

Oral Hygiene Care in the Pediatric Intensive Care Unit: Practice Recommendations

Lisa Johnstone, Deb Spence, Jane Koziol-McLain

Oral hygiene in children is essential for the development of strong, healthy teeth and to minimize the risk of infection (Thomson, Ayers, & Broughton, 2003). In the critical care setting, poor oral hygiene has been associated with increased dental plaque accumulation, bacterial colonization of the oropharynx, and higher nosocomial infection rates, particularly ventilator-associated pneumonia (VAP) (Fourrier, Duvivier, Boutigny, Roussel-Delvallez, & Chopin, 1998; Franklin, Senior, James, & Roberts, 2000; Grap & Munro, 2004). Yet, research suggests that some nurses perceive oral hygiene care to be a low priority (McNeill, 2000; O'Reilly, 2003), and they may lack the necessary knowledge of oral health assessment and hygiene practices (Adams, 1996; Fitch, Munro, Glass, & Pellegrini, 1999).

Developmental dental physiology provides an essential background for justifying age-appropriate interventions and the importance of good oral hygiene for children. Tooth development begins *in utero* and continues until after the teeth erupt (Durso, 2005). The first deciduous teeth, also known as milk teeth, appear at approximately 6 months of age. The eruption of permanent teeth causes deciduous teeth to loosen and fall out between the ages of 6 and 12 years. The final permanent teeth, the third molars or wisdom teeth, generally erupt between 17 and 25 years of age (Marieb, 1998). Teeth act

Oral hygiene significantly affects children's well being. It is an integral part of intensive and critical care nursing because intubated and ventilated children in the Pediatric Intensive Care Unit (PICU) are dependent on the health care team to tend to their everyday basic needs. Fourteen articles were identified as being relevant to pediatric oral care in the PICU. These articles were subsequently appraised, and an oral hygiene in the PICU guideline was developed. Research highlighted the relationship between poor oral hygiene in the intensive care unit (ICU) and an increase in dental plaque accumulation, bacterial colonization of the oropharynx, and higher nosocomial infection rates, particularly ventilator-associated pneumonia. Research and a local, informal audit found the provision of oral hygiene care to PICU children varied widely and was often inadequate. Children in the PICU need their mouths regularly assessed and cleaned. Maintaining consistent, regular, and standardized oral hygiene practices in the PICU will also set an example for children and their families, encouraging and teaching them about the life-long importance of oral hygiene.

as a host for dental plaque, which in turn, acts as a host for harmful pathogens. When teeth first erupt, they take up to two years to develop surface minerals that provide protection against tooth decay. Newly erupted teeth are therefore more vulnerable to tooth decay when compared with teeth that have been erupted for more than a couple of years (Wong et al., 1999).

Saliva plays a major role in cleansing the mouth by keeping mucous membranes moist, regulating the pH of the mouth, and digesting food. A biofilm or pellicle is formed from saliva, and this acts as a protective layer for teeth (O'Reilly, 2003). Saliva also contains natural antimicrobial proteins that protect the oral cavity from harmful pathogens (Brennan et al., 2004). In addition to saliva, oral health is maintained by regularly eating and drinking, as well as daily mechanical and pharmacological maintenance of the mouth (O'Reilly, 2003), for example, brushing teeth with fluoride toothpaste and flossing.

Dental plaque results from the colonization and growth of a variety of microorganisms on the surfaces of teeth, soft tissues, and dental prostheses. Seventy (70%) to 80% of the solid material in plaque is made up of bacteria and 1 mm³ contains more than 10⁸ bacteria with more than 300 varying aerobic and anaerobic species of bacteria (Fourrier et al., 1998). Poor oral hygiene and an accumulation of dental plaque lead to dental caries. This can be painful, costly, and when not treated, will progress to serious tooth damage. Poor oral hygiene will also result in gingivitis (gum disease), which occurs within less than 10 days if dental plaque is not removed. It is characterized by inflamed and bleeding gums that detach from the teeth and result in pocketing between the gums and the teeth (Franklin et al., 2000). Gingivitis is the first stage of periodontal disease, which if left untreated, can progress to periodontitis (Durso, 2005; Marieb, 1998).

Within 48 hours of hospital admission, the oropharyngeal flora of critically

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Figure 1.
1998 Iowa Model of Evidence-Based Practice to Promote Quality Care

Per the author's request, please refer to page 86 of the printed copy of this issue to view the figure.

unwell patients undergoes a change from predominantly gram positive organisms to predominantly gram negative organisms, creating a more virulent flora (Munro & Grap, 2004). This bacterial flora may then migrate to the lungs and result in a hospital-acquired pneumonia. The risk is more pronounced when access to the respiratory tract is impaired due to intubation. Millikan et al. (1988) reported an 11% total mortality rate from nosocomial infections in PICU children. VAP has been documented to be the second most common cause of nosocomial infection in PICU children, with bloodstream infections being the leading cause. The most common pathogens found to cause VAP in PICU children are *pseudomonas aeruginosa* (21.8%), *Staphylococcus aureus* (16.9%), and *Hemophilus influenzae* (10.2%) (Richards, Edwards, Culver, Gaynes, & the National Nosocomial Infection Surveillance System, 1999). In the PICU, VAP has also been associated with congenital syndromes, re-intubation, transport out of the PICU, and bloodstream and central venous line infections (Elward, Warren, & Fraser, 2002).

