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Supervised toothbrushing programs in primary schools and early childhood settings: A scoping review

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Objective: In this article we report the findings of a scoping review that aimed to identify and summarise the range of programs and guidelines available for toothbrushing programs in schools and early childhood settings. Dental caries is one of the most common preventable diseases affecting children worldwide. Untreated caries can impact on child health and wellbeing, development, socialisation and school attendance. Supervised toothbrushing programs in schools and other early childhood settings can be effective in improving the oral health of young children. There is limited understanding of the salient issues to consider when developing such programs or how they are best implemented in real world settings. ***Methods:*** A scoping review methodology was utilised to provide a summary of the guidelines and programs available. Key search terms were developed, mapped and utilised to identify guidelines and programs across 6 databases and key search engines. ***Results:*** We located 26 programs and guidelines that met the inclusion and exclusion criteria for the review. These were collated and summarised across key countries and critical aspects of program development and implementation were identified. Toothbrush type and storage, toothpaste strength and method of dispensing, toothbrush storage, staff training and parental consent are key considerations that varied widely. ***Conclusions and recommendations:*** Guidelines for supervised toothbrushing programs vary within and across countries due to differences in water fluoridation and availability of low fluoride toothpastes. The results of this review provide critical information to be considered when establishing and implementing toothbrushing programs in these settings.

Keywords: Toothbrushing program, toothbrushing guidelines, toothbrushing standards, toothbrushing protocol, scoping review

Introduction

Supervised toothbrushing programs in schools and other early childhood settings can improve the oral health of young children (Curnow *et al*., 2002; Damle *et al*., 2014) by removal of plaque, regular exposure to fluoride, the development of good brushing technique and the formation of good oral hygiene habits (NHS Health Scotland, 2011; Packer & Booth, 2013). While toothbrushing programs can be stand-alone or used in conjunction with other oral health promotion activities, there is limited understanding of the salient issues in their development and how they are best implemented in real world settings. A review was undertaken to ascertain what guidelines and research had been undertaken on toothbrushing activities in early childhood and school settings. As part of a broader project aimed at improving oral health in rural communities (Rural ECOH- Engaging Communities in Oral Health), one community wanted to trial a toothbrushing program in their local primary school. In order to proceed we sought guidelines available for programs. Using the process as outlined by Arksey & O'Malley (2005) we report the findings of a scoping review to identify and summarise literature about the guidelines and programs available for toothbrushing programs within schools and other early childhood settings.

Dental caries in childhood

Dental caries is one of the most common oral diseases affecting children, but is preventable (Kassebaum *et al*., 2015; de Silva-Sanigorski *et al*., 2010; Gussy, *et al*., 2006; Sheiham, 2005). Globally, 60-90% of children are affected (Petersen, *et al*., 2005; World Health Organization, 2013). Untreated caries impacts on child health and wellbeing (including the ability to eat and chew, body weight, growth, self-esteem and communication (Sheiham, 2006)). The impact of dental caries on child development has been documented, with poor school attendance and lack of concentration commonly reported (Petersen, 2005).

There are many determinants for poor oral health, including disadvantaged socioeconomic status, age, gender, geographic location and lifestyle (Watt & Sheiham, 2012). These factors can contribute to the development and severity of dental caries in children including; dietary habits, oral health behaviours and practices, and poor access to dental services (Fisher-Owens *et al*., 2007). Social determinants of health expressed at the individual, family and community level impact on oral health and must be taken into account when implementing oral health improvement programs. Measures to prevent caries in children include developing an oral hygiene routine and cleaning teeth and gums every day with an age-appropriate fluoride toothpaste (Cooper *et al*., 2013; Dental Health Services Victoria, 2014; Jurgensen & Petersen, 2013).

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Although toothbrushing twice a day with a fluoride toothpaste is recommended, a significant proportion of the population do not achieve this rate (World Health Organization, 2003). Whilst childhood caries rates have declined in western countries, disadvantaged children continue to experience caries at higher levels (Pieper *et al*., 2012; Sheiham *et al*., 2011; Watt & Sheiham, 2012). At the international level, advances have not been uniform, and dental conditions, because of their prevalence and magnitude, continue to be a significant public health problem in infancy, with long term negative repercussions across the lifespan.

The preventive effects of fluoride have been recognised by four World Health Assembly resolutions across 40 years (Petersen, 2008). Toothpaste is the most common delivery method of fluoride (Featherstone, 2004) and it is possible to reverse or arrest caries development by brushing with fluoridated toothpaste. Supervised tooth brushing programs are often implemented in schools to increase children's access to fluoride (Al-Jundi, 2006; Curnow *et al*., 2002; Jackson *et al*., 2005).

Schools as settings for oral health promotion

In 1995, the World Health Organization (WHO) launched the "Global School Health Initiative" to improve the health of students, school personnel, families and other community members (Kwan *et al*., 2005). The focus was on the value schools to develop and support of a range of healthy habits in childhood. In 2003, WHO released a report titled *Oral Health Promotion: An essential element of a health promoting school* with the rationale of capitalising on schools as vehicles for oral health promotion. On a global scale, approximately 80% of children attend primary school and around 60% complete at least four years of education. It is estimated that the schools provide an efficient and effective way to reach over one billion children, their families and communities. Primary school children learn and develop lifelong skills, attitudes and beliefs, and lifelong sustainable oral health related behaviours can be developed through school based health promotion activities (Jurgensen & Petersen, 2013; World Health Organization, 2003). Campaigns or oral health programs conducted in community settings, including schools, are associated with improvements in oral health. School-based, supervised toothbrushing can provide training in a skill that might not be taught at home.

The Rural ECOH Project

Rural ECOH (Engaging Communities in Oral Health) (2014-17) is a nationally funded partnership project underway in six rural communities in Victoria and Queensland, Australia. Based on the award winning Scottish Remote Service Futures (RSF) community participation method (Nimegeer *et al*., 2011). In Rural ECOH community members, health professionals, local councils, schools and other key agencies were engaged in a series of community workshops over a period of 12 months. The focus was on designing community-based plans to improve rural oral health. Community participants developed a range of strategies to implement ideas for oral health improvement based on evidence of local oral health and best practice.

Participants at one community sought to implement a supervised toothbrushing program in their local primary school. The pilot program was to be conducted by the local public dental clinic staff and the health promotion team from the local health service. Working with the public dental clinic we identified a need to develop guidelines for their tooth brushing program. This scoping review was undertaken as a first step to assist that development. The question that guided this review was "*What guidelines are currently available for the development of early childhood or school toothbrushing programs?"*

As part of the scoping review we aimed to gather information on key aspects of toothbrushing programs that had been successfully implemented in other settings.

