleaning routine (Peterson 2006). The EVP agreed with this recommendation.

Recommendation 11

At present there is no evidence to support an optimal method of storing oral hygiene tools e.g. tooth brush. However the guideline committee recommend storing these tools in an individual clean container separate from other personal hygiene products.

Grade Consensus

Rationale: To ensure oral cleaning tools are kept clean and free from possible contamination from other items used for personal hygiene. The EVP agreed with this recommendation.

Table 7: Summary Table of Prospective Controlled Trials

Author/year	Method	Results	Recommendations	Quality
(Mori et al. 2006)	Nonrandomized trial with historical controls 1666 ICU Pre-intervention group received no oral care. Intervention consisted of toothbrush, OAS, povidone-iodine swab, 300 ml weakly acidic water for rinsing.	Incidence of VAP was significantly lower in treatment group. No significant difference in ventilation hours or ICU length of stay.	Large scale multi-centre trial on the efficacy of oral care for VAP prevention.	Significant risk of bias given that the control group received no oral hygiene.
Level of evidence: III-3				
(Koeman et al. 2006)	PRCT 385 Sample General ICUs CHX, CHX/COL, placebo.	Reduction in daily risk of VAP in both treatment groups but no difference in ventilation hours, ICU LOS or ICU survival.		Significant risk of bias given that the control group received no reported oral hygiene but application of vaseline paste.
Level of evidence: II				
(Fourrier et al. 2005)	PRCT Sample Size: 228 ICU patients 2 treatment groups: CHX 0.2% gel vs. placebo gel applied 3 times a day.	Day 10 positive dental plaque cultures were lower in the treated group. Ability to reduce incidence of respiratory infections due to multiresistant bacteria was not significant.	Further study to determine if combined dental plaque, oropharyngeal and salivary decontamination will decrease VAP in ICU.	Significant risk of bias: <ul style="list-style-type: none"> Control group received no oral hygiene Toothbrush not allowed. Inclusion criteria included mechanical ventilation but patients remained in the study following extubation and were able to eat & drink. No allowance was made for the stimulation of saliva and its effects, during mastication.
Level of evidence: II				
(Grap et al. 2004)	PCT Sample 34 2 treatment groups: CHX 0.12% by spray or swab.	Reduction in oral culture and CPIS scores in treatment group compared to control group	Use of CHX early post intubation or prior to intubation may reduce incidence of VAP	Risk of bias because control received unreported type of usual care.
Level of evidence: III-1				
(Taylor-Piliae R. et al. 2004)	PCT Sample Size 19 Treatment group: toothbrush & toothpaste. Control: metal forceps with cotton wool soaked in Thymol.	1 control & 3 study group subjects developed VAP. There was a 25% increase in OPC in control vs. 10% in study group.	No recommendations. Limitation of study size acknowledged.	Small sample size reduced proposed causal effect.
Level of evidence: III-1				
(Houston 2002)	PRCT Sample: 561 Cardiac surgery patients CHX 0.12% rinse compared with Listerine rinse. No mention of tooth brushing. Further study required before results can be adopted in broader ICU population.	VAP reduced by 52% in CHX group overall & 71% lower in the CHX group intubated >24 hrs.	CHX is worth considering for pts undergoing cardiovascular surgery. Extremely cost effective compared with a single case of VAP.	
Level of evidence: II				

