

Approaches for adult nursing and residential care homes on promoting oral health, preventing dental health problems and ensuring access to dental treatment

Review 1: Effectiveness

Produced by Specialist Unit for Review Evidence (SURE)¹
Dental Public Health Unit, Dental School²
Cardiff University

Review Team Alison Weightman¹
Weyinmi Demeyin¹
Fiona Morgan¹
Ivor Chestnutt²
Damian Farnell²
Ilona Johnson²
Heather Strange¹
Lydia Searchfield¹
Mala Mann¹

Date 27 July 2015

Version 0.4



¹ <http://www.cardiff.ac.uk/insrv/libraries/sure/index.html>

Section	Content	Page
	List of contents	2
	Executive Summary	4
	Evidence statements	7
	Abbreviations	20
1	Introduction	21
1.1	Aims of the review	21
1.2	Review question	21
1.3	Background – setting the context	21
2	Methods	24
2.1	Literature search	24
2.2	Inclusion and exclusion criteria	26
2.3	Study selection	28
2.4	Quality assessment	28
2.5	Data extraction – study characteristics and methodology	28
2.6	Data synthesis	29
2.7	Developing Evidence Statements	31
3	Results	32
3.1	Search results	32
3.2	Quality and applicability of studies	33
3.3	Outcomes	34
4	Findings	35
Table 1	Brief Summary of included studies	60
5	Discussion	74
6	References	76
7	Acknowledgements	78

APPENDICES (in separate document)

APPENDICES		79
	List of contents	80
Appendix A	Evidence Table of included intervention studies	81

Appendix B	Quality summary of included intervention studies	136
Appendix C	Review Team	139
Appendix D	Search strategy	140
Appendix E	Included papers	142
Appendix F	Systematic reviews discussed comparatively	147
Appendix G	Unpicked systematic reviews	148
Appendix H	Studies in progress	149
Appendix J	Papers excluded from the review at full text	150

EXECUTIVE SUMMARY

1 Introduction

1.1 Aim of the review

To review the evidence about approaches, activities and interventions that promote oral health, prevent dental problems and ensure access to treatment for adults in care home settings.

1.2 Review question

What approaches, activities or interventions are effective in promoting and protecting oral health and ensuring access to dental care (including regular check-ups) for adults in care homes?

1.3 Background

According to Age UK (2014) calculations, in April 2012 there were 431,500 adults in residential care of whom approximately 414,000 (95%) were aged 65 or over. The 2011 Census reported there were 172,000 people aged 85 years or over living in care homes. Of these individuals, 103,000 were living in a care home without nursing and 69,000 in a care home with nursing.

While the majority of care home residents are older people, there is a cohort of those aged 18-65, who are in residential care because their physical or mental health prohibits them living independently. From the Age UK data, it might be assumed that there were 17,500 such individuals in care, but Emerson et al. (2013) stated that the number of people with learning disabilities in residential care in England at 31 March 2012 was over 36,000 of whom just under 6000 were aged 65 or over.

Successive Adult Dental Health Surveys have shown that people are keeping their teeth for longer (Fuller et al. 2011). The ravages of dental decay in the early to mid-twentieth century, together with the then prevailing attitude to oral health meant that many people had all of their teeth extracted when young. However, as attitudes to dentistry changed, the availability of dental care increased, dental technology improved and most importantly fluoridated toothpaste became widely available, the proportion of adults in England who were edentate (no natural teeth) has fallen by 22 percentage points from 28 per cent in 1978 to 6 per cent in 2009 (Fuller et al. 2011). Even amongst those aged

85 years or older, 53% still had some of their own teeth, and only 26% of these dentate adults had 21 or more natural teeth (Fuller et al 2011).

Together these trends mean that in the coming years, not only will there be more older people, a proportion of whom will live in care, the vast majority will have some or indeed all of their own teeth. In part, that many have retained their own teeth is as a result of dental treatment and restorative care. Complex and expensive dental work including crowns, prostheses, implants and bridges are likely to become increasingly prevalent in care home residents. This poses a much greater preventive and dental care challenge than that associated with the older person who has lost all their own teeth and who may or may not be wearing a complete denture (British Dental Association, 2012).

Cognitive and physical disabilities may preclude effective mouth care and this is especially so in those in residential care who may be totally dependent on carers to assist with or clean their teeth and/or dentures. As a result the incidence of oral diseases in care home residents tends to increase (Naorungroj 2013). This may happen prior to individuals entering residential care and may be exacerbated by medications that cause dry mouths (SA Dental Service 2009).

The National Institute for Health and Care Excellence (NICE) has been asked by the Department of Health to develop public health guidance on approaches for adult nursing and residential care homes on promoting oral health, preventing dental health problems and ensuring access to dental treatment. This review is the first of three reviews to inform the guidance. It considers the effectiveness of interventions. Subsequent reviews will consider best practice (Review 2) and barriers/facilitators (Review 3).

2 Methods

A systematic review of effectiveness evidence to address the above review question was undertaken. A wide range of databases and websites was searched systematically, supplemented by identification of grey literature². Searches were carried out to identify relevant studies in the English language published between 1995 and September 2014. A range of supplementary methods including a call for evidence by NICE, contacting authors, reference list checking and citation tracking were also utilised to identify additional research.

² Technical or research reports, doctoral dissertations, conference papers and official publications.

Primary intervention studies of any design were included. To ensure a high degree of applicability to UK settings, inclusion was further restricted to the following countries/regions: the USA, Canada, Western Europe, Australia and New Zealand. However, where evidence gaps were identified, studies identified from other countries were considered for their potential to fill those gaps.

Study selection was conducted independently in duplicate. Quality assessment and data extraction were undertaken by one reviewer and checked by a second, with 10% of papers being considered independently in duplicate.

A narrative summary of the evidence was completed along with meta-analyses of findings where feasible.

3. Results

Forty six studies reported in 58 papers providing data on a range of interventions met the inclusion criteria.

In general, internal validity was moderate with six studies deemed to have high internal validity (++), 23 studies of moderate quality (+) and 17 studies were assessed as being of low quality (-).

The majority of studies (n=36; 80%) provided data on the gender and age range of the residents. One study (Simons et al. 2000) stated the percentage of residents funded by social services, four (Binkley et al. 2014, Fickert et al. 2012, Lin et al. 1999, Quagliarello et al. 2009) give some indications of ethnicity and one (Fickert et al. 2012) described residents' educational level. Two studies (Mac Giolla Phadraig et al. 2013, Paulsson et al. 2001) provided information on the educational level of the care givers in the study. No differences in outcomes according to gender, age or socio-economic status were reported.

No studies reported whether the water used in the residence(s) was fluoridated.

4. Evidence Statements

Evidence Statement 1: Carer education and/or guideline introduction alone versus usual care on clinical oral health measures: overall effects

There is inconsistent evidence from 23 studies (3 UK^{10,15,20}, 5 USA^{1,5,6,17,18}, 2 Belgium^{8,9}, 2 Canada^{12,1}, 2 Sweden^{11,22}, 2 Switzerland^{4,14}, and 7 other applicable countries^{2,3,7,16,19,21,23}) as to whether carer education or protocol/guideline introduction alone for care home staff will deliver improvements in the oral health of residents when compared to usual care.

12 studies^{1,7,10,11,14-19,23} [1 (++) cRCT¹⁰, 2 (+) RCT^{1,23}, 1 (+) cRCT²¹, 1 (-) RCT¹⁶, 1 (+) CBA¹⁴, 2 (-) CBAs^{15,18}, 3 (+) UBAs^{7,11,19} and 1 (-) UBA¹⁷] showed statistically significant improvements in measures of dental, denture or overall oral health hygiene while 11^{2-6,8,9,12,13,22,23} [1 (++) cRCT⁹, 1 (+) RCT⁴, 1 (+) cRCT¹², 1 (-) RCT³, 1 (-) cRCT⁸, 1 (+) nRCT⁶, 2 (+) CBA^{2,23}, 1 (-) CBA²², 2 (+) UBA^{5,13}] did not find a significant intervention effect although two of these observed a positive trend^{2,9}.

Some meta-analyses were feasible and these suggested a non-significant but positive trend towards improvements in dental and denture plaque indices but a tiny negative trend for gingival index. The overall effect size (95% confidence interval) for Dental Plaque Index (Silness & L oe) from 4 studies⁹ was 0.10 (-0.12 to 0.33) [1 (++) cRCT⁹, 1 (+) RCT²¹, 1 (-) cRCT⁸, 1 (+) cRCT¹²]. For the Augsburg & Elahi Denture Plaque Index it was 0.69 (-0.05 to 1.43) [4 studies: 2 (++) cRCT^{9,10}, 1 (+) RCT²¹, 1 (-) cRCT⁸]. However, for the L oe & Silness Gingival Index this was -0.05 (-0.28 to 0.18) [2 studies: 1 (+) cRCT¹², 1 (+) CBA²⁰].

All the evidence is applicable to residential homes in the UK since 3 studies were based in the UK and other studies were conducted in countries with similar settings.

¹ Altabet et al. 2003 (+); ² Avenali et al. 2011 (+); ³ Beck et al. 2008 (-); ⁴ Bellomo et al. 2005 (+); ⁵ Boczko et al. 2009 (+); ⁶ Budtz-Jorgensen et al. 2000 (+); ⁷ Chalmers et al. 2009 (+); ⁸ De Visschere et al. 2011 (-); ⁹ De Visschere et al. 2012 (++) ; ¹⁰ Frenkel 2001 (++) ; ¹¹ Isaksson et al. 2000 (+); ¹² Le et al. 2012 (+); ¹³ McKeown et al. 2014 (+); ¹⁴ Mojon et al. 1998 (+); ¹⁵ Nicol et al. 2005 (-); ¹⁶ Peltola et al. 2007 (-); ¹⁷ Pronych et al. 2010 (-); ¹⁸ Pyle et al. 1998 (-); ¹⁹ Samson et al. 2009 (+); ²⁰ Simons et al. 2000 (+); ²¹ van der Putten et al. 2013 (+); ²² Wardh et al. 2002 (-); ²³ Zenth ofer et al. 2013 (+)

RCT: Randomised controlled trial; cRCT: Cluster RCT; CBA: Controlled before & after; UBA: Uncontrolled before & after

Evidence Statement 2. Carer education and/or guideline introduction alone versus usual care on clinical oral health measures: education intensity/component effects

23 studies (3 UK^{10,15,20}, 5 USA^{1,5,6,17, 18}, 2 Belgium^{8,9}, 2 Canada^{12,13}, 2 Sweden^{11,22}, 2 Switzerland^{4,14}, and 7 other applicable countries^{2,3,7,16,19,21,23}) looked at whether the length or components of in-service education or protocol/guideline introduction for care home staff will deliver improvements in the oral health of residents when compared to usual care.

There was strong evidence that education intensity (as measured by estimated hours of education) does not appear to be an influential factor. Of the 12 studies showing statistically significant improvements^{1,7,10,11,14-19,21,23} [1 (++) cRCT¹⁰, 2 (+) RCT^{1,23}, 1 (+) cRCT²¹, 1 (-) RCT¹⁶, 1 (+) CBA¹⁴, 2 (-) CBAs^{15,18}, 3 (+) UBAs^{7,11,19} and 1 (-) UBA¹⁷] contact hours ranged from 1-8 h (mean ~ 2.8h) while the contact hours for the 11 studies^{2-6,8,9,12,13,20,21} [1 (++) cRCT⁹, 1 (+) RCT⁴, 2 (+) cRCT^{12, 21}, 1 (-) RCT³, 1 (-) cRCT⁸, 1 (+) nRCT⁶, 2 (+) CBA^{2,22}, 2 (+) UBA^{5,13}] that did not find a significant intervention effect ranged from 0.33-10.5 h (mean ~ 3.3h).

There was weak evidence from 3 studies that ongoing support provided post education from a health professional was effective if this involved active motivation of carers. 3 studies where education was combined with re-motivation or monitoring of carer activity [1 (+) RCT²³, 1 (+) UBA¹⁹, 1 (-) UBA¹⁷] found significant improvements while 3 studies where guidance by health professionals alone was provided [1 (+) RCT⁴, 1 (-) RCT³, 1 (+) nRCT⁶] did not.

All the evidence is applicable to residential homes in the UK since 3 studies were based in the UK and other studies were conducted in countries with similar settings.