Methods

In order to answer the question we used Arksey and O'Malley's; (2005) six stage scoping review framework for its rigour (Daudt, Van Mossel, & Scott, 2013; Grant and Booth, 2009). Scoping reviews are particularly useful for examining a broad topic, providing a systematic way to map, collate and summarise existing literature on a topic. This type of review is focused on identifying the nature and extent of current research evidence, rather than providing an assessment of quality of the included studies. As our aim was to locate and summarise existing guidelines this was an appropriate method. Arksey and O'Malley's (2005) six-stage approach involves: identifying the research question; identifying relevant studies; study selection; charting the data; and collating, summarising and reporting results and consultation with stakeholders

Identifying the research question

A broad question and key terms were central. The question: *What guidelines are currently available for the development of early childhood or school toothbrushing programs?* guided our search strategy as we aimed to collate information from the included programs that provided information on the key aspects to consider when developing a toothbrushing program for us in the school setting.

Identifying relevant guidelines

Arksey and O'Malley stress the importance of establishing clear criteria for scoping reviews including placing boundaries on the search that acknowledges time and cost limitations. Key search terms were developed using expert knowledge from practitioners and the literature and working with an expert librarian. Using the PICO framework the following concepts of interest were identified.

Each key word within a concept column was combined with "OR, and then concept columns were combined using "AND". Using truncated words and wild cards (in this case *) we aimed for a broad search to capture all terms within the strings. To determine an appropriate time frame for the review, a Google Scholar search indicated few guidelines before 2003. As the WHO report on oral health promotion was published in that year, 2003-2015 was deemed an appropriate timeframe for our search. Six databases were searched (MEDLINE, PubMed, The Cochrane Library, CINAHL, Embase, Wiley Online Library) as well as Google and Google Scholar. The search was conducted between December 2014 and April 2015.

Concept 1	Concept 2	Concept 3	Concept 4
• Child* • Primary school • Nursery school • Crèche • Kindergarten • Day care • Child care • Play school • Pre-School	• Toothbrush* • Teethbrush* • Tooth clean* • Teeth clean*	• Program • Initiative • Guideline • Training • Report • Protocol • Strateg* • Standards	• Parent* engag* • Parent* involve* • Toothbrush holder system • Toothbrush type • toothpaste types • Toothpaste strength • Rinsing • Spitting • Toothbrush • Toothpaste

Figure 1. Mapped concepts

Inclusion and exclusion criteria were developed (Table 1)

Study selection

Bibliographic software (Endnote X7) was used to import and manage references. Titles, abstracts and keywords (articles, guidelines and protocols where available) were scrutinized against the inclusion and exclusion criteria with two research team members agreeing and confirming the elimination of irrelevant studies. We identified 465 resources from the six databases and a further 214 from the Google searches. After screening, 623 resources were excluded which left 56. Full texts of these 56 were downloaded and scrutinized by two research team members (VDS & LW) for eligibility. A further 30 resources were excluded with the remaining 26 included in the review (Figure 2).

Data charting, collation and consultation

The fourth and fifth stages of the framework include data charting and collation. In addition, Arksey and O'Malley suggest an optional sixth stage of stakeholder and consumer involvement. Levac and colleagues (2010) see this stage as beneficial making the results more useful for practitioners and enhancing translation into practice and policy. Consultation can occur at any stage but is particularly useful to refine charting categories and to reflect on what the items of interest will be (Daudt, van Mossel, & Scott, 2013; Levac *et al*., 2010). The research team consulted with three stakeholders groups (local clinic staff, dental practitioners and experts from Dental Health Services Victoria) to develop the concepts that would be most useful in the charting process. Based on their recommendations, Excel spreadsheets were developed with the relevant aspects of programs charted by country. We charted the author, date, program name, aims of program, program participants, parental involvement, and training provision. Further, we identified a number of practical issues that would be useful to others planning a toothbrushing program; toothbrush type, toothpaste strength and type, toothpaste dispensing method, toothbrush holder or storage system and details regarding rinsing and spitting of toothpaste. Two members of the research team (VDS & AK) extracted the information relevant for each table from all the included guidelines and programs.

Table 1. Inclusion and exclusion criteria

Criterion	*Inclusion*	*Exclusion*
Time period	December 2003 to December 2015	Any study outside these dates
Language	English	Non-English
Full text	Full-text available	No full text available
Type of study	Original research article describing programme guidelines published in a peer reviewed journal. Program guidelines describe how the program was run.	Programs only providing oral health education. Programs providing a one off supervised toothbrushing session.
Websites	Websites were searched using Google"tooth brushing program". Sites had to detail the guidelines adopted rather than a general description	Any website that did not provide detailed information about the guidelines.
Study focus	Guidelines for toothbrushing programs run in schools, kindergartens or day-care centres.	Programs targeted at infants, parents and older people.
Geographical area of interest	International studies including those with specific cultural groups.	Nil
Setting	School, preschool, kindergarten or child-care centres	Program not in these settings and/or designed specifically for children with special needs.