Author/year	Method	Results	Recommendations	Quality
(Yates 2002)	PCT Sample Size 22 Test group: nurses received comprehensive oral care training and used toothbrushes, salt, soda, floss and Sage Product (not described) Control group: followed unit routine and used Sage Product (neither routine nor product described).	No statistical difference between the groups in CPIS, oral assessment scores, mucosal plaque scores or inoculums of plaque	Oral care, including oral assessment, is a risk reduction technique to prevent further infection in the hospitalized patient.	Small sample size reduced proposed causal effect. Limited description of method
Level of evidence: III-3				
(Fourrier et al. 2000)	PCT Sample Size 60 CHX gel 0.2% dental plaque decontamination three times daily, compared to bicarbonate solution rinse 4 times a day, followed by oropharyngeal suction	Reduced plaque colonization in the treatment group on day 5-7. Nosocomial infection rate significantly reduced in the treatment group with a trend to a reduction of mortality, LOS & duration of mechanical ventilation.	A double-blind placebo-controlled study required to confirm these results.	No mention was made of the use of toothbrush. Extubated patients could eat/drink and yet no allowance was made for the stimulation of saliva and its effects, during mastication.
Level of evidence: III-1				
(De Riso et al. 1996)	PRCT Sample Size: 353 Cardiac Surgery Patients Compared effectiveness of CHX 0.12% mouth rinse with alcohol based placebo in reducing the incidence of VAP.	The incidence of VAP was 4.6% in the CHX vs. 13% in control. There was also a 5.5% reduction in mortality in the CHX vs. 1% in control.	CHX is an inexpensive and effective agent in reducing VAP in patients undergoing heart surgery.	
Level of evidence: II sample size				
(Holberton et al. 1996)	PCT 47 ICU Compared tap water, normal saline & 1:1 solution of saline & hydrogen peroxide.	Statistical analysis was not reported. Tap water tolerated best by pts followed by saline. Peroxide & saline solution was not tolerated.	Larger study required.	Sample size Questionable use of hospital tap water as an oral rinse given the potential for contamination.
Level of evidence: III-3				
(Liwu 1990)	PCT 40 ICU Compared Ultra fresh solution / swab stick with saline/swab stick.	No difference between worst scores between both groups. Swab sticks were found to be ineffective in removing oral debris.	Further research needed to determine impact of ETTs on oral mucosa and to evaluate efficacy of mouth care agents.	Given the small sample, risk that relationship is not causal.
Level of evidence: III-3				
(Nelsey 1986)	Prospective Trial 4 ICU patients 5 regimes studied: 1)Toothbrush & paste, 2)Difflam solution, 3)Sodium Bicarbonate solution, 4)Corsodyl (chlorhexidine) solution, 5) Tap water. Regimes 2-5 used gauze wrapped forceps to clean teeth.	Very limited study did not demonstrate any difference between treatment options.	No generalizations possible from this study, further research required.	Sample size questionable use of hospital tap water as an oral rinse given the potential for contamination.
Level of evidence: III-3				

Table 8: Summary Table of Observational Studies

Author/year	Method	Results	Conclusions
(Cutler and Davis 2005)	Observational Study Sample: 253	Oral hygiene practices were observed to have improved following educational sessions based on a standardized protocol	The introduction of a standardized protocol together with availability of appropriate devices improves oral hygiene practices.
Level of evidence: III-2	Random blocks of oral hygiene observations following implementation of an oral cleaning protocol using hydrogen peroxide		
(Hanneman and Gusick 2005)	Cross-sectional replication study Sample 198	Reported use of sodium chloride, peroxide, chlorhexidine & toothette swabs higher in intubated patients. Less use of toothbrush & toothpaste in intubated patients.	Reliability of survey tool not established. Research to determine optimal oral care strategies and their effects is needed.
Level of evidence: IV	Survey & observational process involving intubated & nonintubated patients		
(Binkley et al. 2004)	Questionnaire (Same study as Furr) Sample 556	Foam swabs were the main tool for oral care while 80% reported infrequent use of toothbrushes and toothpaste.	The adoption of oral care research into practice may reduce the incidence of VAP
Level of evidence: IV	To determine type & frequency of oral care in ICUs and the attitudes, beliefs & knowledge of health care workers.		
(Furr et al. 2004)	Questionnaire (Same study as Binkley) Sample 556	Oral care can be improved by providing education, adequate time and by reducing the perception that oral care is unpleasant. Education would also assist in prioritization of oral care.	Multifaceted interventions (not specified) are required to improve oral care and reduce the incidence of VAP
Level of evidence: IV	To determine nurses' attitudes & practices regarding oral care in ICU		
(El-Solh et al. 2004)	Prospective prevalence study Sample 49	Dental plaque colonization evident in 57% Nine respiratory pathogens from PBAL matched genetically corresponding dental plaque of 8 patients.	Future studies to determine if daily oral hygiene in this group would reduce the risk of HAP.
Level of evidence: IV	Plaque indices & quantitative cultures were assessed on admission to ICU. PBAL on 14 patients who developed HAP.		
(Harris 2004)	Quality improvement process to address VAP by improving oral care practices Sample 22	Reduction in VAP rates	Implementation of an oral care protocol can reduce incidence of VAP and improve patient comfort.
Level of evidence: IV	Oral care protocol included oropharyngeal suction, suction toothbrush/antiseptic oral rinse and suction swab		
(Jones et al. 2004)	Questionnaire Sample 103	Results reported that based on available literature, most methods for the provision of oral care were correct	Need for further oral care training. Research required in the use of saliva replacement products.
Level of evidence: IV	To determine oral care priority in ICU		
(Trau 2004)	Team quality improvement approach to reducing VAP included the development of an oral care protocol Oral assessment on admission followed by 2/24 hourly mouth care. Suction toothbrush with hydrogen peroxide twice daily, suction swabs & moisturizer 2/24. Suction oropharyngeal area 6/24 or prior to position changes & extubation.	Incidence of VAP reduced by 33%	Team process plan is crucial to change practice and sustain long-term improvements.
Level of evidence: IV			