¹ Altabet et al. 2003 (+); ² Avenali et al. 2011 (+); ³ Beck et al. 2008 (-); ⁴ Bellomo et al. 2005 (+); ⁵ Boczko et al. 2009 (+); ⁶ Budtz-Jorgensen et al. 2000 (+); ⁷ Chalmers et al. 2009 (+); ⁸ De Visschere et al. 2011 (-); ⁹ De Visschere et al. 2012 (++) ; ¹⁰ Frenkel 2001 (++) ; ¹¹ Isaksson et al. 2000 (+); ¹² Le et al. 2012 (+); ¹³ McKeown et al. 2014 (+); ¹⁴ Mojon et al. 1998 (+); ¹⁵ Nicol et al. 2005 (-); ¹⁶ Peltola et al. 2007 (-); ¹⁷ Pronych et al. 2010 (-); ¹⁸ Pyle et al. 1998 (-); ¹⁹ Samson et al. 2009 (+); ²⁰ Simons et al. 2000 (+); ²¹ van der Putten et al. 2013 (+); ²² Wardh et al. 2002 (-); ²³ Zenthöfer et al. 2013 (+)

RCT: Randomised controlled trial; cRCT: Cluster RCT; CBA: Controlled before & after; UBA: Uncontrolled before & after

Evidence Statement 3. Guideline or protocol introduction supported by carer education versus usual care on clinical oral health measures

There is moderate evidence from eight studies (3 USA^{1,2,7}, 2 Belgium^{5,6}, 1 each Switzerland³, Australia⁴ and the Netherlands⁸) that guideline or protocol introduction supported by carer education is likely to be more effective than education alone.

Five studies found significant improvements in at least one oral health outcome (1 (+) RCT¹, 1 (+) cRCT⁸, 2 (+) UBA^{2,4}, 1 (-) UBA⁷), one (-) cRCT⁶ recorded a non-significant positive trend and two studies (1 (-)cRCT⁵ and (+) nRCT³) found no evidence in either direction.

Three of the controlled studies (1 (++) cRCT, 1 (+) cRCT⁸ and 1 (-) cRCT⁶) measured the same outcomes and recorded non-significant but positive trends for effect on dental plaque index and a significant combined positive effect size (95% CI) on denture plaque index of 0.33 (0.15 to 0.50).

The evidence is applicable to residential homes in the UK since all studies were conducted in countries with similar settings.

¹ Altabet et al. 2003 (+); ² Binkley et al. 2014 (+); ³ Budtz-Jorgensen et al. 2000 (+) ⁴ Chalmers et al. 2009 (+) ; ⁵ de Visschere et al. 2011 (-); ⁶ de Visschere et al. 2012 ; ⁷ Sloane et al. 2013 (-); ⁸ van der Putten et al. 2013 (+)

RCT: Randomised controlled trial; cRCT: Cluster RCT; nRCT Non randomised controlled trial; UBA: Uncontrolled before & after

Evidence Statement 4: Carer education with enhancements versus education alone on clinical oral health measures

There is inconsistent evidence from 10 studies (5 USA^{1,3,4,6,7}, 1 each Switzerland², Canada⁵, Norway⁸, Sweden⁹, Germany¹⁰) as to whether enhanced carer education will deliver improvements in the oral health of residents compared to education alone.

7 controlled studies compared enhanced education with education alone^{1,2,4,5,7,9,10} [1 (++) cRCT⁵, 2 (+) RCT^{2,10}, 4 (-) CBAs^{1,4,7,9}]. Enhancements varied and covered ongoing specialist support and motivation^{1,2,5,9,10}, monitoring (staff accountability)⁴ and multiple training sessions⁷. 2 (-) CBAs^{4,7} reported statistically significant improvements in a range of oral

health outcomes while the other 5 studies [1 (++) cRCT⁵, 2 (+) RCT^{2,10}, 2 (-) CBA^{1,9}] did not find a significant intervention effect.

Interventions and outcomes varied hugely, precluding synthesis, but three uncontrolled studies^{3,6,8} [2 (+) UBAs^{3,8}, 1(-) UBA⁶] reported significant pre-post improvements in clinical oral health outcomes following enhanced education interventions which also included environmental changes and reinforcement³, ongoing trainer support and appointment of an oral health coordinator⁶ or motivation, ward routines and monitoring⁸.

In two studies [1 (-) CBA⁴, 1 (+) UBA⁸] where compliance was actively monitored by a dental hygienist via random dental plaque tests (over 3 weeks)⁴ or reports to management (every 6-18 months over six years)⁸ significant improvements compared to education alone were noted in plaque indices (standard error) in the CBA⁴ which reported changes from baseline to 21 days of 2.13 (0.14) to 0.23 (0.009) in the training plus monitoring group compared to 1.94 (0.17) to 2.12 (0.16) in the training only group. The UBA reported acceptable mucosal plaque scores changes from 36% to 70% over a 6-year period⁸

The evidence is applicable to residential homes in the UK since all studies were conducted in countries with similar settings.

¹ Amerine et al. 2014 (-); ² Bellomo et al. 2005 (+); ³ Binkley et al. 2014 (+) ⁴ Lange et al. 2000 (-); ⁵ MacEntee et al. 2007 (++); ⁶ Pronych et al. 2010 (-); ⁷ Pyle et al. 1998 (-); ⁸ Samson et al. 2009 (+); ⁹ Wardh et al. 2002 (-); ¹⁰ Zenthöfer et al. 2013 (+)

RCT: Randomised controlled trial; cRCT: Cluster RCT; CBA: Controlled before & after; UBA: Uncontrolled before & after

Evidence Statement 5: Carer education alone versus usual care on knowledge immediately post education

There is weak evidence from 4 studies (all USA^{1,2,3,4}) to suggest that carer education can improve residential care staff oral health care knowledge immediately post education.

Three uncontrolled studies [2 (+) UBA^{1,2}, 1 (-) UBA³] reported significant gains in oral health knowledge. One (-) CBA⁴ found that a group of nurses trained for 4 hours made oral health assessments that more closely matched the scores recorded by dentists than a group trained for 1-hour but the difference was not significant.

Interventions varied in both components and length (ranging from 0.5 to 4 h). A range of different outcomes were measured across studies so the overall direction of effect could

not be estimated.

The evidence is applicable to residential homes in the UK since all studies were conducted in countries with similar settings.

¹ Arvidson-Bufano et al. 1996 (+); ² Boczko et al. 2009 (+); ³ Fickert et al. 2012 (-); ⁴ Lin et al. 1999 (-)

CBA: Controlled before & after; UBA: Uncontrolled before & after

Evidence Statement 6: Carer education alone versus usual care on knowledge in the longer term

There is inconsistent evidence from 7 studies (1 UK⁷, 2 USA^{1,4}, 1 Canada², 1 France⁶, 1 Ireland³, 1 Sweden⁵) as to whether oral health knowledge gains are maintained in care home staff in the longer term (two or more months post education). 4 studies [1 (+) cRCT², 1 (+) CBA⁷, 2 (-) UBA^{1,4}] reported no significant evidence of effect while 3 [1 (+) cRCT³, 1 (+) UBA⁵, 1 (-) UBA⁶] found significant gains, at up to three years follow up for 1 (+) UBA⁵; However this study⁵ looked at nurses' perceptions of their knowledge only.

Interventions varied and a range of different outcomes were measured across studies so the direction of effect could not be estimated. Of the 3 studies suggesting benefits in the longer term^{3,5,6}, 2 provided more intensive education for staff with total durations of 9h³ and 2 days (est. 8h)⁶ respectively compared to an estimated average duration of 4.5 hours (range 1-9 h) across all 7 studies reporting longer term outcomes. However, 1 study looked at nurse perceptions only⁵ while another included an unspecified oral health component within a nutrition education intervention⁶.

All the evidence is applicable to residential homes in the UK since 1 study was based in the UK and other studies were conducted in countries with similar settings.

All the studies were carried out in homes for the elderly other than one (+) cRCT³ which took place in a home for adults with disabilities.

¹ Fickert et al. 2012 (-); ² Le et al. 2012 (+); ³ MacGiolla-Phadraig et al. 2013 (+); ⁴ Munoz et al. 2009 (-); ⁵ Paulsson et al. 2001 (+); ⁶ Poisson et al. 2014 (-); ⁷ Simons et al. 2000 (+)

cRCT: Cluster RCT; CBA: Controlled before & after; UBA: Uncontrolled before & after

Evidence Statement 7: Electric versus manual toothbrushes on clinical oral health measures

There is moderate evidence from 3 RCTs [1 (++)³, 2 (+)^{1,2}], two in the USA^{1,2} and one in Norway³ that use of an electric versus a manual toothbrush may be beneficial in terms of clinical oral health measures in some population groups, although there were some conflicts in findings.

1 (+) RCT² found significant benefits from using an electric rather than a manual toothbrush in an elderly population, observing a standard mean difference (95% CI) in dental plaque of 0.7 (0.29, 1.66). The other (+) RCT¹ observed benefits from the use of an electric versus manual toothbrush for those adults with disabilities that brushed independently noting an SMD in Gingival Index (95% CI) of 0.69 (0.03, 1.36). For patients who needed assistance with brushing, no difference was observed (-0.03 (-0.96, 0.90)).

1 (++) RCT³ in an elderly population did not observe a statistically significant difference between electric and manual toothbrush groups but the study found that participants who needed assistance with dental hygiene had significantly better results with the electric vs manual toothbrush than those who did not. The mean improvement in oral hygiene index (SD) was 0.58 (0.45) for those needing assistance and 0.12 (0.48) for those that did not (p<0.001).

All the evidence is applicable to residential homes in the UK since studies were conducted in countries with similar settings.

¹ Carr et al. 1997 (+); ² Day et al. 1998 (+); ³ Fjeld et al. 2014 (++)

RCT: Randomised controlled trial

Evidence Statement 8: Chlorhexidine on oral health outcomes - overall effect

There is strong evidence from 8 studies (3 USA^{5,7,8}, 2 Spain^{2,3}, and 1 UK⁶, Sweden¹ and Finland⁴) that a chlorhexidine intervention improves a range of clinical oral health measures in care home residents. 7 studies^{1,2,4-8} [1 (++) RCT⁸, 2 (+) RCT^{5,6}, 1 (-) RCT⁴, 1 (-) CBA², and 2 (-) UBA^{1,7}] showed a statistically significant improvement in oral health measures while 1 (++) RCT³ and 1 (-) CBA² found an insignificant improvement in some outcomes.

There is weak evidence from 1 study [(+) Canada, RCT⁹] that chlorhexidine was less

effective in preventing dental caries than the positive sodium fluoride control.

Due to the variability in outcome measures, it was only possible to include 2 studies in the meta-analysis. Figures 4.1 and 4.2.

A meta-analysis of 2 studies [1 (++) Spain, RCT³ and 1(+) UK, RCT⁶] estimated the effectiveness of chlorhexidine. One study found a large positive effect⁶ with the remaining study³ suggesting a trend towards a small positive effect for dental plaque index (95% CI) of 0.22 (-0.25 to 0.69) but a negative trend for gingival index of -0.26 (-0.73 to 0.21).

All the evidence is applicable to residential homes in the UK since 1 study was based in the UK and other studies were conducted in countries with similar settings.

¹ Kullberg et al. 2010 – ; ² Lopez et al. 2013 – ; ³ Lopez-Jornet et al. 2012 ++ ; ⁴ Peltola et al. 2007 – ; ⁵ Quagliarello et al. 2009 + ; ⁶ Simons et al. 2001 + ; ⁷ Sloane et al. 2013 – ; ⁸ Stiefel et al. 1995 ++ ; ⁹ Wyatt et al. 2004 +.

RCT: Randomised controlled trial; CBA: Controlled before & after; UBA: Uncontrolled before & after

Evidence Statement 9: Chlorhexidine only versus other oral rinses on oral health outcomes

There is inconsistent evidence from 2 studies [1 (++) Spain, RCT¹ and 1 (+) Canada, RCT²] about the effect of a chlorhexidine intervention on the oral health outcome of care home residents when compared to other oral rinse formulation.

1 study [1 (+) RCT²] indicates that at 2 years follow-up the mean increase of carious surfaces was significantly less in the sodium fluoride group with mean (SD) of 0.7 (4.2) compared to the chlorhexidine group with mean of 3.1 (5.8) and the isopropyl group with mean (SD) of 2.9 (4.9).

1 study [1 (++) RCT¹] observed an insignificant improvement of standard mean difference (95% CI) in dental plaque of 0.22(-0.25, 0.69), but a negative effect of chlorhexidine on gingival index with SMD (95% CI) of -0.26 (-0.73, 0.21). The control group used a similar oral rinse as the intervention group but with no chlorhexidine.