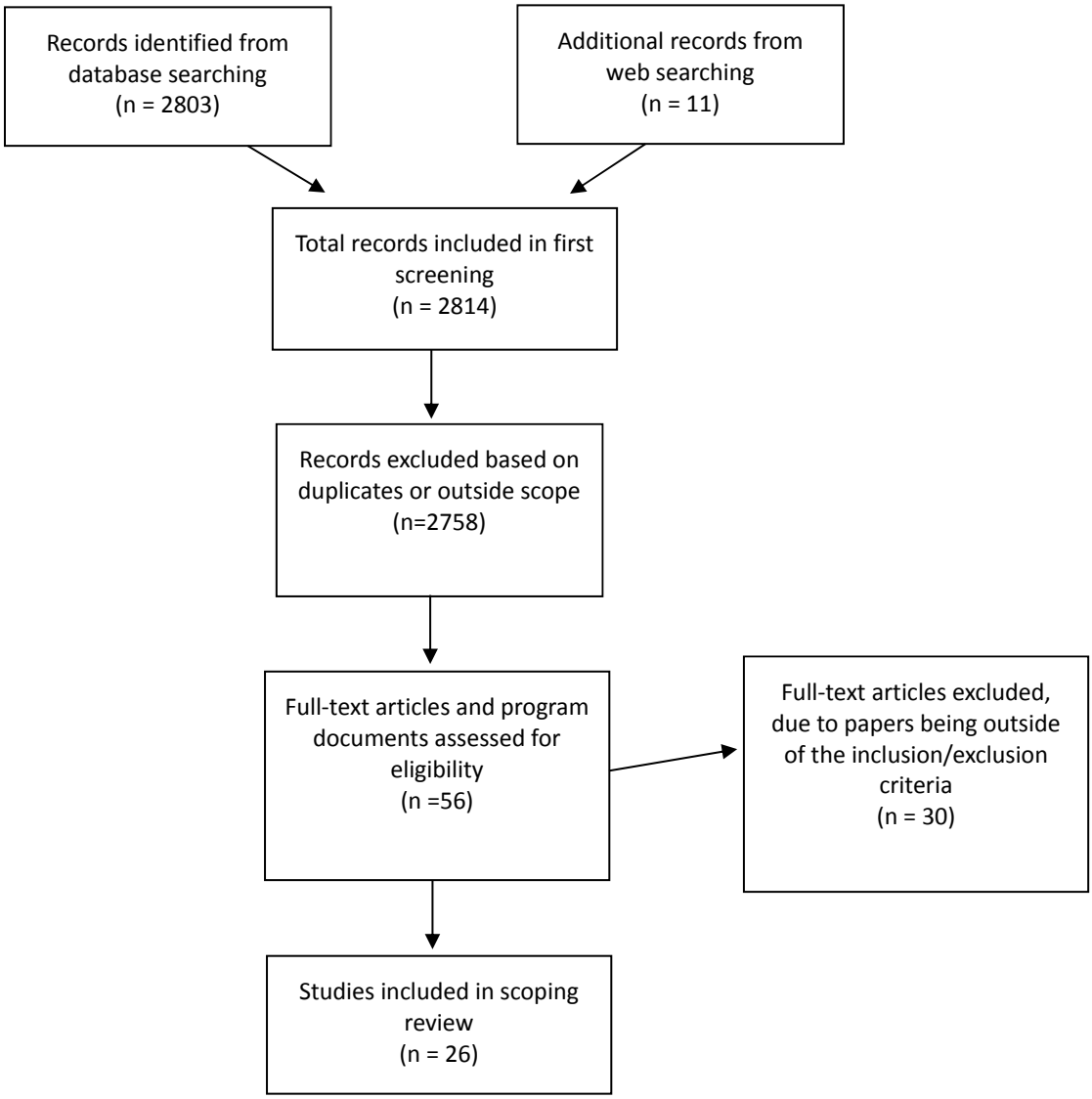

Figure 2. PRISMA diagram

Results

Twenty-six guidelines and toothbrushing programs were located from 12 different countries (Australia, New Zealand, America, Jordan, Pacific Islands, Scotland, Wales, England, Wales, Kuwait, Canada, Grenada and the Philippines). Key themes drawn from the included studies are outlined in the narrative overview provided below, followed by a tabulated outline of the programs.

Settings for toothbrushing

Resources focused on nursery schools (Gwen, 2014; NHS Health Scotland, 2011; Shahid, 2010; Woodall, Woodward, Witty, & McCulloch, 2014), daycare centres, (Arizona Department of Health Services, 2014; Dental Health Education Unit Government of Western Australia Department of Health, 2008; Office of Oral Health Massachusetts, 2009; University of Iowa Department of Pediatric Dentistry, 2004), kindergarten and early childhood education programs (Dental Health Services Victoria, 2014; Milgrom & Tut, 2009b; Monse *et al*., 2013; Queensland Health, 2009) and primary school settings (Al-Jundi, Hammad, & Alwaeli, 2006a; Health Canada, 2014; Hopper & Garcia-Godoy, 2014; NYU College of Dentistry & Henry Shein Cares, 2014; PM Plus Public Health Services, 2005; Potts, 2011; Shahid, 2010). Others were developed for specific cultural groups (Gowda & Croucher, 2011; Latrobe Community Health Service, 2010; Maari Ma Health Aboriginal Corporation, 2007; Northern Territory Government, 2011) and disadvantaged populations (Macnab & Kasangaki, 2012).

Toothbrush type

Whilst not all included resources specified the type of toothbrush most suggested an "age appropriate" brush with small head and soft bristles (Al-Jundi *et al*., 2006a; Arizona Department of Health Services, 2014; Dental Health Education Unit Government of Western Australia Department of Health, 2008; Dental Health Services Victoria, 2014; Gwen, 2014; Health Canada, 2014; Maari Ma Health Aboriginal Corporation, 2007; Macnab & Kasangaki, 2012; Milgrom & Tut, 2009a; NHS Health Scotland, 2011; Northern Territory Government, 2011; PM Plus Public Health Services, 2005; Potts, 2011; Queensland Health, 2009; Shahid, 2010; Woodall *et al*., 2014). One

study used disposable toothbrushes with pre-applied xylitol toothpaste (Hopper & Garcia-Godoy, 2014). Most included labelling of the brushes using a variety of methods and recommended replacing them every three months to six months (Al-Jundi *et al*., 2006a; Gwen, 2014; NHS Health Scotland, 2011; Woodall *et al*., 2014). Shahid (2010) also recommends replacing brushes after periods of sickness.

Toothpaste strength and type

All resources recommend mild flavored fluoride toothpastes. Most suggest a pea sized amount of low fluoride toothpaste (up to 500ppm) for children under 6 years (Dental Health Education Unit Government of Western Australia Department of Health, 2008; Dental Health Services Victoria, 2014; Milgrom & Tut, 2009a; PM Plus Public Health Services, 2005; Queensland Health, 2009) with the strength of the fluoride varying between regions and countries. For example, in Bradford (UK) a smear of toothpaste containing 1000ppm fluoride for children under 3 years and for children over 3 years 1350-1500ppm fluoride is recommended. The Happy Teeth Protocol (Potts, 2011) in Portsmouth, UK recommends toothpaste containing 1450ppm of fluoride for children 3 years and over wheras the Scottish Childsmile program toothpaste containing 10000ppm fluoride for 3-4 year olds (Macpherson *et al*., 2010). Most programs also recommend that volunteers, teachers or support staff dispense toothpaste (due to wastage) using a plastic plate, wax paper or directly from the tube.