An endotracheal tube (ETT) provides a pathway for bacteria into intubated children's lungs (Franklin et al., 2000; Grap & Munro, 2004). Intubated children are at greater risk of developing pneumonia because of their poor or absent cough and gag reflex, as well as their immobility. Intubated children are nil per os (NPO) and likely to have a nasal or oro-gastric tube *in situ* that passes through the oral cavity, causing the child's mouth to be continuously open, which in turn may contribute to xerostomia (Munro & Grap, 2004). Furthermore, PICU children are often on medications and infusions (such as inotropes, diuretics, anticonvulsants, anticholinergics, and sedatives) that may lead to or exacerbate xerostomia, a decrease in salivary production leading to a dry mouth (McNeill, 2000). The risk of xerostomia is further exacerbated by stimulation of the sympathetic nervous system and dehydration (McNeill, 2000; Munro & Grap, 2004).

Compared with adult ICU patients, PICU children have a number of differences that may increase their risk of developing VAP. These include an uncuffed ETT, a nasal ETT, open circuit suctioning, saline lavage during suctioning, and developing dentition (Institute for Healthcare Improvements [IHI], 2005).

Table 1.
Oral Hygiene Practice Survey (N = 47)

	<i>n</i>	%
Is oral hygiene an essential task when caring for children in the PICU?		
☐ Yes	45	96
☐ No	2	4
<i>"Oral hygiene is very important" (Likert Scale)</i>		
☐ Strongly agree	38	81
☐ Somewhat agree	8	17
☐ Somewhat disagree	1	2
Have you ever received any form of education on oral hygiene in the PICU?		
☐ Yes	26	55
☐ No	21	45
☐ Never read any literature or research on what constitutes good oral hygiene.	31	66
<i>"The oral cavity is difficult to clean" (Likert Scale)</i>		
☐ Strongly agree	12	26
☐ Somewhat agree	26	55
Do your oral hygiene cares vary for intubated versus non-intubated children?		
☐ Yes	40	85
☐ No	6	13
☐ No Response	1	2
Assess oral cavity once a shift ☐ Yes ☐ No	10	21
Assess oral cavity prior to every oral care ☐ Yes ☐ No	29	62
Used a foam swab for oral care ☐ Yes ☐ No	44	93
Please tick boxes that best describes your practice.		
Do you use a toothbrush for oral care? ☐ Yes ☐ No	41	87
If yes, how often during a shift do you use a toothbrush for oral care?		
☐ Twice during a 12-hour shift	8	17
☐ Once during a 12-hour shift	23	49
Do you use chlorhexidine 0.2% mouth rinse for oral hygiene cares? ☐ Yes ☐ No	5	11
If yes, how often do you use chlorhexidine 0.2% mouth rinse?	4	9
☐ Q4 hourly	23	49
Do you use chlorhexidine 0.1% mouth rinse for oral hygiene cares? ☐ Yes ☐ No	13	28
If yes, how often do you use chlorhexidine 0.1% mouth rinse?	39	83
☐ Q4 hourly		
Do you use toothpaste? ☐ Yes ☐ No	19	40
If yes, how often do you use it?	4	9
☐ Once in 12 hours	4	9
☐ Q4 hourly		
☐ Never		

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Table 1. (continued)
Oral Hygiene Practice Survey (N = 47)

	<i>n</i>	%
What benefits might good oral hygiene provide? (Please tick appropriate box)		
☐ Patient comfort – short-term	39	83
☐ Patient comfort – long-term	38	81
☐ Plaque reduction	22	47
☐ Reduce risk of infection	43	91
☐ Prevent tooth decay and gum disease	33	70
Identified barriers that may prevent adequate oral hygiene for children in the PICU. (Please tick appropriate box)		
☐ Oral ETT	15	32
☐ Maxillofacial surgery children	6	13
☐ Lack of education	7	15
☐ Non-sedated child	4	9
☐ Unstable/critically ill	13	28
☐ Time/workload	4	9
Keen to learn more about oral hygiene in the PICU.		
☐ Yes	42	89
☐ No	3	6
☐ No response	2	4
In support of an oral hygiene in the PICU guideline being developed for the PICU.		
☐ Yes	46	98
☐ No	1	2

In a large New Zealand PICU, informal discussions identified significant diversity in the oral care provided by nurses. A goal was identified – “To improve standards of oral care for children in the PICU.” To accomplish this goal, an evidence-based practice process informed by the 1998 Iowa Model was implemented (see Figure 1) (Titler et al., 2001).

Triggers Contributing To the Problem

The first step in the Iowa Model is to identify “triggers” to the problem. A survey of nurses was conducted to establish baseline knowledge of oral hygiene and current oral hygiene practices in the PICU. Following ethical Institution Review Board (IRB) approval, all PICU nurses were invited to anonymously complete the 14-item questionnaire developed by the investigator. Depending on the type of question, nurses answered each question using a

Likert Scale, circling yes or no, or ticking boxes that indicated their practice in relation to the question. After one month, 47 of the 65 nurses had returned the questionnaire (response rate of 72%). The results confirmed that while most nurses considered oral hygiene to be important, there was a need for staff education and a clinical guideline (see Table 1). The problem-based triggers the survey identified included a) absence of a clinical protocol for oral hygiene, b) multiple oral hygiene practices including inadequate oral hygiene cares, c) the lack of consistent oral hygiene care, d) poor knowledge of effective oral hygiene care, and e) lack of appropriate oral hygiene equipment.