All the evidence is applicable to residential homes in the UK since studies were conducted

in countries with similar settings.

¹ Lopez-Jornet et al. 2012 ++ ; ² Wyatt et al. 2004 +.

RCT: Randomised controlled trial

Evidence Statement 10: Chlorhexidine or amine fluoride versus usual care*

There is weak evidence from 1 study [(–) CBA, Spain¹] that a chlorhexidine only intervention and an amine fluoride intervention both resulted in a statistically significant remineralisation of decayed dental surfaces when compared with usual care; $p = 0.0151$.

There was a decrease in plaque index from 2.004 to 1.205 in chlorhexidine group, 2.599 to 2.158 in amine fluoride group and 2.178 to 1.87 in usual care group. There was also a reduction in gingival index from 1.03 to 0.11 in chlorhexidine group, an increase from 1.85 to 2.00 in the amine fluoride group and 1.51 to 1.61 in the usual care group, but there was no significant inter-group difference for both the plaque and gingival index ($p > 0.05$).

This evidence is applicable to residential homes in the UK since the study was conducted in a country with a similar setting

¹ Lopez et al. 2013 –.

*usual care involved participants brushing without toothpaste

CBA: controlled before and after

Evidence Statement 11: Chlorhexidine/xylitol or xylitol only versus usual care

There is moderate evidence from 1 study [(+) UK, RCT¹] that a chlorhexidine/xylitol chewing gum intervention significantly improves plaque and gingivitis scores when compared to usual care in care home residents.

The (+) RCT indicated a significantly lower plaque score with mean (SD) of 0.8 (0.8) in the Chlorhexidine/xylitol group, 1.6 (1.0) in the xylitol only group and 2.6 (0.6) in the control group. It also showed a significantly lower gingival score with mean (SD) of 0.5 (0.7) in the chlorhexidine/xylitol group, 1.6 (1.0) in xylitol only group and 2.2 (1.0) in the usual care group, all significantly different from each other at $p < 0.001$.

This study was conducted in the UK and the evidence is directly applicable.

¹ Simons et al. 2001 +.

RCT: Randomised controlled trial

Evidence Statement 12: Chlorhexidine plus toothbrushing on oral health measures

There is weak evidence from 1 study [(+) RCT, USA¹] that a 3 months intervention of chlorhexidine plus oral brushing in care home residents resulted in a mean reduction in plaque score of 1.45 ± 0.52 ($p < 0.001$) with a measure of dose response relationship.

This study is applicable to the UK since it was conducted in a country with a similar setting.

¹ Quagliarello et al. 2009 +

RCT: Randomised controlled trial

Evidence Statement 13: Chlorhexidine/Sodium fluoride/dental prophylaxis

There is moderate evidence from 1 study [(++) RCT, USA¹] that an intervention involving the use of chlorhexidine and sodium fluoride plus dental prophylaxis in care home residents showed a significant reduction in plaque score (from 1.83 to 1.28, $p < 0.001$), calculus score (1.18 to 0.35, $p < 0.001$), gingivitis score (2.07 to 1.10; $p < 0.001$) and pocket depth (2.78 to 2.26 ($p < 0.001$)). There was no significant difference in Decayed Missing and Filled Surface score (i.e. no impact on dental caries).

This study is applicable to the UK since it was conducted in a country with a similar setting
Stiefel et al. 1995 ++

RCT: Randomised controlled trial

Evidence Statement 14: Chlorhexidine/educational intervention on oral health measures

There is weak evidence from 3 studies [1 (-) UBA, Sweden¹, 1 (-) RCT, Finland² and 1 (-) UBA, USA³] that a chlorhexidine/educational intervention improved some clinical oral health outcomes in care home residents.

In 1 (–) UBA¹ it was observed that a chlorhexidine/educational/electric toothbrush intervention resulted in significant pre-post improvements in plaque and Gingival Bleeding Index (GBI) at 3 weeks follow up. Median difference in plaque score (after vs before education) (95% CI) = -12.0 (-14.0 to -7.0; p<0.001). Median difference in GBI (after vs before education) = -6.0 (-7.0 to -1.0; p<0.001).

In 1 (–) RCT² the chlorhexidine was only used on dentures and this resulted in a significant increase in good denture hygiene in all groups (p =0.02). By subjects, denture hygiene improved in all groups, but this change was most prominent in the group where nursing staff took charge of oral hygiene (56%) compared to the usual care group that had no chlorhexidine intervention (27%) or the group where a dental hygienist took charge of oral hygiene (35%).

In 1 (–) UBA, USA³ the chlorhexidine/educational intervention was combined with a sodium fluoride paste intervention. This study indicated a significant improvement in plaque index for –long-term care (2.5±0.5 to 1.7±0.8; p < 0.001) and gingival index-long term care (1.8±0.5 to 1.4±0.5; p < 0.001) and denture plaque index (2.9±0.9 to 2.1±0.7; p=0.04) at 8 weeks follow-up. There was an insignificant reduction in inflamed or bleeding gums from 64±85 to 60±85; p=0.96) at 8 weeks follow-up.

This evidence is applicable to residential homes in the UK since the studies were conducted in countries with a similar setting.

¹ Kullberg et al. 2010 –; ² Peltola et al. 2007 –; ³ Sloane et al. 2013 –.

RCT: Randomised controlled trial; UBA: Uncontrolled before & after

Evidence Statement 15: Adverse events from chlorhexidine use

There is moderate evidence from 2 (++) RCTs^{1,2}, one in Spain¹ and one in the USA², of some adverse events attributed to chlorhexidine use in elderly care¹ and adult disability² settings.

In 1 (++) RCT¹ authors reported that adverse effects included staining of teeth/dentures and tongue (p=0.000 at 30 days in both cases). It was also reported that no resident showed mucosal desquamation (breakdown of the lining of the mouth) or alterations in taste sensation.

The other (++) cross-over RCT² reported that, during chlorhexidine use, staining was a

major problem for one subject (3%), a minor problem for 19% and no problem for 78%. Taste was a major problem for 11%, a minor problem for 22% and no problem for 67%. Gagging was a major problem for 11%, a minor problem for 3% and no problem for 86%.

The evidence is applicable to residential homes in the UK since one study¹ was conducted in Spain and the other² in the USA

¹ Lopez-Jornet et al. 2012 ++; ² Stiefel et al. 1995 ++

RCT: Randomised controlled trial

Evidence Statement 16: Xylitol gum on clinical oral health measures

There is moderate evidence from 1 (+) RCT¹ and 1 (–) UBA² that a xylitol chewing gum intervention significantly improves oral health outcome in residents when compared to usual care.

The (+) RCT¹ indicated a significantly lower plaque score with mean (SD) of 1.6 (1.0) in the xylitol only group and 2.6 (0.6) in the control group with no-gum at $p < 0.001$ and a significantly lower gingival indices score with mean (SD) of 1.2(1.0) and 2.2 (1.0) in the xylitol only and control group respectively at $p < 0.001$. The (–) UBA² reported a decrease in biofilm (dental plaque) amongst residents and improved nurses' attitude towards oral care resulting from twice daily chewing of xylitol gum and casein phosphopeptide–amorphous calcium phosphate (CPP-ACP) use but only photographic results were provided.

The evidence is applicable to residential homes in the UK since one study¹ was conducted in the UK and the other² in a country with a similar setting.

¹ Simons et al. 2001 (+); ² Stone et al. 2013 (–)

RCT: Randomised controlled trial; UBA: Uncontrolled before & after

Evidence statement 17: Access to dental treatment/regular check-ups

There was no evidence identified for interventions in care home settings that specifically explored effects on resident access to dental treatment or regular check-ups.

5. Discussion

The aims of this review were to seek evidence as to what approaches, activities or interventions were effective in promoting oral health, preventing dental problems and ensuring access to dental care (including regular check-ups) for adults in care homes. Approaches identified were education/guideline introduction for care home staff, the use of electric versus manual toothbrushes, chlorhexidine and xylitol use.

Despite the large number of relevant studies, the evidence for education or guideline introduction was inconsistent, with no clear indications as to whether intervention intensity (the number of hours of education) or specific components had an effect on clinical oral health outcomes.

However, there was some evidence that education combined with active monitoring of compliance by care home staff or specific guideline introduction within the home, might be more effective. Education was found to increase staff knowledge in the short term but evidence for long term retention of this knowledge was inconsistent.

Three studies suggested that the use of an electric rather than a manual toothbrush may be useful but the evidence as to whether this leads to improvements for population groups brushing independently, or for those needing assistance, was conflicting. At least two of the three studies providing the evidence base were funded by electric toothbrush manufacturers.

There was strong evidence for the use of chlorhexidine as an adjunct to other interventions (such as education or tooth brushing) but it is associated with side effects and its value as compared to alternative treatments such as sodium fluoride or xylitol was unclear.

No studies were identified that specifically explored effects on resident access to dental treatment or regular check-ups. Some guidance for those involved in care provision in this area has been identified within the best practice review (Review 2 in this series) and views of care home staff and dental health professionals on this topic are being identified within the barriers & facilitators review (Review 3).

Comparability of findings with the Coker 2014 systematic review

A recently published well conducted systematic review (Coker et al 2014) examined the effectiveness of educational programmes in dependent older adults residing in long-term care or having extended hospital stays. Unlike this current review, Coker et al. included only randomised and non-randomised controlled studies – eight of which met the inclusion criteria for this review

and were included (Budtz-Jorgensen et al. 2000, De Visschere et al. 2012, Frenkel et al. 2001, MacEntee et al. 2007, Mojon et al. 1998, Nicol et al. 2005, Simons et al. 2000, van der Putten et al. 2013).

In keeping with the findings from this review, Coker et al. noted the range of educational approaches used and concluded that *“none emerged as being desirable over the others, as methodologically strong studies with good intervention integrity were lacking, and a variety of oral health outcomes were used to measure the effectiveness of the interventions, making comparisons across studies difficult”*.

Strengths and limitations of this review

This review was built on a comprehensive search strategy. The literature search included a thorough attempt to identify relevant published and unpublished studies.

The quality of studies overall was judged as moderate but the very large number of outcomes used limited the feasibility of meta-analysis to synthesise the results of similar interventions.

The available evidence was relevant to care home populations in general but no specific data were available to assess variations by gender or other socio-economic factors.

Abbreviations

CBA	Controlled before and after study
CHX	Chlorhexidine
CI	Confidence Interval
cRCT	Cluster randomised controlled trial
DH	Department of Health
DI-S	Debris Index – Simplified
DMFT	Decayed, missing or filled teeth
DPI	Denture Plaque Index
GBI	Gingival Bleeding Index
GDI-S	Geriatric Simplified Debris Index
GI-LTC	Gingival Index for Long-Term Care
GOHAI	Geriatric Oral Health Assessment Index
GP	General Practitioner
IP	Isopropyl Alcohol
ITS	Interrupted time series
MDS	Minimum Data Set
MPS	Mucosal-plaque score
NaF	Sodium Fluoride
NFPA	Nutrition Focussed Physical Assessment
NICE	National Institute for Health and Care Excellence
nRCT	Non-randomised controlled trial
OAG	Oral Assessment Guide
OHAT	Oral Health Assessment Tool
OHI-S	Oral Hygiene Index-Simplified
OHKT	Oral Health Knowledge Test
ONS	Office for National Statistics
PI-LTC	Plaque Index for Long-Term Care
RAI-MDS	Resident Assessment Instrument- Minimum Data Set
RCI	Root Caries Index
RCT	Randomised controlled trial
SD	Standard Deviation
SMD	Standardised Mean Difference
UBA	Uncontrolled before and after study
WHO	World Health Organisation

1 Introduction

1.1 Aim

To review the evidence about approaches, activities and interventions that promote oral health, prevent dental problems and ensure access to treatment for adults in care home settings.

1.2 Review question

What approaches, activities or interventions are effective in promoting oral health, preventing dental problems and ensuring access to dental care (including regular check-ups) for adults in care homes?

1.3 Background and understanding

Care Home Residents - Demographics

The demographics of people living in care homes at any point in time are difficult to quantify precisely. According to Age UK (2014) calculations, in April 2012 there were 431,500 adults in residential care of whom approximately 414,000 (95%) were aged 65 or over. The 2011 Census reported there were 172,000 people aged 85 years or over living in care homes. Of these individuals, described by the Office for National Statistics (ONS) as the “oldest old”, 103,000 were living in a care home without nursing and 69,000 in a care home with nursing.