Toothbrush holder or storage system

A range of storage systems were outlined from individual plastic cases (Dental Health Education Unit Government of Western Australia Department of Health, 2008; Latrobe Community Health Service, 2010; NYU College of Dentistry & Henry Shein Cares, 2014; PM Plus Public Health Services, 2005) to "brush-bus" (rack) type systems (Arizona Department of Health Services, 2014; Gwen, 2014; Health Canada, 2014; Potts, 2011; Shahid, 2010; University of Iowa Department of Pediatric Dentistry, 2004; Woodall *et al*., 2014). Systems should store brushes upright without touching each other and away from toilet areas to minimize the spread of bacteria. Three programs suggested upside-down egg cartons as a useful method for storing brushes when funds were limited (Northern Territory Government, 2011; Office of Oral Health Massachusetts, 2009; University of Iowa Department of Pediatric Dentistry, 2004). If individual cases are being used it is important that they are allowed to dry properly in a ventilated area before being stored to minimize mould growth (PM Plus Public Health Services, 2005). Using individual double thickness cloth bags for storing toothbrush and paste have also found to be effective (PM Plus Public Health Services, 2005)

Rinsing/Spitting

Rinsing after brushing can diminish the benefits of fluoride. However the message that children shout spit out the toothpaste but not rinse was evident in only eight resources (Gwen, 2014; NHS Health Scotland, 2011; Potts, 2011; Woodall *et al*., 2014). Contrary to this, Arizona Department of Health Services (2014) recommend that children must be able to rinse and spit to prevent swallowing too much toothpaste. In the Hopper & Garcia-Godoy (2014) study using disposable xylitol infused brushes there was no need for rinsing or spitting as it was safe to ingest the xylitol.

Training provided

Most programs involved some type of training for volunteer staff and teachers. The training was often provided by a dentist, dental assistant or dental hygienist and included aspects such as, anatomy, brushing technique, hygiene, storage and infection control procedures. Childsmile in Scotland trained dental nurses to run the program, whereas most others focused on capacity building those involved in the running of the program

Parental engagement

The need for parental consent was outlined in most resources located and some education for parents was suggested. The Massachusetts program recommended that an information session be provided to inform parents of the program and to discuss why oral health is important. This session could also be used to discuss dental visits, diet and tooth brushing at home. The EMPOWER program recommended engaging families by giving them with a role in the program. It is suggested that child care organisations involve parents and carers by sending out letters, having a dietician or oral health professional hold an information night or face-to-face reminders about the program.

Effectiveness and Evaluation

Not all programs and guidelines included specific detail about evaluation or effectiveness and further searches within the literature were required to examine the key evaluations of the included programs. Two key exceptions were the Childsmileand the Smiles for Miles Programs. Both have undergone extensive evaluation and have been shown to improve childrens' oral health status and to be cost effective.

Other interventions

A range of other interventions were provided that could be undertaken alongside a toothbrushing activity. Fluoride varnishing was mentioned in six programs (provision ranged from every 3 to 6 months), fissure sealants in two and provision of free toothpastes and toothbrushes for home use in three. Oral health education provided to teachers, children and parents was outlined in six. In the Pacific Island program children were also given 9 Xylitol gummy bears provided at school each day (daily dose – 11.7g Danisco). A range of posters, books, stickers and other materials was also provided to children and parents to increase oral health knowledge.

Tables 2-5 summarise the included guidelines and programs grouped by geographic location. Details of the toothbrushes used, toothpaste and storage systems and direction for rinsing after brushing are reported in Table 6.

Table 2. Australia and New Zealand programs

Author, date	*Program name*	*Aim*	*Population and setting*	*Parental involvement*	*Training provided*	*Supervision*	*Program details*	*Evaluation*
Latrobe CommunityHealth Service (2010).	Top Tips for Teeth.	Improve oral health knowledge,attitudes and behaviours.	Primary and preschool aged indigenous children in the Latrobe Valley.	Mothers who were employed by the school to supervise lunch were trained	Mothers were trained	Mothers trained by the school	The strategies included an after-lunch brushing program where each child brushed their teeth before commencing afternoon classes.This was supported by four culturally appropriate education sessions focussing on oral health, skill enhancement and brushing technique. These sessions were facilitated by a local dental therapist. Culturally sensitive educational resources were also provided to the students suchas fridge magnets,newsletters and information sheets.	Process evaluation revealed that younger students responded more positively to the program. Plaque scores revealed that by term three there was a significant improvement in the students brushing techniques. Students were more aware of the importance of looking after their teeth and gums and individual brushing techniques and coordination improved. Knowledge, awareness and acceptance of dentistry had also improved. As a result of this successful program oral health has been included as part of the school curriculum and Top Tips for Teeth is a component of the Koori Health and Wellbeing Project
Dental Health Services Victoria, (2014).	Smiles 4 Miles.	Improve oral health of children attending kindergarten, day care and family day care.	Children attending early childhood education services - kindergarten, long day care and family day care. No specific age groups but children in these settings are from 6 weeks to 6 years.	Not specified	A training session was provided for staff and refresher training is offered the following year.	Supervised tooth-brushing is one aspect of the program that centres can adopt	This program follows the Drink Well, Eat Well, Clean Well principle. Many options are provided in the program, individual services can tailor the program to suit their needs.	Internationally recognised and award winning there have been a number of evaluations of this program
Maari Ma Aboriginal Corporation (2007).	Clean Teeth, Wicked Smiles.	Improve the oral health of indigenous children by providing oral health education and increasing access to toothbrushes and fluoride toothpaste.	Primary school aged Indigenous children in New South Wales	Not specified	Local oral health and dental staff provided the program	Local health staff	The local health service staff and dental team attended each class from kindergarten to year 6 and provided the children with oral health education. Poster and activity booklet and tooth brushing demonstration from an oral health professional.	No evaluation provided

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table 2 continued...