Author/year	Method	Results	Conclusions
(Grap et al. 2003)	Questionnaire	Nurses' awareness of value of oral care not congruent with practice reported	Further research to develop optimal oral care interventions.
Level of evidence: IV	Sample 77 5 regimes reported		
(Houston et al. 2003)	5 year CPI process based on a previous study	NP decreased from 7.0 to 3.6 cases per 1000 patient days.	Replication of the NP reduction process in other centres.
Level of evidence: IV	Multifaceted approach including the use of CHX rinse, to reducing NP in CV surgery patients		
(Schleder et al. 2002)	Retrospective study to evaluate the impact of an oral care protocol on incidence of VAP	VAP rates dropped from 5.6 VAPs per 1,000 to 2.2 per 1,000 following adoption of the oral care protocol.	Challenge current thinking on oral care for mechanically ventilated patients and stimulate further research in this important area.
Level of evidence: IV	Tools used were a suction toothbrush and oral swab, hydrogen peroxide rinse, Vitamin E water-based moisturizer and sub glottal suction catheter.		
(Munro 2004)	Longitudinal, descriptive study	Subjects who had VAP had lower oral immunity scores than those who did not develop VAP.	This study supports a link between oral health status and the development of VAP.
Level of evidence: IV	Sample 66 Risk of VAP using CPIS. Biological measurement of local oral immunity, oral microbial culture and oral health assessment were done on Days 1, 4 & 7.	Dental plaque increased & growth of organisms increased in both groups.	
(Genuit et al. 2001)	Cohort Study	The WP resulted in slight decrease in VAP but 40% reduction in the median duration of mechanical ventilation. The addition of CHX resulted in 37% reduction in VAP but similar reduction in length of ventilation.	Topical CHX together with a WP is effective in reducing the incidence of VAP and length of ventilation hours.
Level of evidence: III-3	Sample 95 Compared the use of a weaning protocol (WP) (1 st 5 months) with the addition of CHX 0.12% oral rinse twice daily (2 nd 5 months)		
(Franklin et al. 2000)	Cohort Study	Statistically significant increase in plaque scores.	Evidence based protocols need to be developed for critically ill children.
Level of evidence: IV	54 Paediatric ICU Oral assessment including plaque accumulation on admission & repeated on discharge		
(Fitch et al. 1999)	Nonequivalent comparison, longitudinal study	Significantly lower mean inflammation scores in the experimental group compared to the control group. Lower, although not significant, scores of candidiasis, bleeding & plaque in the experimental group.	A well designed oral hygiene protocol can improve oral health of ICU patients.
Level of evidence: IV	Sample 60 Assessment of an oral care protocol incorporating a soft, pediatric toothbrush, toothpaste & antibacterial mouthwash. Comparison of oral assessment by nurses and dental hygienists.		
(Fourrier et al. 1998)	Prospective Study	Dental plaque cultures were positive at 10 ³ CFUs for aerobic pathogens at day 0 = 23% day 5 = 39% day 10=46% of ICU admission.	Dental plaque colonization by aerobic pathogens might be a specific source of nosocomial infection in ICU patients.
Level of evidence: IV	Sample: 57 medical surgical ICU patients Quantitative cultures of dental plaque, nasal secretions & tracheal aspirates		
(Kite and Pearson 1995)	Interviews	Nurses' concerns were a major factor influencing the reasons for various approaches to mouth care in ICU	Further study in the area of changing nursing practice.
Level of evidence: Expert Opinion	Sample 10 Evaluation of pre and post teaching of oral care in ICU.		
(Block 1995)	Quality assurance investigational study	Use of CHX reduced the VAP rate from 33. to 9.84 per 1,000 ventilator days	CHX rinse is easy to administer and shows promise in the quest to reduce VAP rates.
Level of evidence: III-3	Sample 85 Compared VAP rates before & after use of CHX mouth rinse		