While the majority of care home residents are older people, there is a cohort of those aged 18-65, who are in residential care because their physical or mental health prohibits them living independently. From the Age UK data, it might be assumed that there were 17,500 such individuals in care, but Emerson et al. (2013) stated that the number of people with learning disabilities in residential care in England at 31 March 2012 was over 36,000 of whom just under 6000 were aged 65 or over. A previous report (Emerson et al. 2012) noted that the proportion of residential care use by learning disabled adults aged 65 or over was increasing (from 11.3% in 2005/06 to 15.8% in 2011/12).

It is therefore apparent that the characteristics of those living in residential care are heterogeneous and their needs, wants and ability, both physical and cognitive, will vary significantly. Policies designed to encourage more independent living for people with learning disabilities in group and halfway houses, and to support older people to live in their own homes mean that numbers of people in residential care have decreased

slightly. However, the evidence also suggests higher levels of care are being required by those in residential homes (ONS 2013; ONS 2014).

Care Home Residents – Demographic trends

Successive Adult Dental Health Surveys have shown that people are keeping their teeth for longer (Fuller et al. 2011). The ravages of dental decay in the early to mid-twentieth century, together with the then prevailing attitude to oral health meant that many people had all of their teeth extracted when young. However, as attitudes to dentistry changed, the availability of dental care increased, dental technology improved and most importantly fluoridated toothpaste became widely available, the proportion of adults in England who were edentate (no natural teeth) has fallen by 22 percentage points from 28 per cent in 1978 to 6 per cent in 2009 (Fuller et al. 2011).

The most recent figures from the Office for National Statistics (ONS 2014) indicate that the numbers of people aged 65 or over in the UK continues to rise and is currently 11.1 million or 17.4% of the UK population. The biggest percentage rise is in the population aged 85 or older and the 2011 census (ONS 2013), found 1.25 million people aged 85 or older; almost a 25% increase from the 2001 census. In 2009, approximately 53% of adults aged 85 or older were dentate and only 26% of these dentate adults had 21 or more natural teeth (Fuller et al 2011).

Together these trends mean that in the coming years, not only will there be more older people, a proportion of whom will live in care, the vast majority will have some or indeed all of their own teeth. In part, that many have retained their own teeth is as a result of dental treatment and restorative care. Complex and expensive dental work including crowns, prostheses, implants and bridges are likely to become increasingly prevalent in care home residents. This poses a much greater preventive and dental care challenge than that associated with the older person who has lost all their own teeth and who may or may not be wearing a complete denture (British Dental Association, 2012).

Oral disease and care home residents

Dental caries and periodontal disease are to a large degree preventable. However, failure to maintain good oral hygiene, a diet rich in sugars and inadequate exposure to fluoride increase disease risk. Poor oral health can have a significant impact on the management of medical conditions, general health status, ability to eat and quality of life (Weening-Verbree et al. 2013). In addition, Azarpazhooh & Leake (2006) undertook a systematic review of associations between oral health and respiratory disease. The

presence of oral pathogens, dental decay and poor oral hygiene were all identified as potential risk factors for pneumonia.

A Cochrane review (Brady et al. 2006) looked at the oral health of stroke patients in residential care and identified a lack of rigorous evidence on the topic, but stated that oral healthcare interventions "can improve staff knowledge and attitudes, the cleanliness of patients' dentures and reduce the incidence of pneumonia."

In a systematic review Miegel & Wachtel (2009) identified a number of barriers to good oral health in care homes. These included lack of oral health education of care providers (including staff training); care provider attitudes to the oral health of residents; oral health policy and documentation; lack of oral health resources in terms of equipment and staff time and a failure to undertake oral health assessments. Wardh et al. (2012) identified dislike or fear of providing oral care particularly when combined with lack of adequate training or time to complete the task to be an issue for caregivers. These problems are exacerbated where the older person has dementia, communication or behaviour difficulties, or resists care (Jablonski et al. 2011).

Cognitive and physical disabilities may preclude effective mouth care and this is especially so in those in residential care who may be totally dependent on carers to assist with or clean their teeth and/or dentures. As a result the incidence of oral diseases in care home residents tends to increase (Naorungroj 2013). This may happen prior to individuals entering residential care and may be exacerbated by medications that cause dry mouths (SA Dental Service 2009).

The National Institute for Health and Care Excellence (NICE) has been asked by the Department of Health to develop public health guidance on approaches for adult nursing and residential care homes on promoting oral health, preventing dental health problems and ensuring access to dental treatment. This review is the first of three reviews to inform the guidance. It considers the effectiveness of interventions. Subsequent reviews will consider best practice (Review 2) and barriers/facilitators (Review 3)

2 Methods

In keeping with the NICE Manual: *Methods for the development of NICE public health guidance*³ a best evidence approach was adopted.

2.1 Literature search

A wide range of databases and websites were searched systematically; supplemented by grey literature⁴ searches. Searches were carried out to identify relevant evidence in the English language published between January 1995 and September 2014 that is:

- of the highest quality available;
- publicly available, including trials in press (“academic in confidence”)

The following types of evidence were sought for inclusion: systematic reviews and meta-analyses⁵; randomised controlled trials; controlled trials; controlled before and after studies, interrupted time series, uncontrolled before and after studies.

For the search, a strategy was developed in Ovid Medline (see Appendix 1) and was adapted to all other databases listed below.

Databases

AMED (Allied and Complementary Medicine) - Ovid
 ASSIA (Applied Social Science Index and Abstracts) - Proquest
 CINAHL (Cumulative Index of Nursing and Allied Health Literature) - EBSCO
 Embase - Ovid
 Health Management Information Consortium (HMIC) - Ovid
 MEDLINE and MEDLINE in Process - Ovid
 OpenGrey <http://www.opengrey.eu/>
 Social Care Online <http://www.scie-socialcareonline.org.uk/>

Websites

Australian Research Centre for Population Oral Health
<http://www.adelaide.edu.au/arcpoh/>
 British Society of Gerodontology

³ <http://publications.nice.org.uk/methods-for-the-development-of-nice-public-health-guidance-third-edition-pmg4>

⁴ Technical or research reports, doctoral dissertations, conference papers and official publications.

⁵ Unless directly relevant to answering one or more question, systematic reviews and meta-analyses will be unpicked to identify studies meeting the inclusion criteria.

British Society for Disability and Oral Health

Clinical trial registers:

- WHO ITCRP <http://www.who.int/ictcp/en/>

- Clinicaltrials.gov <http://www.clinicaltrials.gov/>

Electronic Theses Online Service (EThOS) <http://ethos.bl.uk>

European Association of Dental Public Health <http://www.eadph.org/>

Health Evidence Canada <http://www.healthevidence.org/>

International Association of Dental Research (IADR)

National Oral Health Conference

<http://www.nationaloralhealthconference.com/>

NICE Evidence Search <https://www.evidence.nhs.uk/>

Public Health England <https://www.gov.uk/government/organisations/public-health-england>

Public Health Wales <http://www.wales.nhs.uk/sitesplus/888/home>

Scottish Public Health network <http://www.scotphn.net/>

Social Care Institute for Excellence (SCIE) <http://www.scie.org.uk/>

US National Guideline Clearing House <http://www.guideline.gov/>

Australian Clinical Practice Guidelines Portal <http://www.clinicalguidelines.gov.au/>

New Zealand Guidelines Group <http://www.health.govt.nz/about-ministry/ministry-health-websites/new-zealand-guidelines-group>

Public Health Agency of Canada <http://www.phac-aspc.gc.ca/dpg-eng.php>

In addition a variety of supplementary methods were employed to identify additional research:

- For included papers, reference lists were checked and citation tracking was undertaken in Web of Science and Scopus databases.
- The electronic table of contents of three key journals were searched: *Special Care in Dentistry*, *The Journal of Disability and Oral Health* and *Gerodontology*.
- Experts in the field and authors of included papers were contacted to identify additional research and 'sibling' studies.
- A call for evidence was issued by NICE.

Results of all searches were combined in a Reference Manager 12 database.

2.2 Inclusion and exclusion criteria

Inclusion	<p>Population</p> <p>Adults in care homes with or without nursing provision, including people staying for rehabilitation or respite care. The term ‘care homes’ covers homes that provide 24 hour residential care. This may include adults living in community hospitals that provide long term-care.</p> <p>Activities:</p> <ul style="list-style-type: none"> • Conducting assessments of individual oral health, for example on entry to a care home and in response to changing oral health needs. • Maintaining access to dental services, including those offered by local salaried dental services, general dental practice and coordinating other health care services. For example joining up oral health services with other health initiatives provided in care home settings (such as services offered by GPs, vision testing, social services, podiatry). • Staff training about oral health (including understanding the effect of oral health on general health and wellbeing). • Increasing access to fluoride for people living in care homes. For example, by providing free fluoride toothpaste or gels, providing fluoride supplements, or by dental health care professionals offering fluoride varnish applications in care homes. • Providing oral health education and information about promoting and maintaining oral health (for example the role of diet, techniques for brushing teeth and maintaining healthy dentures). • Providing resources to improve oral hygiene for people living in care homes (as appropriate), for example providing a range of toothbrushes including electric toothbrushes. • Managing transitions if oral function deteriorates or a person’s usual diet has to change. • Considering the effect of diet, alcohol and tobacco on the oral health of people living in care homes. <p>Comparator:</p> <p>All comparators</p> <p>Outcomes:</p> <ul style="list-style-type: none"> • Changes in: <ul style="list-style-type: none"> . The oral health of people living in care homes. For
------------------	--

	<p>example, by identifying earlier the incidence and prevalence of tooth decay, periodontal disease, oral discomfort including pain and oral cancer. Also, for example, leading to a change in nutritional status among people living in care homes.</p> <ul style="list-style-type: none"> . Modifiable risk factors, including the use of fluoride toothpaste, fluoride supplements, fluoride varnishes, frequency and quality of oral hygiene practices, and access to or visits from dental services. . Policies or procedures in care homes. . Knowledge and attitudes of care home managers and staff, and other health and social care professionals. . Resident’s quality of life, including social and emotional wellbeing. . People’s knowledge and ability to improve and protect their oral health. . People’s oral health behaviours. <ul style="list-style-type: none"> • Adverse events or unintended consequences
Exclusion	<ul style="list-style-type: none"> • Adults living independently in the community. • Adults in hospitals providing secondary or tertiary care for example acute hospitals or specialised units. • Adults in prison. • Children and young people under 18 years. • Water fluoridation. • Specialised oral health interventions, including dental clinical procedures, treatments or medicines. • Concentration of fluoride in fluoride products such as toothpastes and supplements. • Specific techniques or instruction for carers to help people with their oral hygiene (for example, techniques to remove dentures, clean the mouth, brush teeth, or perform a range of oral hygiene tasks). • Interventions to manage oral health for adults with specific health conditions. • Interventions to manage behaviours that are seen as challenging and associated with resisting care or treatment • Interventions with an indirect oral health outcome only (eg bacterial count or pneumonia incidence)

Other than for those with the potential to fill evidence gaps, studies were restricted to those conducted in the UK, Western Europe, North America and Australia/New Zealand. This ensured high levels of applicability.

2.3 Study selection

After de-duplication and removal of clearly irrelevant citations (e.g. papers not related to oral health, animal studies), study selection at both title/abstract and full text stages was undertaken independently by two reviewers using the inclusion and exclusion criteria. Any disagreements at either stage were resolved by recourse to a third reviewer. Papers excluded at full text are reported in Appendix J with the reason for exclusion.

2.4 Quality assessment

Quality assessment was conducted using the relevant quality appraisal checklist (NICE 2012). Each paper was assessed by one reviewer and checked for accuracy by another. Ten percent of the studies were double assessed. Each study was rated ('++', '+' or '-') to indicate its quality.

- ++ All or most of the checklist criteria have been fulfilled, and where they have not been fulfilled the conclusions are very unlikely to alter.
- + Some of the checklist criteria have been fulfilled, and where they have not been fulfilled, or are not adequately described, the conclusions are unlikely to alter.
- Few or no checklist criteria have been fulfilled and the conclusions are likely or very likely to alter.

2.5 Data extraction – study characteristics and methodology

Evidence was extracted directly into a form agreed with NICE. Data was selected and characterised using PROGRESS-Plus.

Each data extraction form was completed by one reviewer and checked for accuracy by another. Ten percent of the studies were extracted independently by two reviewers.

Papers were added to an NVivo database and relevant outcomes and demographic data was coded. This allowed rapid identification for data 'slicing'; including data specific to populations of interest.