Literature Review

Having identified the problem – poor oral hygiene care in the PICU – a literature search was undertaken to gather relevant literature and research studies.

The Cochrane Library, Cochrane Database of Systematic Reviews, Cumulative Index to Nursing and Allied Health (CINAHL), and Medline were searched (restricted to 1990-2006, English language, and human research), including the *related links* option and journal cross referencing for papers not previously identified. The search produced a number of articles on oral hygiene and ventilator-associated pneumonia in adult intensive care units. However, very little research was found specific to oral hygiene in the pediatric critical care setting. The Iowa Model encourages the use of case reports, expert opinion, and theories to inform practice when research findings are not available (Titler et al., 2001), allowing protocols to be developed based on “best available evidence.” Fourteen articles were identified as relevant to pediatric oral care in the critical care setting and were subsequently appraised (see Table 2). They included two systematic reviews, two randomized controlled trials (with adequate sample size), four non-randomized trials (or randomized with small sample sizes), one comparative trial, and five expert opinions. Only four of the 14 articles were specific to the pediatric population.

Using definitions developed by Stetler and colleagues (1998), levels were assigned that rated the quality or strength of evidence of the 14 studies. Levels ranged from Level I (meta-analysis of multiple controlled studies) to Level VI (opinions of respected authorities, or the opinions of an expert committee, including their interpretation of non-research-based information) (Stetler et al., 1998). The more rigorous level of evidence (Level I) reports evaluated the effectiveness of pharmacological interventions included in oral rinses and toothpastes in reducing oral bacterial flora, dental plaque, and dental caries. The lack of robust research evidence related to direct nursing practice of oral care in the pediatric critical care setting is significant for future research. Across the “best available evidence,” three nursing interventions were identified for oral hygiene care in the pediatric critical care setting: 1) oral assessment, 2) mechanical interventions, and 3) pharmacological interventions.

Oral Assessment

A number of articles highlighted the importance of regular oral assessment to guide good oral care (Hayes & Jones, 1995; McNeill, 2000; O'Reilly, 2002). Barriers to consistent oral assessment

Table 2.
Oral Care Studies

Author, Title, and Design	Objective, Sample Size, and Time Period	Result	Limits	Level (Stetler et al., 1998)
Cheng (2004) Prospective Randomized Crossover Trial	To determine acceptability and tolerability of chlorhexidine (CHX) and benzydamine oral rinse agents in children 6 to 17 years old $n = 34$ (6 to 16 years, mean age = 10.32 years) 12-month period	Both oral rinses accepted and tolerable. Children found CHX more helpful in reducing mucositis and palliating discomfort associated with mucositis. Children older than 6 years used CHX mouth rinse.	Small sample size	III
Cheng, Molassiotic, Chang, Wai, & Cheung (2001) Prospective Comparative Study	To determine the effectiveness of a preventative oral care protocol in reducing chemotherapy induced oral mucositis in children (6 to 17 years old) with cancer $n = 42$ (6 to 16 years, mean age = 10.3 years) 8-month period	A 38% reduction in the incidence of oral mucositis in the children enrolled in the oral care protocol group. Children older than 6 years used CHX mouth rinse.	Small sample size	IV
Davies, Ellwood, & Davies (2004) Systematic Review (of Randomized Trials)	To compare the effectiveness of triclosan/PVA/MA copolymer and fluoride dentifrices in improving plaque control and gingival health 16 trials reviewed	A toothpaste containing triclosan/PVA/MA copolymer provide a more effective level of plaque control than a fluoride dentifrice.	Adult population Limitations for ICU as study time period at least 6 months and patients are seldom in ICU for this long.	I
DeRiso, Ladowski, Dillon, Justice, & Peterson (1996) Prospective, Randomized, Double-Blinded, Placebo-Controlled Clinical Trial	To test the effectiveness of oropharyngeal decontamination (CHX) on nosocomial infections in a comparatively homogenous population of patients undergoing heart surgery $n = 353$ (mean age = experimental group 64.1 years and control group 63.5 years) 10-month period	Inexpensive and easily applied oropharyngeal decontamination with CHX mouth rinse reduces total nosocomial pneumonia (69%, $p < 0.05$). Also a reduction in the need for prophylactic IV antibiotics by 43% ($p < 0.05$).	Adult population	II
Fourrier, Cau-Pottier, Boutigny, Roussel-Delvallez, Jourdain, & Chopin (2000) Single Blind Randomized Comparative Study	To document in ICU patients the effect of dental plaque antiseptic decontamination on the occurrence of plaque colonization by aerobic nosocomial pathogens and nosocomial infections $n = 60$ (more than 18 years of age, mean age treated group 51.2 years and control group 50.4 years) 13-month period	Oral decontamination with 0.2% CHX decreases bacterial colonization and may be related to a reduction in the incidence of nosocomial infections in ventilated patients.	Small sample size Adult population	II
Fourrier, Duvivier, Boutigny, Roussel-Delvallez, & Chopin (1998) Prospective Non-Randomized Clinical Trial	To study the dental status and colonization of dental plaque by aerobic pathogens and their relation with nosocomial infections in ICU patients $n = 57$ (18 to 83 years, mean age = 49 years) 12-month period	Dental plaque and colonization increases during patients ICU stay. Dental plaque must be considered a reservoir of colonization and nosocomial infection in ICU patients.	Small sample size Adult population	III