Author/year	Method	Results	Conclusions
(Treloar and Stechmiller 1995a)	Convenience sample of 16 to test oral assessment tool Oropharyngeal assessment, including sputum & mouth cultures, was collected on enrollment & subsequent days.	Oropharyngeal cultures of 4 subjects grew the same organisms as sputum cultures. Seven patients displayed severe xerostomia, 9 subjects displayed lip, mucosal & tongue lesions	Systematic oropharyngeal assessment may prevent serious oropharyngeal infections.
Level of evidence: IV			
(Scannapieco et al. 1992)	Prospective, non-randomized. 34 medical ICU Compared cultures of dental plaque & buccal mucosa of ICU patients with age-matched patients in the initial visit to the preventive dentistry clinic	Plaque &/or oral mucosa of 65% of medical ICU patients were colonized by respiratory pathogens compared to 16% of the control group.	Bacteria causing HAP colonize the dental plaque of ICU patients. Improvements in oral hygiene in ICU patients could reduce oropharyngeal colonization.
Level of evidence: III-3			

Table 9: Summary Table of Descriptive Studies

Study	Theme	Recommendation
(Evans 2001)	Literature review of commonly used tools and solutions used in mouth care. Brief mention of ICU nursing practice which omitted the use of brushing pts' teeth.	Nursing curriculum should include research based mouth care practices.
Level of evidence: Expert Opinion		
(Garcia 2005)	Literature review of oral and dental colonization and its relationship with HAP	Perform oral assessment and care several times a day using a toothbrush
Level of evidence: Expert Opinion		
(Hixson et al. 1998)	Oral care of ICU patients mentioned in prevention of VAP review.	Systematic oral assessment in intubated patients, use of toothbrush and mouth rinses (type not specified) together with further studies to evaluate oral care.
Level of evidence: Expert Opinion		
(Jones 2000)	Comprehensive overview of chlorhexidine and its uses.	Chlorhexidine is a valuable adjunct to the provision of oral hygiene in patients within whom this procedure is compromised.
Level of evidence: Expert Opinion		
(Kollef 1999)	Concepts in the prevention of VAP	Use of chlorhexidine mouth rinse in selective high risk patients. Cautioned against overuse in view of superinfection with chlorhexidine-resistant pathogens.
Level of evidence: Expert Opinion		
(Munro 2004)	Literature review revealed a lack of extensively tested evidence-based oral care protocols for the general critical care population.	While research is needed to determine optimal frequency, procedures and tools for oral care in the critically ill, tooth brushing and chlorhexidine mouth rinse have merit.
Level of evidence: Expert Opinion		
(Munro et al. 2006)	Oral health assessment of 66 medical ICU patients. Reported a relationship between higher dental plaque scores and severity of illness with increased risk for VAP.	Further study of the relationship between oral hygiene and the incidence of VAP.
Level of evidence: Expert Opinion		
(O'Reilly 2003)	Literature review revealed a number of treatment modalities with many exhibiting limited and sometimes conflicting advice.	Frequency of oral care should be individualized. A small, soft bristled toothbrush is recommended to clean the teeth, gums and tongue. Chlorhexidine mouth rinse following cleaning is advised. Moistening the mucosa with water is also recommended.
Level of evidence: Expert Opinion		
(Pineda et al. 2006)	Meta-analysis of oral decontamination with CHX and incidence of VAP.	While the application of CHX failed to demonstrate any clinical benefits in relations to VAP, routine oral care is recommended.
Level of evidence: I	Meta-analysis of 4 studies, 2 of which varied in population and strength of study solution.	
(Scannapieco and Mylotte 1996)	Description of the relationship between periodontal disease and bacterial pneumonia with particular focus on mechanically ventilated ICU patients.	Attention to good oral hygiene may reduce the risk of nosocomial pneumonia
Level of evidence: Expert Opinion		
(Scannapieco 1999)	Role of oral bacteria & respiratory infection.	Improved oral health may decrease the prevalence of oropharyngeal colonization by respiratory pathogens.
Level of evidence: Expert Opinion		