PM plus Public Health Service (2005).	Bayside District Tooth brushing Program (TIPS).	To increase tooth brushing frequency with fluoride toothpaste to decrease incidences of dental caries and to promote tooth brushing as a daily habit.	460 year one students (age 5-7) in selected primary schools involved in the program for three years	Informed consent and participant's medical histories were collected from parents.	Teachers provided with a presentation by the project team outlining the aims of the project. They were also provided with training on how to implement the project and a manual.	Teachers	Child health nurses provided information to schools about oral health. Dental therapists conducted one session at the school where participants were taught about correct brushing techniques. All schools were provided with a pack that included oral health books, a puppet and Colgate Bright Smiles, Bright Futures package. Informed of other oral health promotion programs available (Germ Busters, Food for Smiles).	This program produced a small difference in the level of dental caries between the control and intervention groups, however, this was neither clinically or statistically significant. It is argued that the costs of this program outweigh the benefits.
Dental Health Education Unit, Government of Western Australia (2008).	Tooth brushing in child-care centres.	To improve the oral health of children in child care and to develop healthy habits.	Child care centres children ranging in age from 6 weeks to 5 years.	Parental consent required.	Child care staff training.	Trained child care workers	A sample letter to parents is included.	No evaluation included
Queensland Health (2009).	Happy Teeth: Resource Kit.	Prevent tooth decay in early childhood.	Child care settings in Queensland children aged 6 weeks to 6 years.	Parental consent required.	Child care staff training.	Trained staff	Part of a program that includes healthy eating and drinking. Sample forms available.	No evaluation included
Northern Territory Government 2011).	Tooth brushing Child Oral Health.	To support children to brush their teeth at school.	School aged children in the Northern Territory (aged 5-12 years).	Refers to the need to involve parents and staff in the program but no specific guidelines are provided.	Refers to the need to involve staff in the program but no specific guidelines were provided.	Not specified	A range of activity resources, colouring books, songs etc.	No evaluation reported
Packer & Booth (2013)	Sustainable toothbrushing programs in remote Indigenous communities	To increase oral health promotion activities in Top End (Northern Australia) remote communities	Indigenous school children up to the age of 16 years in remote Top End communities in 12 selected schools.	Parental consent required	Training for schools involved in the toothbrushing	Trained teachers	Involved working with the Closing the Gap Clinical Outreach teams for the application of fluoride and with the schools for the toothbrushing program.	Has resulted in an increased access to fluoride for children. Oral health awareness in schools and local community also increased as a result of contact with schools.
Gowda & Croucher, (2011)	School-based toothbrushing programme in a high-risk rural community in New Zealand – an evaluation.	To have good oral health become a part of normal life.	Rural, low socio-economic Maori population attending Opononi Area School Aged 5-13 years	Parental consent required.	Training for teachers included an information session on tooth anatomy, dental caries, gingivitis, tooth brushing techniques, hygiene issues and toothbrush storage.	Supervised by teachers	Oral health education sessions on the first day of the program, after 6 months, 18 months and 30 months.	Following participation in the program, participants experienced a reduction in the mean Plaque Index from 1.49 to 0.72, the Gingival Index also decreased.

Table 3. United Kingdom programs

Author, date	*Program name*	*Aim*	*Population and setting*	*Parental involvement*	*Training provided*	*Supervision*	*Program details*	*Evaluation*
NHS Health Scotland National Standards for nursery and school tooth brushing programs (2011).	Child Smile Core.	To improve the oral health of children aged three years and over, to promote dental care to those in need and to promote oral health behaviours.	3 and 4 year olds attending nursery school and first and second year primary school students in disadvantaged areas of Scotland.	Parental consent required.	Nursery and School staff are provided with training	Trained nursery and school staff	Free oral health packs (toothbrush and toothpaste) are given to every child in Scotland at least 6 times from age 0-5. They also receive twice yearly fluoride varnish applications.	The study reports that in 2009 95% of all nursery schools in Scotland participated in supervised tooth brushing as part of their daily routine.
Yusef, Wright & Robertson (2015).	Keep Smiling.	To evaluate a pilot program prevention program (fluoride varnishing & toothbrushing) in schools.	3-7 year old children in 5 primary schools in a deprived area of London.	Parental consent for both toothbrushing and varnishing required.	Dental staff from local clinics. School staff and appointed health champions were provided 2 training sessions to support the program.	School staff	The pilot program was a combined daily toothbrushing program with fluoride application. Staff from the local clinic worked with school teachers and locally identified health champions (community members). Consent rates were high (average fluoride varnish consent 74% and toothbrushing 79%). In some schools the consent figures were much higher (up to 89% and 97% respectively).	Process and outcomes evaluations identified this as a useful program.
Woodall, Woodward, Witty & McCullough (2014).	Calderdale's Tooth brushing in Schools Scheme.	To introduce a life skill & improve the oral health of young children.	3-5 year olds in a school setting.	Parental consent required.	School staff members were trained in the areas of hygiene and cross contamination of brushes.	Trained school staff	The toothbrushing was accepted by children and they enjoyed participating. Children had often become more knowledgeable about toothbrushing and the consequences of not regularly cleaning their teeth. Evidence that children can act as positive "change agents" with siblings and other family members.	The scheme was contingent on key staff in the school and the program was more successful when embraced by the school.

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Gwen (2014).	Designed to Smile.	To teach effective tooth brushing to disadvantaged children from a young age.	Disadvantaged children in Welsh communities aged 3-5 years old.	Parents provide informed consent by receiving a letter and consent form or attending a presentation.	Staff members in nurseries and schools were trained to provide this program and are supported by a designated Designed to Smile team (the team consists of a Dental Health Educator or Oral Health Improvement Practitioner as well as a Dental Support Worker).	Designed to smile staff	Fluoride Varnish Application Program, Fissure Sealant Application Program, oral health and healthy living education, toothbrushes and toothpaste for use at home and the Designed to Smile team visits the classroom to assist with supervised tooth brushing and to provide advice to teachers.	The program is evaluated in each nursery or school annually. Each school is provided with an evaluation pack containing 16 forms.
Potts (2011).	Happy Teeth: Protocol for the Implementation of the Supervised Toothbrushing Programmes in Primary Schools.	To promote a holistic approach to healthy living, teaching children an important life skill.	School children in the Portsmouth area aged 5 to 11 years.	Parental consent required.	Teachers were provided with training about how to run the program, the correct technique for tooth brushing in children and infection control procedures.	Trained teachers	Toothpaste, toothbrushes, oral health education and dental support are provided to each school.	The effectiveness of the program is assessed at the end of each term by relevant staff completing a checklist. This checklist is provided in the document. Further evaluation is assessed at least once per term consisting of observation of tooth brushing and seeking feedback from teachers about how they feel the program is running.
Shahid (2010).	Building Brighter Smiles.	Nursery schools.	Children attending child care and nursery schools aged from birth to 6 years	Parental consent required.	Child care staff training.	Trained child care staff	A sample letter to parents is included.	No outcomes or evaluations provided.

Table 4. United States and Canada programs

Author, date	*Program name*	*Aim*	*Population and setting*	*Parental involvement*	*Supervision*	*Training provided*	*Program details*	*Evaluation*
Office of Oral Health Massachusetts Department of Public Health (2009).	Growing Healthy Smiles in the Child Care Setting.	To implement a supervised tooth brushing program for children who spend over 4 hours in care or have a meal while in care.	Children aged 0-5 years in child care centres.	Not specified	Child care staff but not specifically mentioned	A letter or information session was recommended to inform parents of the program and to discuss why oral health is important. This session can also be used to discuss dental visits, diet and tooth brushing at home.	A sample fact sheet for parents is provided.	No evaluation reported
University of Iowa (2004).	Tooth brushing in childcare settings with children 3-5 years.	The purpose of this guide is to provide a framework for centres to set up a tooth brushing program.	Children aged 3-5 years in childcare settings	Parental consent required.	Trained child care staff	Child care staff undergo training.	This program follows the Drink Well, Eat Well, Clean Well principle. Many options are provided, individual services tailor the program to suit their needs.	Not specified
Arizona Department of Health Services (2014).	EMPOWER	To promote good oral health practices to children aged 3-5 years in child care centres to enable them to develop a healthy mouth and healthy lifelong habits.	3-5 year old children in child care centres	Parental consent required. EMPOWER recommends that families are engaged by providing them with a role in the program. It is suggested that child care organisations involve them by sending out letters, having a dietician or oral health professional hold an information night or face-to-face reminders about the program.	Not specified	Child care staff undergo training.	10 ways to empower children to live healthy lives includes suggestions for physical activities, sun safety, breastfeeding, healthy eating and smoke-free schools.	Not specified

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table 4 continued...