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Table 2. (continued)
Oral Care Studies

Author, Title, and Design	Objective, Sample Size, and Time Period	Result	Limits	Level (Stetler et al., 1998)
Franklin, Senior, James, & Roberts (2000) Prospective Non-Randomized Control Trial	To examine the dental status of critically ill children in PICU and determine the efficacy of the mouth care provided $n = 54$ (mean age 4.8 ± 4.3) 6-month period	The present mouth care regime was ineffective in preventing a build up of plaque and maintaining gingival health. Significant increase in dental plaque accumulation and gingivitis during PICU admission.	Small sample size	III
Grap & Munro (2004) Review Expert Opinion	A summary of specific risk factors associated with VAP and a summary of EBP recommendations for prevention	VAP is a significant problem. Need EBP guidelines to reduce the incidence of VAP. Further research is warranted.	Adult population	VI
Hayes & Jones (1995) Expert Opinion	Insight into how the oral care needs of the critically ill patient can be met	Implementation of an oral assessment tool. Collaboration between professions is needed to improve care for patients.	Adult population	VI
Marinho, Higgins, Logan, & Sheiham (2003) Systematic Review (of Randomized or Quasi-Randomized Controlled Trials)	To determine the effectiveness and safety of fluoride toothpaste in preventing dental caries in child/adolescent population 74 trials reviewed (children aged 16 or less)	Clear evidence that fluoride containing toothpaste has a caries inhibiting effect – 24% reduction.	Adult population	I
McNeill (2000) Review Expert Opinion	Review of issues surrounding oral hygiene in orally intubated patients	Education on oral hygiene in ICU for ICU nurses is needed. Research on oral hygiene regimes is warranted.	Adult population	VI
Munro & Grap (2004) Review Expert Opinion	A review of oral health and care in ICU	Combined use of toothbrush and paste and an antibacterial mouth rinse may be beneficial. Additional research is warranted.	Adult population	VI
O'Reilly (2003) Review Expert Opinion	What is the best method of oral care for the critically ill patient in ICU?	Regular oral assessment, individualized patient care and the use of a oral care protocol is vital in order to provide good oral care for ICU patients.	Small sample size	VI
Pearson & Hutton (2002) Time Series Cross-Over Trial	To measure how effective foam swabs are at removing dental plaque when compared with using a toothbrush $n = 34$	The foam swab is ineffective in removing dental plaque. A toothbrush is effective in removing dental plaque.	Adult population	III

include lack of time and lack of knowledge (McNeill, 2000). Hayes and Jones (1995) developed a simple mnemonic to guide oral assessment, the “*Brushed*” oral assessment tool. This instrument was modified by the addition of “*Teeth*” to form the “*Brushed Teeth*” oral assessment instrument (see Table 3). Conducting systematic, routine oral assessment prior to each oral hygiene

care is a best practice recommendation. Similar to other nursing standardized assessments, research is needed to test the efficacy and efficiency of this instrument in practice.

Mechanical Interventions

Mechanical oral care interventions aim to physically remove dental plaque and debris from the oral cavity (Grap &

Munro, 2004). Although nurses have used foam swabs for many decades, the toothbrush is more effective in removing dental plaque; however, success depends on how often the toothbrush is used and for what duration (Franklin et al., 2000; Pearson & Hutton, 2002). In a United Kingdom pediatric critical care setting where foam swabs were the most commonly used oral care tool,

Table 3.
The “BRUSHED Teeth” Oral Assessment Tool

BRUSHED Teeth	
B – Bleeding	Gums, mucosa, coagulation status?
R – Redness	Gums, stomatitis, tongue?
U – Ulceration	Size, shape, number, location, infected?
S – Saliva	Consistency, hyper/hyposecretion?
H – Halitosis	Character, acidotic, infected?
E – External factors	ETT tapes/ribbon, braces, angular cheilitis?
D – Debris	Plaque, thrush, foreign particles?
T – Teeth	Decay, loose, broken swelling abscess?

Source: Adapted with permission from Hayes & Jones, 1995.

study results revealed a significant increase in mean dental plaque accumulation ($p = 0.001$) and gingivitis ($p = 0.006$) admission to discharge (Franklin et al., 2000). A small, soft toothbrush is recommended for intubated, dentate children (Munro & Grap, 2004). Current guidelines by the New Zealand Dental Association (2006) recommend that the gums of babies whose teeth have not yet erupted should be cleaned and moistened with a small, soft toothbrush or a gauze swab moistened with clean water or saline. A plain foam swab is recommended only to moisten the oral cavity or to apply mouth rinse.

Pharmacological Intervention

Pharmacological oral care interventions involve the use of topical applications to assist with plaque control and decontamination of the oropharynx. The anti-caries effect of fluoride results from its action on the tooth/plaque interface, promoting demineralization of early caries and reducing tooth enamel solubility (Marinho, Higgins, Logan, & Sheiham, 2003). Additional benefits include reducing the formation of plaque acids (O'Reilly, 2003). Use of fluoride in toothpaste and other products has been proven to reduce dental caries in children. A Cochrane Collaboration systematic review of over 42,300 children in 70 trials demonstrated an average reduction of 24% in decayed, missing, and filled tooth surfaces in children using fluoride toothpaste (95% confidence interval 21 to 28; $p < 0.0001$) (Marinho et al., 2003).