2.6 Data Synthesis

The key findings of evidence are summarised in concise narrative summaries and evidence statements which are supported by evidence tables (Appendix A). The evidence statements indicate the message given by the evidence and the applicability of the results to the UK.

Meta-analysis proved feasible for some studies reporting the following outcome measures: Plaque Index [Silness and L oe], Gingival Index [L oe and Silness], Denture hygiene/plaque (Augsbuger and Elahi). A number of studies reported the Simplified Oral Hygiene Index [Greene & Vermillion] and Denture plaque (Amb ornsen) indices but sufficient outcome data in the papers were not available to permit meta-analysis for these outcomes.

Measuring oral hygiene - Plaque and Gingival Indices

There are two primary ways of measuring the effectiveness of tooth cleaning and oral hygiene measures. These involve (i) quantifying the accumulation of dental plaque on a number of Index teeth; (ii) recording the degree of inflammation of the gingival (gum) tissues. This is done by running a probe along the gum margin and determining if this elicits bleeding.

There are a number of different indices that have been developed to record these features – the different indices vary in how they record the amount of plaque present. This heterogeneity prevents studies conducted with different indices being combined and was a limitation in performing meta-analyses in this review.

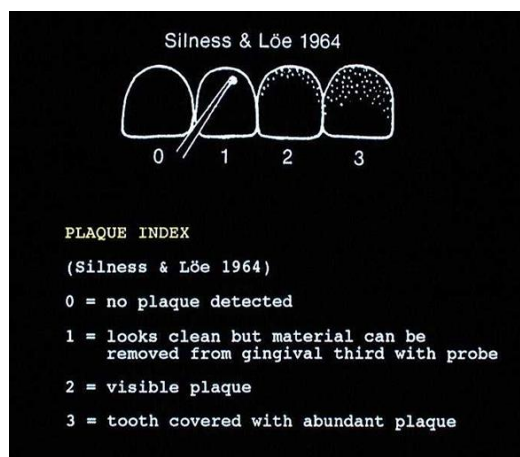


Figure 2.1 The Plaque Index of Silness and L oe (1964)

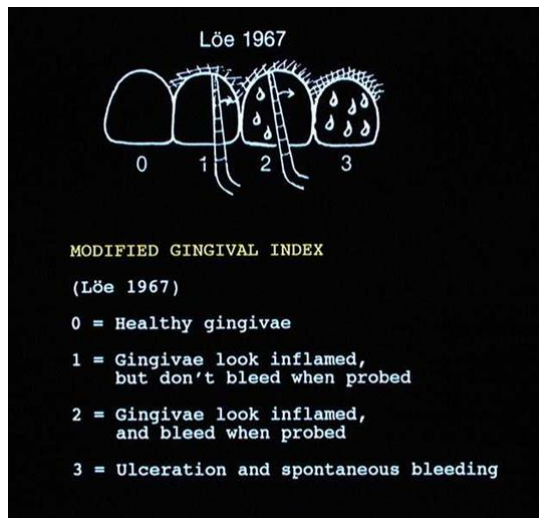


Figure 2.2 Löe's Modified Gingival Index (1967).

While both plaque and gingival indices are markers of oral hygiene, the gingival index provides a more stable indicator of underlying oral hygiene status as it is less susceptible to change as a result of one off thorough brushing (for example immediately before a dental examination).

It should be noted that gingival indices only record the inflammatory status of the superficial periodontal tissues and do not record the overall periodontal health of the patient (i.e. they do not give any indication of the degree of underlying periodontal pocketing or supporting bone loss).

Measuring dental caries (tooth decay)

The traditional method of recording the impact of dental caries is to count the number of teeth and tooth surfaces that are either decayed, filled or extracted because of caries. The prevalence of dental caries can be determined by a simple dental clinical examination. However, caries increment (the number of new caries lesions developing) can only reliably be recorded over a period of two years. None of the included studies reported dental caries as an outcome variable.

Statistical meta-analyses (using the "metan" command in STATA version 13) with Forest plots were conducted where feasible and the pooled difference in mean values for each index was determined. Homogeneity between study design, interventions and populations was explored using chi-square analysis. It was found that $P < 0.01$ for all cases and so the data was heterogeneous. All meta-analyses were therefore conducted using random-effects models and summarised data provided with associated 95% confidence intervals (CI).

2.7 Developing Evidence Statements

Standardised terms have been used in the evidence statements to describe the strength of the evidence in keeping with the NICE guidelines manual (NICE 2014)⁶:

No evidence: Where there is no evidence, this is clarified with information on the search scope and date (e.g. English language studies from 1995 onwards);

Weak evidence: 'There was weak evidence from 1 (-) RCT'.

Moderate evidence: 'There was moderate evidence from 2 (+) controlled before and after studies'.

Strong evidence: 'There was strong evidence from 2 (++) controlled before and after studies and 1 (+) RCT'.

Inconsistent evidence: Where inconsistent evidence is identified, this will be accompanied by an explanatory sentence or section, with details of variations.

The direction of effect is summarised by the use of positive, negative, mixed and none with appropriate contextual detail. Where synthesis of results was feasible via meta-analysis, the effect size and 95% confidence interval are reported within the evidence statement. Where this was not feasible, the number of studies reporting statistically significant and non-significant results was reported. Due to the wide variation in intervention design and outcomes it was not feasible to define and use standard notations such as small, medium or large for direction of effect.

Each evidence statement is accompanied by information on the applicability of the evidence to the UK population and sub-populations as directly applicable, partially applicable or not applicable to the UK population using guidance from the Manual (NICE 2014). Details of the population, setting, intervention (including any costs if provided) and outcomes are provided in the evidence statements (Appendix 1).

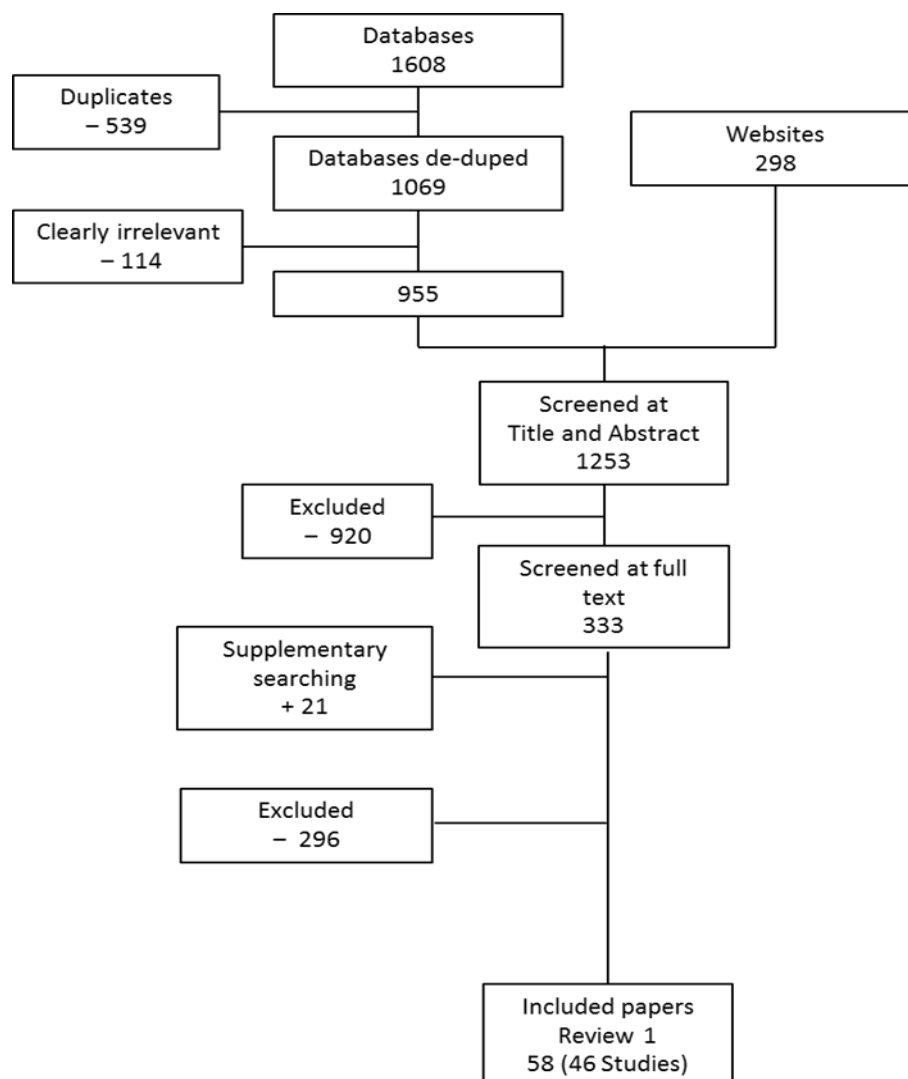
⁶ <http://www.nice.org.uk/article/PMG20/chapter/1%20Introduction%20and%20overview>

3 Results

3.1 Search results

The search strategy identified 1,680 citations from database searching of which 653 were excluded as duplicates or clearly irrelevant (e.g. animal studies or no mention of oral health). 1,253 citations (955 from the database searches and 298 from web site searching) were reviewed in title and abstract and 354 in full text. Full details are provided in the flow diagram below.

In total 58 papers describing 46 studies were included in the review.



3.2 Applicability and quality of studies

Forty six studies (reported in 58 papers) providing data on a range of interventions were included in the review. All were carried out in the UK or in applicable countries.

An additional four studies (comprising 4 papers) were available in abstract form only or based in countries not deemed to be applicable to the UK. These were considered since they potentially filled evidence gaps (e.g. resident training). The abstract (Kasche et al. 2006) did not provide sufficient data for inclusion and the three studies from non-applicable countries (Brody et al. 2014, Lim et al. 2003, Park et al. 2014) were not regarded as sufficiently relevant to the UK population. These studies are highlighted in the exclusions table (Appendix J) with detailed reasons for exclusion.

Internal validity was moderate with 6 studies deemed to have high internal validity (++) 23 studies of moderate quality (+) and 17 studies assessed as being of low quality (-).

3.3 Outcomes

A large number of oral health outcomes were used across studies, making comparisons extremely difficult. Figure 3.1 indicates the large number of outcomes used in the 34 studies exploring carer education or guideline introduction.

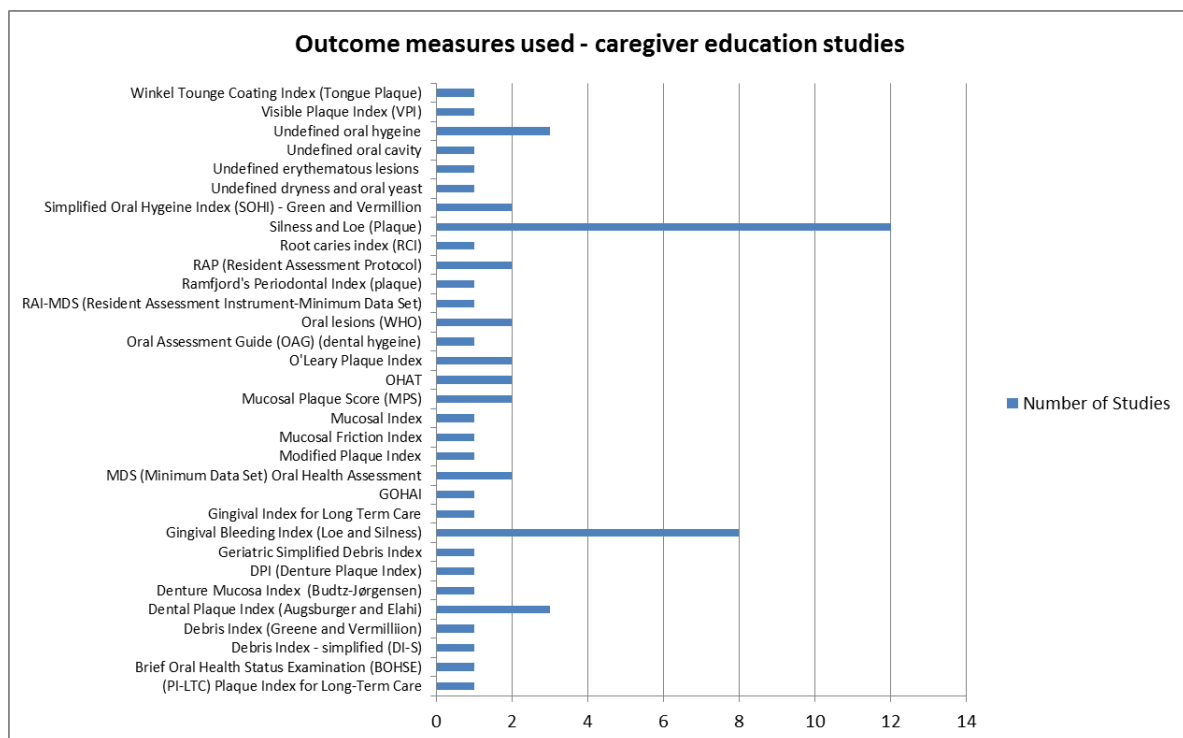


Figure 3.1: Outcome measures used in interventions exploring carer education or guideline introduction

4 Findings

Evidence was found relating to four types of intervention: Education/guideline introduction for care home staff, the use of electric versus manual toothbrushes, chlorhexidine and xylitol use. Findings for each have been summarised below by narrative synthesis and evidence statements, with meta-analyses where feasible. A brief summary of each intervention is given in Table 1 with details in the Evidence Table (Appendix 1).