Hopper & Gracia-Godoy (2014).	Disposable brushing with pre-pasted xylitol.	To determine if children in a school setting would accept an after lunch brushing program and such a program would be effective in reducing plaque	300 children from kindergarten to eighth grade in Tennessee in a 30 day program.	Parental consent required.	Teachers and volunteers	Teachers were given a DVD that they could play while children were brushing. Also used the "tell show and do" approach which consisted of explaining and demonstrating the skill as it was being performed.	DVD with instruction on brushing technique. Also used disclosing solution that stained the children's teeth so they could see how effective their brushing had been.	The study demonstrated that the lunchtime tooth brushing program for school children utilizing the xylitol pre-pasted toothbrush was feasible, well accepted, and effective in controlling plaque.
Health Canada (.).	Protocols for School-based Sealant, Tooth brushing and Fluoride Varnish Programs.	To provide guidance for operating community-based preventive programs and what is needed to implement them in new communities.	Schools (up to grade 4) and day care centres in Manitoba	Parental consent required.	Dental providers and trained personnel.	All staff have training.	Fluoride varnish and fissure sealants are also part of the program.	Not specified

Table 5. Others

Country, Author, date	*Program name*	*Aim*	*Population and setting*	*Parental involvement*	*Supervision*	*Training provided*	*Program details*	*Evaluation*
Phillipines Monse, Benzian, Naliponguit, Belizario, Schratz & van Palenstein Helderman (2013).	Fit for School.	To improve health and school attendance and performance by decreasing illness and making positive changes to children's personal hygiene habits.	Children in schools in 23 provinces of the Philippines (900,000 children) from 5 years,	Not specified	School staff	The program promotes capacity building of those involved in the running of the program, therefore training is provided to relevant staff members.	Supervised tooth brushing with fluoride toothpaste is one of three interventions offered as part of this program. It also offers daily hand washing with soap and twice yearly worming.	In 2009, a project was initiated to assess the effectiveness of the Fit for School program. Although not published
Grenada NYU College of Dentistry & Henry Schein Cares (2014).	Smile Grenada.	To provide service, education and research, while fostering sustainability of the program.	26,000 children in all of Grenada's schools.	Parental education sessions are conducted when necessary and all parents are encouraged to attend.	Staff trained by NYU dental staff	Staff receive training from New York University College of Dentistry, public health dentists and dental hygienists.	Oral health education, fluoride varnish and sealants.	The program was evaluated in 2009; results indicate that there has been a 90% decrease in new tooth decay since the beginning of the program.

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Uganda Macnab & Kasangaki, (2012).	Many voices, one song: a model for an oral health programme as a first step in establishing a health promoting school.	To improve the oral health of children in rural and remote communities.	Grade one students from four schools in rural communities in Uganda. As these students moved through their schooling they continued to be involved in the program. As new students began grade 1, they were also included. The program began with 600 participants and grew to 2500 participants within 4 years.	Not specified	Teachers	All teachers involved are invited to participate in training to ensure they understand the relevance of the program and their roles within the program.	Oral health education in the classroom by both teachers and visiting medical or dental trainees, t-shirts worn by teachers to promote 'team identity', supply of toothbrushes and fluoride application twice yearly.	Effectiveness of the program is evaluated by examining participants annually. Data were collected at baseline and at years 1-4 using a questionnaire completed by teachers and students and an examination completed by dental students. Following the program, there was an increase in participants brushing their teeth at home and brushing their teeth before bed, this was statistically significant. All teachers reported positive effects of becoming a health promoting school and stated that participants' confidence had increased.
Pacific Islands Milgrom & Tut (2009).	Pacific Islands Early Childhood Caries Prevention Project: Republic of the Marshall Islands.	To reduce tooth decay in children.	Participants consisted of 473 children with an average age of 64 months receiving care from early childhood education programs.	Not specified	Trained assistants and students	The program is delivered by recent high school graduates and dental assistants who received 3.5 months of training prior to commencement.	Fluoride varnish application every 3 months during the school year, toothbrushes and toothpaste provided for use at home and at school, 9 Xylitol gummy bears provided at school each day (daily dose – 11.7g Danisco). Participants were examined at the beginning and end of the school year by the same examiner.	After one year, the participants who received supervised tooth brushing twice per day, fluoride varnish every 3 months and Xylitol gummy bears daily were half as likely to have dental caries compared to those who received only fluoride varnish every 3 months.
Jordan Al-Jundi, Hammad & Alwaeli (2006a).	Four year school-based caries prevention program.	To test the efficacy of a school-based caries prevention program.	856 children in Jordan divided into 2 groups (mean ages 6.3 years in group 1 and 11.7 years group 2. One group received oral hygiene instruction and the other received both instruction and toothbrushing at school.	Parental consent obtained.	Assistant	Training was given to a research assistant who supervised the brushing.	Oral hygiene education sessions and supervised toothbrushing at school. .	The study findings show that children who participated in the tooth brushing were at much lower risk of developing dental caries.
Ministry of Health Kuwait and Forsyth Research Institute (2011).	School Oral Health Program.	Comprehensive school based program providing oral health education, treatment and prevention to school children in Kuwait.	All children aged 4-15 years in Kuwait	Parental consent required. Oral health education sessions are held for parents of kindergarten and school children and pregnant mothers.	Trained teachers	School teachers provided with dental training prior to commencement of program.	Twice yearly fluoride varnish and pit and fissure sealants, at least two oral health education sessions per year, school oral health activities, community oral health activities, brochures and posters.	Evaluation of the program was completed by relevant staff and outcomes evaluated every 5-6 years. Decreases in caries rates have been recorded and an increase in parental consent for fluoride varnishes also recorded which is believed to be due to increased oral health awareness and oral health education.