Fluoride concentrations as low as 400 parts per million of fluoride (ppm F) are available in children's toothpastes, but research suggests a fluoride concentration of at least 1000 ppm F is needed to reduce dental caries (Marinho et al., 2003). Rinsing out toothpaste following

brushing has been found to decrease fluoride absorption and caries prevention (Ashley, Attrill, Ellwood, Worthington, & Davies, 1999; Chesnutt, Schäfer, Jacobson, & Stephen, 1998). Thus, it is recommended that spitting out excess toothpaste rather than rinsing, or keeping rinsing to an absolute minimum, more effectively reduces caries (Ashley et al., 1999; Chesnutt et al., 1998; Marinho et al., 2003).

Chlorhexidine gluconate is a commonly used broad-spectrum antibacterial mouth rinse that decontaminates the oropharynx and reduces dental plaque (Grap & Munro, 2004; Houston et al., 2002; O'Reilly, 2003). The rinse is active against both gram negative and gram positive organisms, and there are no documented cases of microbial resistance (Grap & Munro, 2004). Once fixed to the oral surfaces, chlorhexidine gluconate is released between 8 to 24 hours. Thus, the 12-hourly (BD) use of chlorhexidine gluconate is recommended (O'Reilly, 2003).

Many nurses and other caregivers are unaware that sodium lauryl phosphate and sodium monofluorophosphate present in the majority of toothpastes interact and inactivate the action of chlorhexidine gluconate mouth rinses (O'Reilly, 2003). Toothpaste and chlorhexidine gluconate mouth rinse are therefore not recommended to be used in conjunction with one another. Kolahi & Soolari (2006) recommend a time lapse of at least 30 minutes between using toothpaste and a chlorhexidine gluconate mouth rinse.

No serious side effects of chlorhexidine gluconate mouth rinse have been reported, but altered taste sensation, tooth discoloration, and tongue discoloration may occur. This tooth discoloration is easily removed by dental hygienists (Munro & Grap, 2004).

Numerous studies completed in children with cancer using an oral hygiene regime have recommended the use of a chlorhexidine gluconate mouth rinse because it reduces the severity of mucositis and alleviates oral discomfort (Cheng, 2004; Cheng, Molassiotis, Chang, Wai, & Cheung, 2001; Gibson & Nelson, 2000). A study in children with cancer between 6 and 17 years of age reported that children using chlorhexidine gluconate mouth rinse also found the taste acceptable and tolerable (Cheng, 2004).

No evidence was found to support the use of chlorhexidine gluconate mouth rinse in the PICU or adult ICU, or in cancer treatments in children under 6 years of age. For this reason, the guideline recommends that only children 6 years of age and older should use chlorhexidine gluconate 0.12% mouth rinse. Further research is needed to substantiate the use of chlorhexidine gluconate mouth rinse in children less than 6 years of age.

Two randomized controlled trials completed in adult cardiothoracic ICU patients have shown beneficial results from using twice-daily chlorhexidine gluconate mouth rinse in combination with twice-daily tooth brushing. DeRiso, Ladowski, Dillon, Justice, and Peterson (1996) found a significant reduction in the overall nosocomial infection rate (65%; $p < 0.01$), the incidence of total respiratory tract infections (69%; $p < 0.05$), and the need for intravenous antibiotics (43%; $p < 0.05$) for subjects in the chlorhexidine gluconate group. In another study, Houston et al. (2002) found patients who were intubated for more than 24 hours and in the chlorhexidine group had a 58% ($p = 0.06$) reduction in the incidence of nosocomial pneumonia. Review of the literature revealed that toothpaste containing fluoride and the use of chlorhexidine gluconate mouth rinse were the most effective products for oral care in the intensive care environment.

Sodium bicarbonate, hydrogen peroxide, and lemon and glycerine swabs are also available for oral care; however, research suggests their use may be harmful for patients (Hayes & Jones, 1995; Kite & Pearson, 1995; McNeill, 2000; Munro & Grap, 2004; O'Reilly, 2003). Hydrogen peroxide is used to break down debris and crusting within the oral cavity; however, it has been reported to cause superficial burns if diluted incorrectly (Hayes & Jones, 1995; O'Reilly, 2003). Sodium bicarbonate is recommended for cleansing