Education and/or guideline introduction

The majority of interventions, 34 of the 46 studies, explored education for caregivers and/or the introduction of a guideline or protocol within the care setting.

Interventions varied and there were no clear boundaries between education alone, education plus additional interventions (e.g. equipment provision, monitoring), formal protocol and guideline introduction so these have been considered within a single section.

A large range of outcomes were presented across the body of evidence. Where studies used the same outcome measures, meta-analyses were carried out if feasible.

Twenty three studies looked at the effect of carer education and/or guideline introduction versus usual care on oral health outcomes. Grouping these studies as a whole, there is inconsistency but a suggestion of a positive trend in terms of effects on clinical oral health measures.

Twelve studies observed statistically significant improvements (Altabet et al. 2003, Chalmers et al. 2009, Frenkel 2001, Isaksson et al. 2000, Mojon et al. 1998; Nicol et al. 2005, Peltola et al. 2007, Pronych et al. 2010, Pyle et al. 1998, Samson et al. 2009, Zenthófer et al. 2013), two noted a non-significant positive trend (Avenali et al. 2011, De Visschere et al. 2012), while 9 found no clear direction of effect (Beck et al. 2008, Bellomo et al. 2005, Boczeko et al. 2009, Budtz-Jorgensen et al. 2000, de Visschere et al. 2011, Le et al. 2012, McKeown et al. 2014, Simons et al. 2000, Wardh et al. 2002). Of these latter studies one (+) UBA (Avenali et al. 2011) observed a positive trend in relation to oral cavity assessment but a negative trend for gingival health.

Three of the 23 studies were based in care homes for adults with disabilities, as opposed to elderly care facilities, and all three noted significant benefits (Altabet et al. 2003, Mojon et al. 1998) or a non-significant positive trend (Avenali et al. 2011).

Evidence Statement 1: Carer education and/or guideline introduction alone versus usual care on clinical oral health measures: overall effects

There is inconsistent evidence from 23 studies (3 UK^{10,15,20}, 5 USA^{1,5,6,17, 18}, 2 Belgium^{8,9}, 2 Canada^{12,1}, 2 Sweden^{11,22}, 2 Switzerland^{4,14}, and 7 other applicable countries^{2,3,7,16,19,21,23}) as to whether carer education or protocol/guideline introduction alone for care home staff will deliver improvements in the oral health of residents when compared to usual care.

12 studies^{1,7,10,11,14-19,23} [1 (++) cRCT¹⁰, 2 (+) RCT^{1,23}, 1 (+) cRCT²¹, 1 (-) RCT¹⁶, 1 (+) CBA¹⁴, 2 (-) CBAs^{15,18}, 3 (+) UBAs^{7,11,19} and 1 (-) UBA¹⁷] showed statistically significant improvements in measures of dental, denture or overall oral health hygiene while 11^{2-6,8,9,12,13,22,23} [1 (++) cRCT⁹, 1 (+) RCT⁴, 1 (+) cRCT¹², 1 (-) RCT³, 1 (-) cRCT⁸, 1 (+) nRCT⁶, 2 (+) CBA^{2,23}, 1 (-) CBA²², 2 (+) UBA^{5,13}] did not find a significant intervention effect although two of these observed a positive trend^{2,9}.

Some meta-analyses were feasible and these suggested a non-significant but positive trend towards improvements in dental and denture plaque indices but a tiny negative trend for gingival index. The overall effect size (95% confidence interval) for Dental Plaque Index (Silness & Lőe) from 4 studies was 0.10 (-0.12 to 0.33) [1 (++) cRCT⁹, 1 (+) RCT²¹, 1 (-) cRCT⁸, 1 (+) cRCT¹²]. For the Augsbuger & Elahi Denture Plaque Index it was 0.69 (-0.05 to 1.43) [4 studies: 2 (++) cRCT^{9,10}, 1 (+) RCT²¹, 1 (-) cRCT⁸]. However, for the Lőe & Silness Gingival Index this was -0.05 (-0.28 to 0.18) [2 studies: 1 (+) cRCT¹², 1 (+) CBA²⁰].

All the evidence is applicable to residential homes in the UK since 3 studies were based in the UK and other studies were conducted in countries with similar settings.

¹ Altabet et al. 2003 (+); ² Avenali et al. 2011 (+); ³ Beck et al. 2008 (-); ⁴ Bellomo et al. 2005 (+); ⁵ Boczeko et al. 2009 (+); ⁶ Budtz-Jorgensen et al. 2000 (+); ⁷ Chalmers et al. 2009 (+); ⁸ De Visschere et al. 2011 (-); ⁹ De Visschere et al. 2012 (++) ; ¹⁰ Frenkel 2001 (++) ; ¹¹ Isaksson et al. 2000 (+); ¹² Le et al. 2012 (+); ¹³ McKeown et al. 2014 (+); ¹⁴ Mojon et al. 1998 (+); ¹⁵ Nicol et al. 2005 (-); ¹⁶ Peltola et al. 2007 (-); ¹⁷ Pronych et al. 2010 (-); ¹⁸ Pyle et al. 1998 (-); ¹⁹ Samson et al. 2009 (+); ²⁰ Simons et al. 2000 (+); ²¹ van der Putten et al. 2013 (+); ²² Wardh et al. 2002 (-); ²³ Zenthőfer et al. 2013 (+)

RCT: Randomised controlled trial; cRCT: Cluster RCT; CBA: Controlled before & after; UBA: Uncontrolled before & after

The results for the meta-analyses are illustrated in Figures 4.1 to 4.6.

Meta-Analysis of Plaque Index (Silness & Loe, 1964)

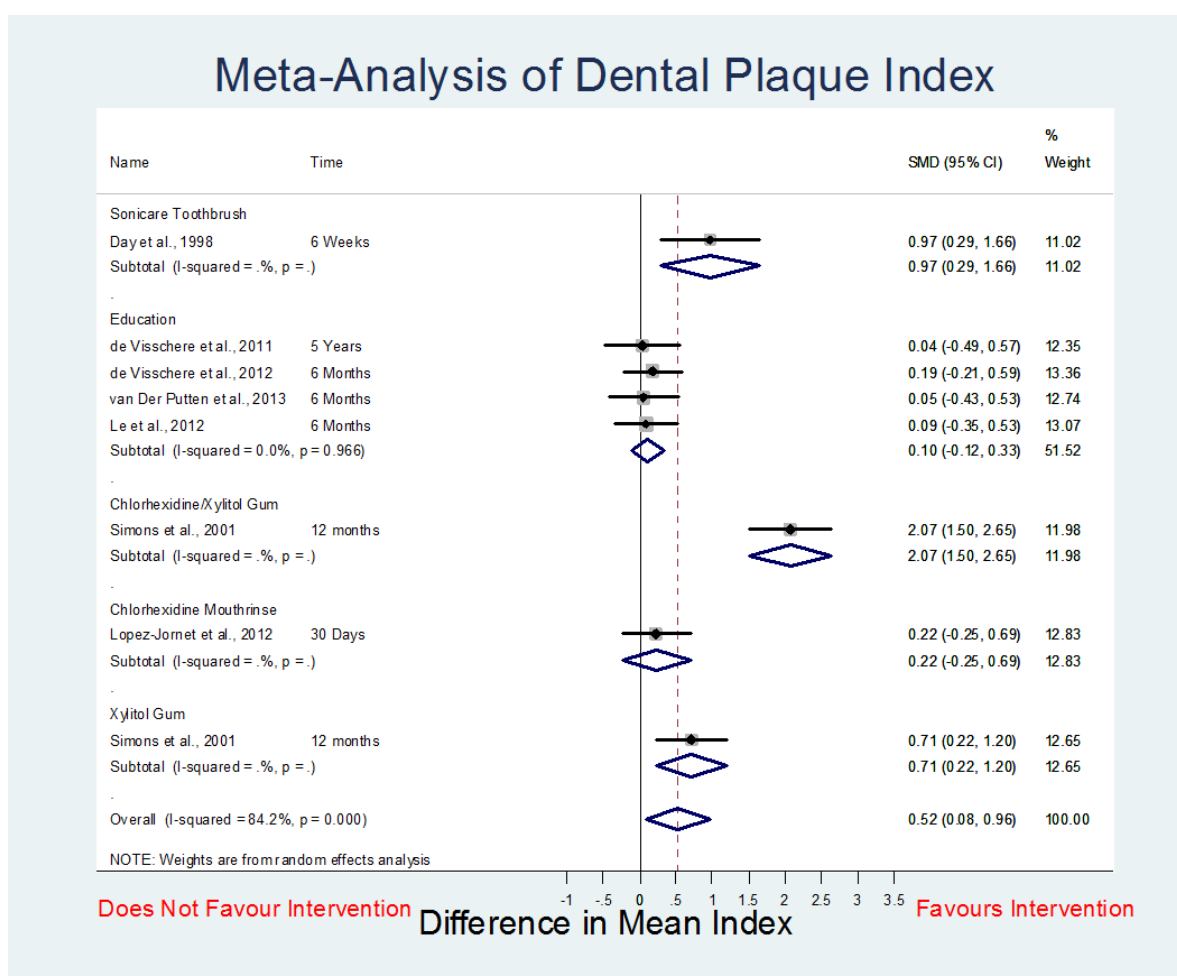


Figure 4.1: Forest plot showing results of individual studies and also results of random-effects meta-analysis (overall includes results from all studies and sub-group analysis only those for a given intervention) with baseline results adjusted for.

Interpretation of Analysis:

Figure 4.1 shows the results of meta-analysis for all studies included in this analysis. Due to the lack of common time points at follow-up, results were taken from different time points at follow-up (shown in the column “Time” in the figures). This figure shows difference in means values

(adjusted for baseline differences) in the plaque indices for the Silness and Loe index⁷ (Silness & Loe, 1964) between an intervention (e.g., education or sonicare toothbrush) compared to a control group.

The results of each study are shown, where the difference in mean values is indicated by the central symbol and the 95% confidence interval for the difference in mean values is indicated by the horizontal line. A positive value for the difference in mean values therefore indicates that the intervention is favoured, a negative value indicates that that the intervention is not favoured, and a value of zero indicates that the intervention made no difference. In order to make this clearer, a reference line for a difference in means values of zero is shown by the solid vertical line.

Meta-analysis allows us to pool the results of different studies that use the same outcome measure and this process should provide in theory a more accurate result than that provided by any one study alone. The results of meta-analysis are given by the diamonds; the middle of the diamond gives pooled difference of means and the edges of the diamond indicates the pooled 95% confidence interval for the difference of means. Meta-analysis is carried out for each subgroup (sonicare toothbrush, education, chlorhexidine/xylitol gum, and xylitol gum), and the results of meta-analysis are identical to those of the study for those subgroups with only a single study in them. An overall meta-analysis that included all studies irrespective of subgroup is shown by the bottom-most diamond; the middle of the diamond gives pooled difference of means (also shown by the dashed vertical line in this case) and the edges of the diamond indicates the pooled 95% confidence interval for the difference of means.