Table 6. Guidelines provided across programs

Toothbrush type	*Toothpaste strength and type*	*Dispensing toothpaste*	*Toothbrush holder/system*	*Rinsing/spit*
Age appropriate toothbrush, individually identifiable and replaced once a term (Gwen, 2014; NHS Health Scotland, 2011; Woodall *et al.*, 2014).	Fluoride toothpaste (Arizona Department of Health Services, 2014; Gowda & Croucher, 2011; Gwen, 2014; Latrobe Community Health Service, 2010; Maari Ma Health Aboriginal Corporation, 2007; Andrew Macnab & Kasangaki, 2012; Monse *et al.*, 2013; NYU College of Dentistry & Henry Shein Cares, 2014; Office of Oral Health Massachusetts, 2009; Woodall *et al.*, 2014).	Put onto a paper plate if a communal toothpaste tube is used. (NHS Health Scotland, 2011)	A "brush bus" cleaned once a week with household detergent (Gwen, 2014; Potts, 2011; Shahid, 2010; Woodall *et al.*, 2014).	It is recommended that children are discouraged from actively rinsing after tooth brushing as it decreases the benefits of fluoride (NHS Health Scotland, 2011).
Small soft toothbrush labelled with child's name and date (Arizona Department of Health Services, 2014; Potts, 2011)	Children aged three years and over use a pea-sized amount of fluoride toothpaste 1,450ppm. Participants who are allergic to toothpaste or who do not use toothpaste due to it containing animal derivatives must be offered a suitable alternative (Potts, 2011).	Toothpaste not to be shared amongst participants. It is recommended that a paper plate or piece of paper towel be used to dispense toothpaste (Gwen, 2014).	Toothbrush holder (Arizona Department of Health Services, 2014).	Children should be discouraged from spitting (Woodall *et al.*, 2014).
Age appropriate toothbrush labelled with full name and the date the toothbrush was given to the child (Office of Oral Health Massachusetts, 2009).	Toothpaste containing at least 1000 ppm (parts per million) fluoride (NHS Health Scotland, 2011).	If using a communal tube of toothpaste. A plastic plate, wax paper or bottom of a plastic cup is recommended (Arizona Department of Health Services, 2014; Office of Oral Health Massachusetts, 2009).	An upside down egg carton with holes in the bottom is suggested. There are also a number of toothbrush holders that are suggested by this program, the program does not endorse any particular type (Office of Oral Health Massachusetts, 2009).	Enforce spit don't rinse (Gwen, 2014; Maari Ma Health Aboriginal Corporation, 2007; Office of Oral Health Massachusetts, 2009).
Small soft headed toothbrush. Brushes should be labelled with the child's name. Toothbrushes should be replaced every 3 months or sooner if the bristles become splayed or after a period of sickness (Shahid, 2010).	Fluoride toothpaste is used. Children aged three years and over use a pea-sized amount of fluoride toothpaste 1,450ppm. Participants who are allergic to toothpaste or who do not use toothpaste due to it containing animal derivatives must be offered a suitable alternative (Potts, 2011).		A numbering and storage system was devised, details of this are not provided (Andrew Macnab & Kasangaki, 2012).	Children must be able to rinse and spit to prevent swallowing of too much toothpaste (Arizona Department of Health Services, 2014).

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Disposable brushes with pre-applied xylitol toothpaste (Hopper & Garcia-Godoy, 2014).	ADA approved 27 tuft brush, with a 13.5 centimetre handle on which .5 gms of paste was applied. The paste was composed of 48-49% by weight of xylitol, 48-49% by weight of glycerine, 2-2.5% by weight of baking soda and 1-1.5% by weight of flavouring (Hopper & Garcia-Godoy, 2014).	Toothbrushes are kept in individual storage containers which much be cleaned and dried (Dental Health Education Unit Government of Western Australia Department of Health, 2008; Latrobe Community Health Service 2010,; NYU College of Dentistry & Henry Shein Cares, 2014).	Encourage children to spit out after tooth brushing and discourage rinsing as this will wash away the topical benefits of fluoride (Potts, 2011).
Small head brush replaced in May and September of each year (Al-Jundi *et al*., 2006a)	Low fluoride children's toothpaste from 18 months – 6 years of age (Dental Health Services Victoria, 2014; Northern Territory Government, 2011; PM Plus Public Health Services, 2005; Queensland Health, 2009).	Individual or rack systems can be used, a brush bus or similar system is suggested. Household detergent is to be used to clean the brush bus (or similar) once per week (Shahid, 2010).	No need for rinsing or spitting as the xylitol can be ingested (Hopper & Garcia-Godoy, 2014).
Age appropriate/soft toothbrush (Dental Health Education Unit Government of Western Australia Department of Health, 2008; Maari Ma Health Aboriginal Corporation, 2007; Andrew Macnab & Kasangaki, 2012; Milgrom & Tut, 2009; Northern Territory Government, 2011; PM Plus Public Health Services, 2005; Queensland Health, 2009)	Mild, mint fluoride toothpaste is recommended. 0-3 years: a smear of toothpaste containing 1000ppm fluoride. 3 years and over: a pea sized amount of toothpaste containing 1350-1500ppm fluoride (Shahid, 2010).	Numbering and storage system (Andrew Macnab & Kasangaki, 2012).	
	For children in first group (mean age 6.3) toothpaste containing 500ppm of fluoride used and for older children (mean age 11.7) 1000ppm was used (Al-Jundi *et al*., 2006a)	The storage of toothbrushes was checked by tooth brushing coordinators throughout the program. Individual toothbrush cases were trialed but mould was found to be a problem. Individual double thickness cloth bags were used and found to be effective. Participants stored their toothbrush and toothpaste in the bag for 4-6 weeks. Following this, they would move their items into a second bag while the first was being laundered by a hospital linen service. Toothpaste with a screw lid is recommended for use with the bags as younger children would often squeeze toothpaste into the bag if the toothpaste lid (flip top) was not closed properly (PM Plus Public Health Services, 2005).	

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table 6 continued...

	Storage racks for toothbrush storage are available commercially, or alternatively, Styrofoam or cardboard egg cartons can be used (purchase new unused cartons to avoid possibility of salmonella contamination from eggs). Egg cartons should be closed and placed flat-side down (University of Iowa Department of Pediatric Dentistry, 2004).
	Two sealable cloth bags for storage of brush and paste or a toothbrush case that can also hold a toothpaste tube. Bags must be stored in a dry area to allow them to dry thoroughly or cases must be stored with lids open for a couple of hours to allow brushes to dry (this will help to prevent mould and bacterial growth) (Queensland Health, nd).
	One disposable brush per day per child (Hopper & Garcia-Godoy, 2014).