Figure 2.
Oral Hygiene in the PICU Guideline

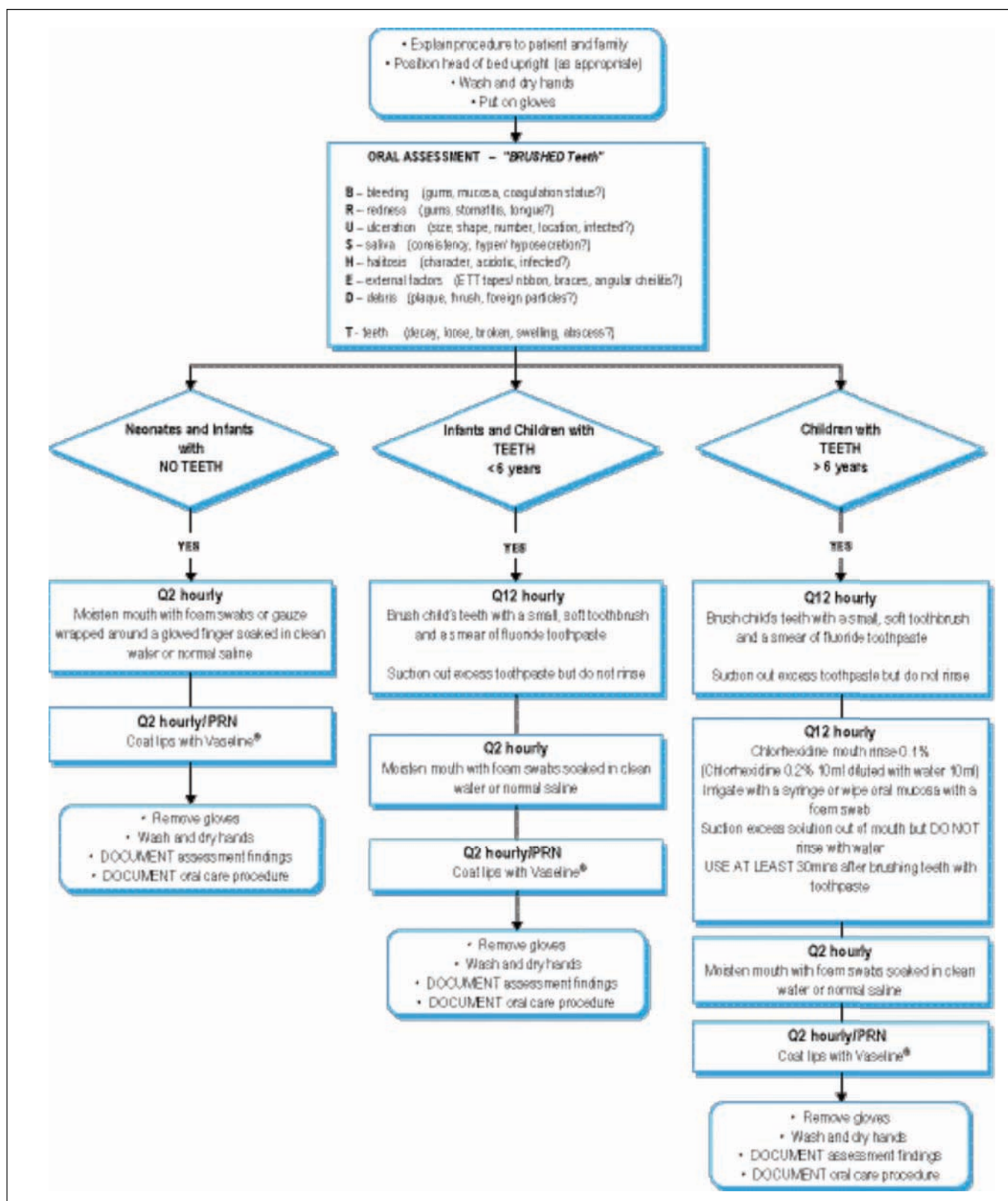
ORAL HYGIENE IN PICU	
Objectives	• To prevent complications from poor oral hygiene in the PICU • To reduce dental plaque and decontaminate the oropharynx • To reduce the risk of infection (such as ventilator associated pneumonia) • To prevent tooth decay and gum disease • To promote patient comfort – long and short-term • To help strengthen developing teeth • To maintain consistent and regular oral care in the PICU • To educate children and their families about oral health
Responsibility	All Registered Nurses working in the PICU
Frequency	Please refer to the Flowcharts 1 and 2
Associated Documents	The table below indicates other documents and sources associated with this recommended best practice.
Type	Document Titles
<i>Company Policy Infection Control</i>	<i>Standard Precautions</i>
Journal article	Cheng (2004)
Journal article	Cheng, Molassiotic, Chang, Wai, & Cheung (2001)
Journal article	Davies, Ellwood, & Davies (2004)
Journal article	DeRiso, Ladowski, Dillon, Justice, & Peterson (1996)
Journal article	Fourrier, Duvivier, Boutigny, Roussel-Delvallez, & Chopin (1998).
Journal article	Fourrier, Cau-Pottier, Boutigny, Roussel-Delvallez, Jourdain, & Chopin (2000).
Journal article	Franklin, Senior, James, & Roberts (2000)
Journal article	Grap & Munro (2004)
Journal article	Hayes & Jones (1995).
Journal article	Marinho, Higgins, Logan, & Sheiham (2003)
Journal article	McNeill (2000)
Journal article	Munro & Grap (2004)
Journal article	O'Reilly (2003)
Journal article	Pearson & Hutton (2002)
Overview Intubated and ventilated children in the PICU are dependent on the health care team to tend to their everyday basic needs, including oral hygiene. Poor oral hygiene has been associated with increased dental plaque accumulation, bacterial colonization of the oropharynx, and nosocomial infection rates, particularly ventilator-associated pneumonia (VAP). Within 48 hours of ICU admission the oropharyngeal flora undergoes change to a more virulent flora that increases a patient's risk of developing VAP (Munro & Grap, 2004). Research has suggested that reducing the bacteria in the oropharynx reduces the pool of organisms that may contaminate the lungs and cause VAP. An ETT provides a pathway for bacteria into the lungs. Many drugs (inotropes, diuretics, anticonvulsants, anticholinergics, antihistamines, antihypertensives, and sedatives/anaesthetic agents) used in the PICU increase a child's risk of developing xerostomia. Xerostomia is a decrease in salivary production, which leads to a dry mouth and may impact on a child's overall oral health (McNeill, 2000). Other factors that may impact on a PICU child's risk of developing a nosocomial infection, such as VAP, include: • Fluid restriction • Very young age • Immunocompromised • Decreased mobility • Ineffective/absent gag and cough reflex • Poor nutrition • Naso/orogastric tube • Supine position	
Key Points • Flowchart 1 (Figure 2) applies to all children except HDU children that are eating and drinking regularly (full oral intake) (Flowchart 2; Figure 3). • Follow the flowchart as per your patient's age. • If the patient is an oncology patient, you may need to refer to the Paediatric Haematology/Oncology Oral Care Chart. • Ensure Nilstat® is prescribed where indicated. • If the patient experiences pain, swelling, or bleeding, inform medical staff.	
Equipment Available • Gloves • Plain foam swabs (Toothette®) • Soft paediatric toothbrush • Oral suction brush • Fluoride toothpaste (Colgate Total®) • Chlorhexidine gluconate 0.2% (<i>must be diluted 1:1 [10 ml chlorhexidine and 10 ml clean water]</i>) • Gauze swabs • Clean water • 0.9% NaCL • Syringe • Yankeur suction • Guedal/oral airway • Vaseline® • Mouth moisturiser • Bite block • Pupil torch (flashlight)	