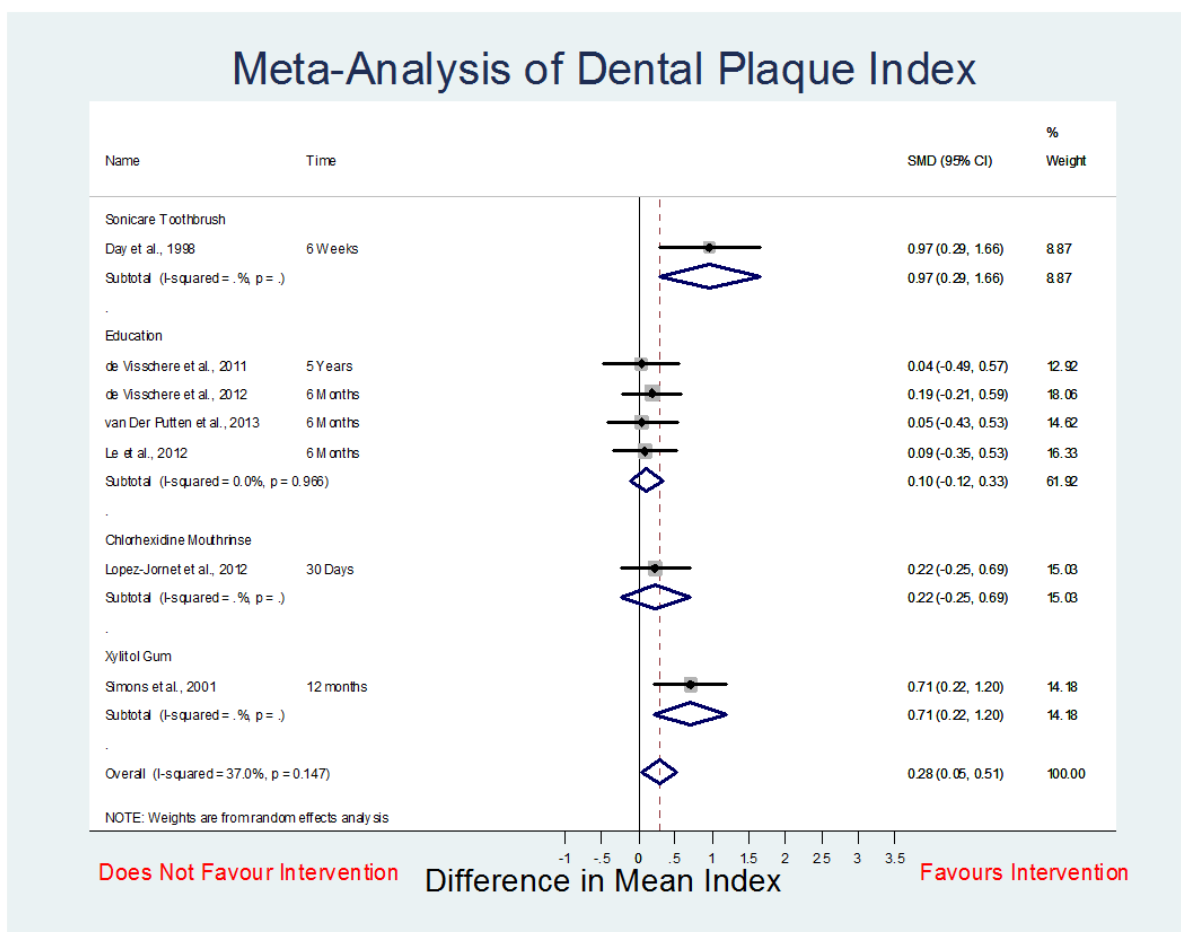
Chi-squared analysis indicated that the data was “heterogeneous” ($I^2 = 84.2\%$; $P = 0.000$), which in plain English means that the magnitudes of differences in mean values for the different studies differed quite strongly. As is appropriate in this situation, “random-effects” meta-analysis was employed rather than “fixed-effects,” and this approach ought to be more robust towards the effects of the heterogeneous nature of the data (e.g., confidence intervals are typically larger). Overall, the difference in means (adjusted for baseline differences) in plaque index for the Silness and Loe index (Silness & Loe, 1964) between intervention and control groups was 0.52 (95% confidence intervals: 0.08 to 0.96).

As part of sensitivity analysis, results of chlorhexidine/xylitol gum of Simons et al. (2001) were removed, as this study had the largest magnitude for the difference in mean values, and random-effect meta-analysis was carried out again (see Fig. 2). (Note that the data was not heterogeneous in this case ($I^2 = 37.0\%$; $P = 0.147$), though results were not affected greatly by using a fixed-effects meta-analysis.) In this case, the overall difference in means (adjusted for baseline differences)

⁷ Silness & Loe, 1964 plaque index: 0 = no plaque ; 1 = plaque detectable by probe; 2 = visible plaque; and, 3 = abundant plaque

between intervention and control groups was reduced slightly to 0.28 (95% confidence intervals: 0.05 to 0.51), thus demonstrating a small amount of sensitivity to the exclusion of the study on chlorhexidine/xylitol gum of Simons et al. (2001).

Figure 4.2: Sensitivity analysis: forest plot showing results of individual studies with the study involving chlorhexidine/xylitol gum of Simons et al. (2001) excluded.



Meta-Analysis of Gingival Index (Loe & Silness, 1964)

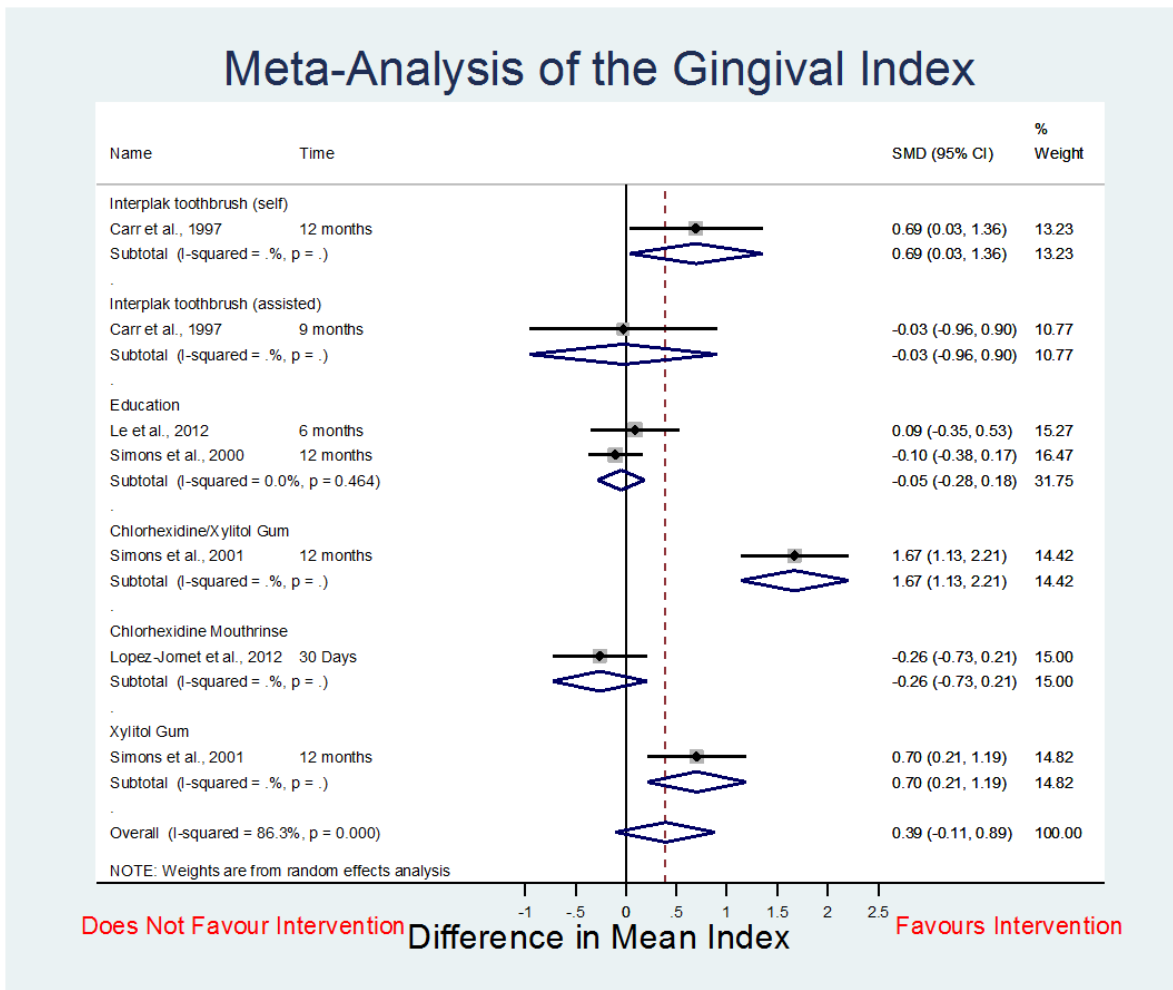


Figure 4.3: Forest plot showing results of individual studies and also results of random-effects meta analysis (overall includes results from all studies and sub-group analysis only those for a given intervention) with baseline results adjusted for.

Interpretation of Analysis:

Figure 4.3 shows the results of meta-analysis for all studies included in this analysis. Due to the lack of common time points at follow-up, results were taken from different time points at follow-up (shown in the column “Time” in the figures). This figure shows difference in means values

(adjusted for baseline differences) in for the gingival index⁸ (Loe & Silness, 1964) between an intervention (e.g., education or sonicare toothbrush) compared to a control group.

The results of each study are shown, where the difference in mean values is indicated by the central symbols and the 95% confidence interval for the difference in mean values is indicated by the horizontal lines. A positive value for the difference in mean values therefore indicates that the intervention is favoured, a negative value indicates that that the intervention is not favoured, and a value of zero indicates that the intervention made no difference. In order to make this clearer, a reference line for a difference in means values of zero is shown by the solid vertical line.

Meta-analysis allows us to pool the results of different studies that use the same outcome measure and this process should provide in theory a more accurate result than that provided by any one study alone. The results of meta-analysis are given by the diamonds; the middle of the diamond gives pooled difference of means and the edges of the diamond indicates the pooled 95% confidence interval for the difference of means. Meta-analysis is carried out for each subgroup (sonicare toothbrush, education, chlorhexidine/xylitol gum, and xylitol gum), and the results of meta-analysis are identical to those of the study for those subgroups with only a single study in them. An overall meta-analysis that included all studies irrespective of subgroup is shown by the bottom-most diamond; the middle of the diamond gives pooled difference of means (also shown by the dashed vertical line in this case) and the edges of the diamond indicates the pooled 95% confidence interval for the difference of means.

Chi-squared analysis indicated that the data was “heterogeneous” ($I^2 = 86.3\%$; $P = 0.000$), which in plain English means that the magnitudes of differences in mean values for the different studies differed quite strongly. As is appropriate in this situation, “random-effects” meta-analysis was employed rather than “fixed-effects,” and this approach ought to be more robust towards the effects of the heterogeneous nature of the data (e.g., confidence intervals are typically larger). Overall, the difference in means (adjusted for baseline differences) in gingival index for the Loe and Silness index (Loe & Silness, 1964) between intervention and control groups was 0.39 (95% CI: -0.11 to 0.89).

As part of sensitivity analysis, results of chlorhexidine/xylitol gum of Simons et al. (2001) were removed, as this study had the largest magnitude for the difference in mean values, and random-effect meta-analysis was carried out again (see Fig. 4.4). (Note that the data were heterogeneous ($I^2 = 62.1\%$; $P = 0.000$.) In this case, the overall difference in means (adjusted for baseline differences) between intervention and control groups was reduced slightly to 0.15 (95% confidence intervals: -0.17 to 0.48), thus demonstrating *little sensitivity* to the exclusion of the study on chlorhexidine/xylitol gum of Simons et al. (2001).