Discussion

The purpose of this review was to identify what toothbrushing programs were available and to summarise key aspects of their guidelines. We located programs across a range of countries and settings including: nursery schools, day care centres, kindergarten and early childhood education programs, primary schools and a number that were developed for specific cultural groups. Overall, the programs vary by toothbrush type, toothbrush storage, toothpaste strength and dispensing and guidelines for rinsing or spitting. Some countries have developed national guidelines for supervised toothbrushing programs (Macnab *et al*., 2010; Macpherson *et al*., 2010; Monse *et al*., 2013; NHS Health Scotland, 2011) and have reported effectiveness in decreasing caries rates, particularly in young children (see for example Al-Jundi *et al*., 2006a; Monse *et al*., 2013; NHS Health Scotland, 2011). The development of national guidelines for the Australian context is not useful due to the differences within and between different communities with differential caries rates, water fluoridation and access to low fluoride toothpaste. However, a summary of key international guidelines can provide communities wishing to develop their own program, with key points to consider in the development of a toothbrushing program.

Data on the effectiveness of behavioural interventions such as supervised toothbrushing are limited, with a recent systematic review concluding that there was insufficient evidence for the efficacy of primary school-based behavioural interventions for reducing caries and plaque reduction (Cooper *et al*., 2013). As the programs did not always report on effectiveness (measured as caries reduction) we cannot draw conclusions on the effectiveness of such programs. However, there is evidence that supervised toothbrushing programs within schools and early childhood settings are more likely to be successful in terms of cost effectiveness when the rates of childhood caries are high, where water fluoridation does not exist and where children are not already brushing twice daily with a fluoride toothpaste (Gowda & Croucher, 2011; Macpherson *et al*., 2010; Twetman *et al*., 2003). Children that participate in toothbrushing programs show improved dental cleanliness, oral hygiene, toothbrushing technique and gum health. For the success of school based programs it is also important to link the program to the home by providing other resources such as toothbrushes, toothpastes, colouring books, stickers, and charts. The support of parents and setting staff are vital to the continued success and sustainability of the program.

Most programs involved some type of training for volunteer staff and teachers. The training was often provided by a dentist, dental assistant or dental hygienist, and included aspects such as, anatomy, brushing technique, hygiene, storage and infection control procedures. In the Childsmile program in Scotland, nursery and school staff deliver the toothbrushing program with supported training (Macpherson *et al*., 2010).

In many programs, the toothbrushing program was supplemented by other preventive measures. The use of fluoride varnishes, in addition to toothbrushing, have been shown to decrease caries rates (Agouropoulos *et al*., 2014; Carey, 2014; Divaris *et al*., 2013). Fluoride varnishing was

mentioned in a number of programs (provision ranged from 3 to 6 monthly) (Latrobe Community Health Service, 2010; Macnab & Kasangaki, 2012; Milgrom & Tut, 2009; Ministry of Health & Kuwait and Forsyth Research Institute, 2011; NYU College of Dentistry & Henry Shein Cares, 2014; Turner *et al*., 2010; Yusuf *et al*., 2015). Other interventions that could be undertaken included fissure sealants (Gwen, 2014; Health Canada, 2014.; Ministry of Health & Kuwait and Forsyth Research Institute, 2011) and provision of free toothpastes and toothbrushes for home use (Gwen, 2014; Macpherson *et al*., 2010). Oral health education to teachers, children and parents was also included. The Pacific Island program used gummy bears, and after one year, the children who received supervised toothbrushing twice daily, fluoride varnish every 3 months and the gummy bears were half as likely to have dental caries compared to those who received only the 3-monthly fluoride varnish. This demonstrates the importance of not relying on only one source of fluoride for at risk children.

Whilst most programs provide guidance on toothbrush type, the advice differed on toothbrush storage and strength of toothpaste. As some programs were conducted in communities without water fluoridation, the recommended toothpaste strength varied from 500ppm to 1450ppm. Internationally, low strength fluoride toothpaste has been recommended for children under 6 years (Pukallus *et al*., 2013; Wright *et al*., 2014). However, it is not available in all countries. Where low strength fluoride toothpaste is not available, one program recommends that a rice grain size amount or smear of adult strength toothpaste be used (Wright *et al*., 2014). Toothbrush storage is a key consideration in many programs. Keeping toothbrushes clean and stored correctly with minimal disruption was identified as a key challenge when implementing programs.

The only national program included in this review is the Scottish Childsmile program (Macpherson *et al*., 2010). This program has undergone a robust evaluation and been shown to be cost effective (Macpherson et. al., 2013; Anopa *et al*., 2015). Many countries, including Australia lack national guidelines for local toothbrushing programs. In the absence of guidelines, this review has identified a number of important considerations in their development

Conclusions & Recommendations

The delivery of toothbrushing programs in schools and other early childhood setting has the ability to address some of the social determinants that impact on oral health through a settings approach. The goal of this review was to provide an overview of toothbrushing programs within these settings and to outline some of the key points for consideration when establishing them. As schools and early childhood settings are a popular site for oral health promotion, it is important for those wishing to develop and implement such programs to consider what might be included. The review highlights important aspects that must be considered before implementing them. Evaluations should consider how best to promote good brushing technique and how to ensure the long term provision of toothbrushes and fluoridated toothpaste for program sustainability, particularly in challenging contexts.

Based on these findings we recommend that if early childhood and school settings are to develop and implement a supervised toothbrushing program they should consider the following within their guidelines:

1. Toothbrush type (age appropriate small head, soft bristles, labelled with child's name and date, replaced once a term or when bristles become worn or after a period of illness).
2. Toothpaste (low fluoride toothpaste <500ppm for children under 6 years (if available), or adult strength between 1000ppm-1450ppm depending on the country and the fluoridation status of the water supply..
3. Toothpaste amount (a smear if using adult toothpaste for children under 6, or a pea sized amount if using low fluoride), dependent on the fluoridation status.
4. Toothpaste dispensing by an adult, individually or with pea sized amounts on plastic or paper plates.
5. Storage system that does not allow brushes to touch each other, good air flow and ability to air dry without contamination. Individual containers can be used but these will need to be cleaned and dried.
6. Brushing as a supervised group at a specific time each day
7. Children should be encouraged to spit out the toothpaste but not rinse after brushing.
8. Staff training.
9. Involving parents and gaining consent.

We recommend that before any toothbrushing guidelines are developed for local programs, that these key points are considered and that a further exploration of current evaluations is undertaken.

The pilot toothbrushing program developed for the Rural ECOH study using these results of this review was based on the guidelines provided by the Scottish Childsmile program, with some site specific alternations. These guidelines have been further refined and have recently been adopted by a range of state-based agencies trialing school toothbrushing programs.

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