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Figure 2. (continued)
Oral Hygiene in the PICU Guideline

Flowchart 1:

Oral Hygiene in the PICU Guideline for Intubated Children or Those with a Lowered Glasgow Coma Score

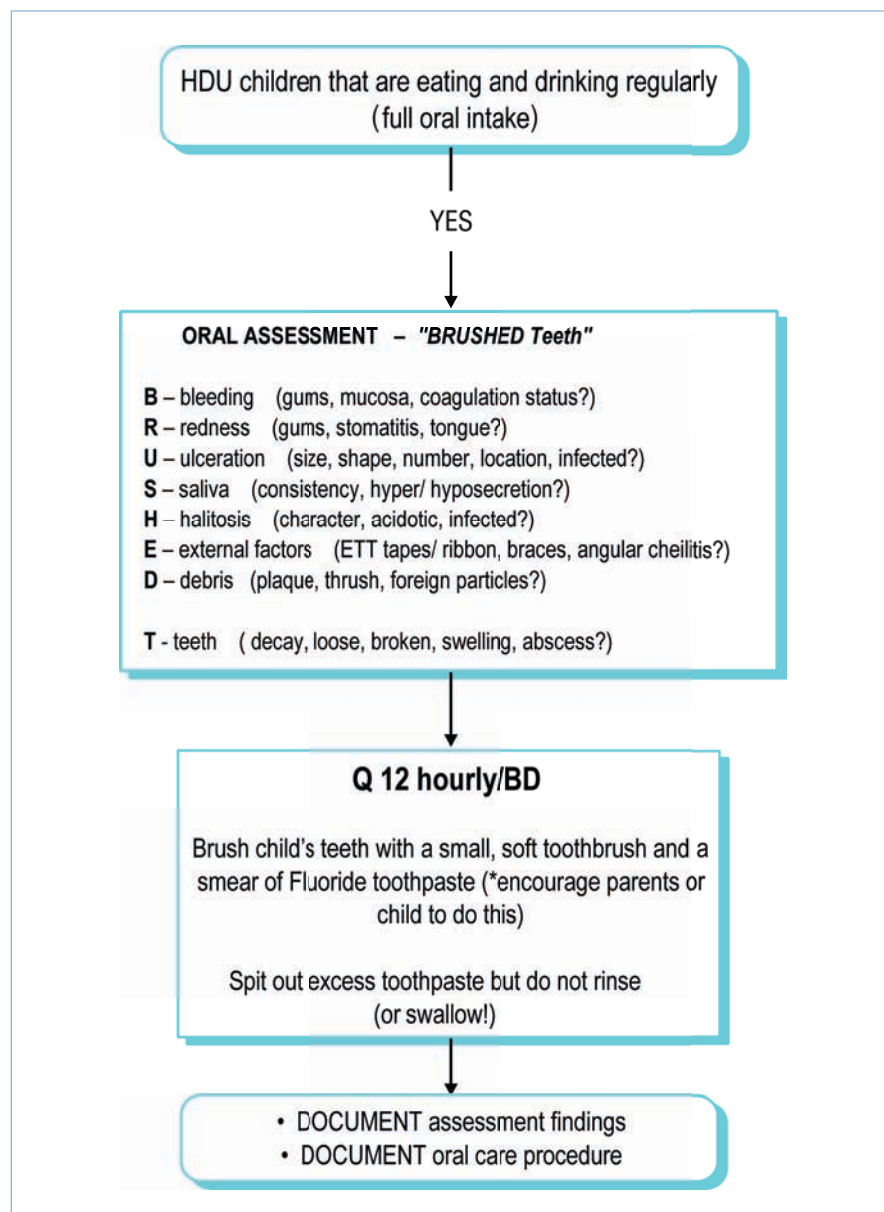


Note: "BRUSHED Teeth" adopted with permission from Hayes & Jones, 1995.