Appendix 1 – Data Extraction Tools

Primary Study	The empty cells are for describing or discussing the concept above. If RCT use validity Checklist at bottom of page - Cells will expand / use small font			Use article in systematic review narrative Yes /No		
Full reference Ethics approval sort/gained Yes/No						
Study Aims/Objectives	Setting	Sample Inclusion/exclusion criteria	Interventions	Outcome Measure/s		
Short reference	Design/Method	Sample Description	Outcomes/findings	Methodological Quality		
Is the literature review adequate? Yes/No	Does the method suit the question/s? Yes/No	Sample size calculated and then achieved? Yes/No	Statistical significance? Yes/No	What are the authors' conclusions?		
Are data collection instruments adequately described? Yes/No	RCT or quasi-experimental? Yes/No (RCT score)	Is the sample homogenous? Yes/No	Clinical significance? Yes/No			
Were data collection instruments validated? Yes/No	Were the statistics used appropriate? Yes/No	Were all patients enrolled accounted for? Yes/No	Is there enough information to judge results? Yes/No	Clinical Bottom Line		
Randomised Control Trial Validity Checklist #				Yes	No	?
Was the assignment to treatment groups really random?			Were the control and treatment groups comparable at entry?			
Were the participants blinded to treatment allocation?			Were groups treated identically other than for the named interventions?			
Was allocation to treatment groups concealed during the allocation process?			Were the outcomes of people who withdrew described and include in the analysis (i.e. was the analysis by intention to treat?)			
Were those assessing outcomes blind to the treatment allocation?			Were outcomes measured in a reliable way?			
			Was an appropriate statistically analysis used?			

Reviews – systematic and narrative

- Use one per article which is a review of the literature.
- Please be brief. Cell size is locked so add text; use a smaller font size to fit your conclusions in.
- Where yes/no are asked for, text can be added to flesh out answer.
- Where a number exists, please refer to the expanded question.
- For the databases searched please add a tick and describe the hand search strategy.

1. Is there an explicit review plan documented?
2. Was an explicit search strategy documented?
3. Was an explicit article review method used?
4. Were points 1-3 covered adequately?
5. Does the summary of each reviewed study reflect the essential components of the study design, research process and analysis techniques?
6. Is the organisation of the reviewed studies chronological and logical?
7. Does the organisation of the reviewed studies lead the reader to the same conclusions as the authors?

d

Full Reference ⇒					
1 - Review Plan - yes/no		3 - Review Method - yes/no		Findings	Synthesis
Clinical Question -		What was the article review method?		Are all the relevant concepts and variables included? yes/no	6 - Organisation chronological/logical? yes/no
→ Population -				5 - Summary yes/no	7- Organisation ⇒ Conclusions? yes/no
→ Intervention/s		Are all articles found accounted for? yes/no		What are the key findings of the Review?	
→ Outcome/s		Type of review?			
2 - Search Strategy		4 Quality of the review –			
Keyword/s (list)		Limits (list)			
Search Time Line				Are the conclusions of the authors warranted? Yes/no & discuss	
Data Bases – adequate? Y/N		Please tick list below <input checked="" type="checkbox"/>			
CINAHL	Pubmed	Embase	Cochrane		
Psych info	DARE	Hand search	Other		

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