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Figure 2. (continued)
Oral Hygiene in the PICU Guideline

Flowchart 2:
Oral Hygiene in the PICU Guideline for Children Who Are Eating and Drinking



Note: "BRUSHED Teeth" adopted with permission from Hayes & Jones, 1995.

the oral cavity and breaking down tenacious saliva, but like hydrogen peroxide, if not diluted sufficiently, it will cause superficial burns (Munro & Grap, 2004; O'Reilly, 2003). Lemon and glycerine swabs have been used for over 70 years and are considered a moistening agent; however, they initially stimulate saliva production but then cause rebound xerostomia. They are acidic and can

cause irritation and demineralization of the tooth enamel (Hayes & Jones, 1995; Munro & Grap, 2004; O'Reilly, 2003). A moist oral mucosa is essential both for comfort and to reduce the symptoms of xerostomia. Clean water or normal saline are appropriate, inexpensive, widely available, and have minimal side effects (O'Reilly, 2003). McNeill (2000) suggests moistening the oral mucosa of

intubated patients every two hours.

Practice Change: A Guideline for Oral Hygiene in the PICU

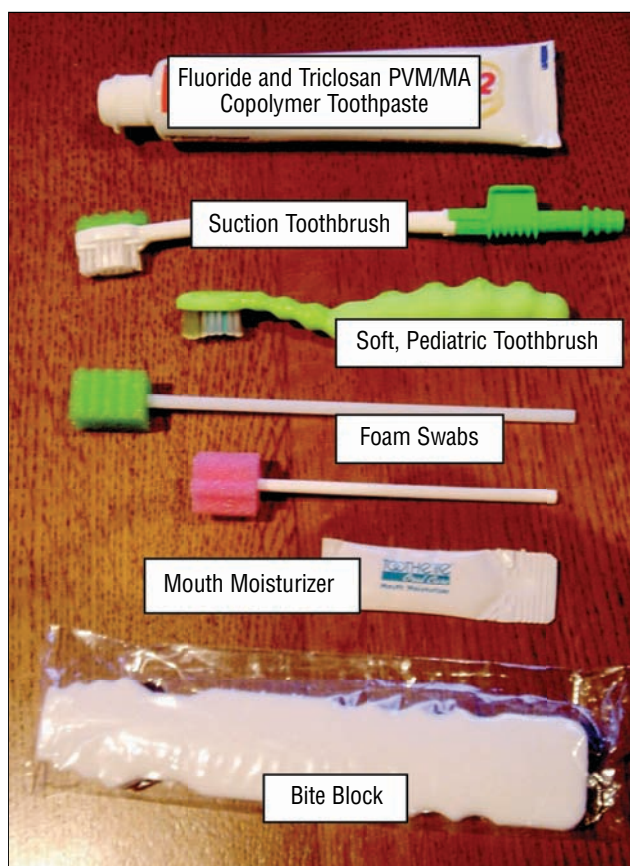
Synthesis of the above literature facilitated the development of an oral hygiene guideline for children in the PICU. The aims for the protocol were to a) increase nurses' knowledge of oral health and oral hygiene, b) maintain consistent and regular oral care, c) prevent complications from poor oral hygiene, d) reduce dental plaque and decontaminate the oropharynx, e) reduce the risk of infection (such as VAP), f) prevent tooth decay and gum disease, g) promote patient comfort – long and short-term, h) help strengthen developing teeth, i) educate children and their families about oral health, and j) encourage parents to be involved with their child's care where possible.

Two flowcharts were developed. The first flowchart (see Figure 2, Flowchart 1) guides care for children in the PICU who are intubated and at high risk of developing a nosocomial infection (such as VAP). This flowchart may also be used for children in the PICU who are not intubated, such as those who have a reduced level of consciousness and/or are NPO and/or may be dehydrated/fluid restricted. The second flowchart (see Figure 2, Flowchart 2) relates to children who are able to eat and drink frequently. These children may also be able to participate in their own oral care, and their parents should be encouraged to help where possible.

Key points were also included in the guideline to prompt nurses where there may need to be a change or addition to the PICU oral care flowchart (see Figure 2). For example, the addition of Nystatin for oral thrush, or if the child is under the care of the oncology team, the Oncology Oral Care Chart provided by the Oncology Services may need to be used (Kolahni & Soolari, 2006). To complement the implementation of the guideline, a variety of oral care products appropriate for use in the PICU were sourced (see Figures 2 and 3).

Adding a new protocol does not ensure there will be a change in practice. The implementation of clinical change requires other processes, such as staff education and support (Powell, 2003). A month was dedicated to "oral hygiene in the PICU," during which various educational strategies were used to educate nurses about oral hygiene in the PICU and the new guideline. Educational

Figure 3.
Oral Care Products Sourced for the Oral Hygiene
in the PICU Guideline



strategies included an extensive education board, a note in the staff communication book, regular reminders at staff handover, a copy of the guideline on the clinical practice focus board, and a poster on the "what's news" notice board. Following the adoption of a change in practice, the 1998 Iowa Model (Titler et al., 2001) suggests that environmental, staff, fiscal, and patient and family variables need to be monitored and evaluated. Evaluation activities are ideally done locally. Suggested evaluation measures for this project include a post-implementation audit of the nurse's knowledge pertaining to oral hygiene in the PICU, an evaluation on the amount and cost of oral hygiene products ordered for the PICU, and an audit of nursing documentation of oral care.

Conclusion

Standardized oral hygiene practice has the potential to contribute to improved oral and general health of infants and children in the pediatric crit-

ical care setting. Equipped with better information, the right supplies, and practice recommendations, pediatric nurses can help ensure that children receive consistent, regular, and effective oral hygiene. More research in the pediatric critical care setting is needed to continue the development and establishment of evidence-based guidelines for oral hygiene.

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Additional Readings

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