⁸ Loe & Silness, 1964 gingival index: 0 = No inflammation.; 1 = Mild inflammation; 2 = moderate inflammation ; and, 3 = severe inflammation

Meta-Analysis of the Gingival Index

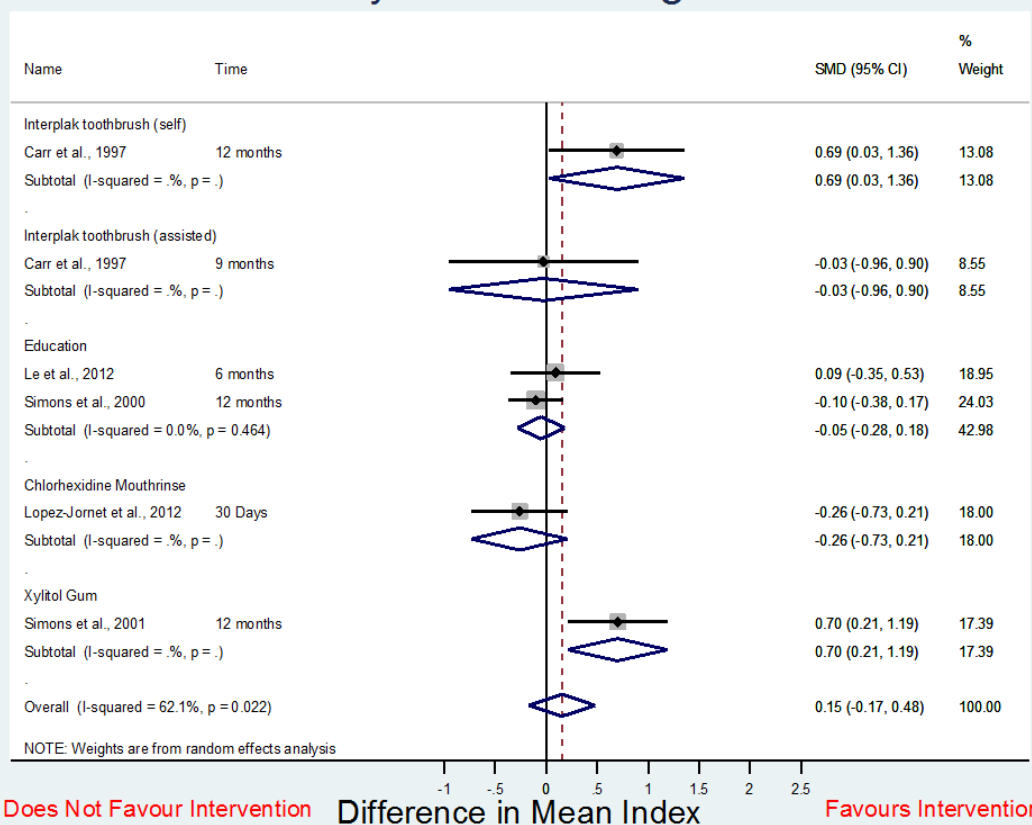


Figure 4.4: Sensitivity analysis: forest plot showing results of individual studies with the study involving chlorhexidine/xylitol gum of Simons et al. (2001) excluded.

Meta-Analysis of Denture Hygiene/Plaque Index (Augsbuger and Elahi)

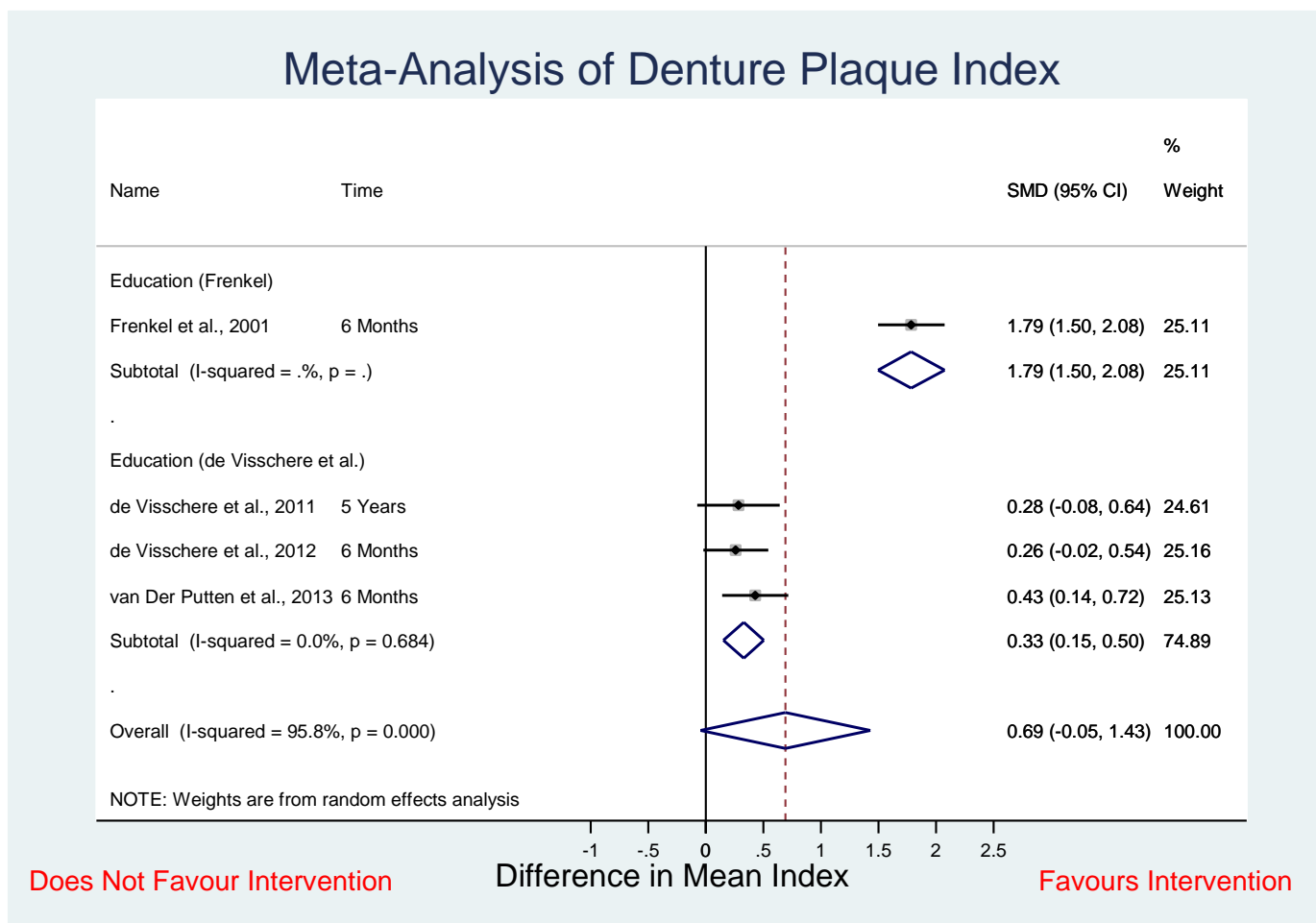


Figure 4.5: Forest plot showing results of individual studies and also results of random-effects meta analysis (overall includes results from all studies and sub-group analysis only those for a given intervention) with baseline results adjusted for.

Interpretation of Analysis:

Figure 4.5 shows the results of meta-analysis for all studies included in this analysis. Due to the lack of common time points at follow-up, results were taken from different time points at follow-up (shown in the column “Time” in the figures). This figure shows difference in means values (adjusted for baseline differences) in denture plaque index of Ausbuger & Elahi (on a scale of 0 to 4 for increasing levels of denture plaque) between an intervention (i.e., education) compared to a control group.

The results of each study are shown, where the difference in mean values is indicated by the central symbols and the 95% confidence interval for the difference in mean values is indicated by the horizontal lines. A positive value for the difference in mean values therefore indicates that the intervention is favoured, a negative value indicates that the intervention is not favoured, and a value of zero indicates that the intervention made no difference. In order to make this clearer, a reference line for a difference in means values of zero is shown by the solid vertical line.

Meta-analysis allows us to pool the results of different studies that use the same outcome measure and this process should provide in theory a more accurate result than that provided by any one study alone. The results of meta-analysis are given by the diamonds; the middle of the diamond gives pooled difference of means and the edges of the diamond indicates the pooled 95% confidence interval for the difference of means. Meta-analysis is carried out for each subgroup (those studies by Frenkel and de Vischere), and the results of meta-analysis are identical to those of the study for those subgroups with only a single study in them. An overall meta-analysis that included all studies irrespective of subgroup is shown by the bottom-most diamond; the middle of the diamond gives pooled difference of means (also shown by the dashed vertical line in this case) and the edges of the diamond indicates the pooled 95% confidence interval for the difference of means.

Chi-squared analysis indicated that the data was “heterogeneous” ($I^2 = 95.8\%$; $P = 0.000$), which in plain English means that the magnitudes of differences in mean values for the different studies differed quite strongly. As is appropriate in this situation, “random-effects” meta-analysis was employed rather than “fixed-effects,” and this approach ought to be more robust towards the effects of the heterogeneous nature of the data (e.g., confidence intervals are typically larger). Overall, the difference in means (adjusted for baseline differences) in denture plaque index of Ausbuger & Elahi between intervention and control groups was 0.69 (95% confidence intervals: -0.05 to 1.43).

As part of sensitivity analysis, results of Frenkel et al. (2001) were removed, as this study had the largest magnitude for the difference in mean values, and random-effect meta-analysis was carried out again (see Fig. 4.6). (Note that the data was not heterogeneous in this case ($I^2 = 0.0\%$; $P = 0.684$), though results were not affected *at all* by using a fixed-effects meta-analysis.) In this case, the overall difference in means (adjusted for baseline differences) between intervention and control groups was reduced slightly to 0.33 (95% confidence intervals: 0.15 to 0.50), thus demonstrating some sensitivity to the exclusion of the study Frenkel et al. (2001).

Meta-Analysis of Denture Plaque Index

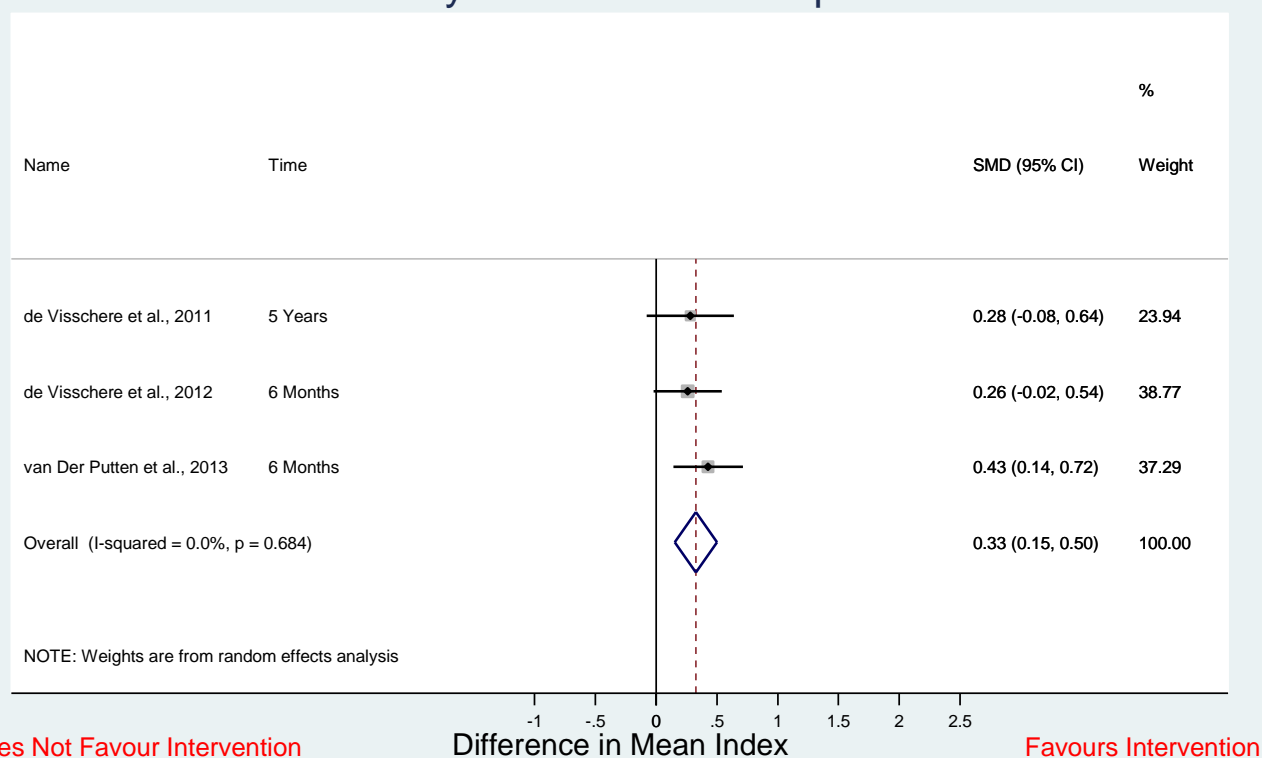


Figure 4.6: Sensitivity analysis: forest plot showing results of individual studies with the study of Frenkel et al. (2001) excluded.

Education components

The components of the 23 studies looking at the effect of carer education and/or guideline introduction, versus usual care, on oral health outcomes were examined to see whether education intensity (as measured by estimated contact hours) or additional support might be linked to outcomes.

There was no clear link with education intensity (see Evidence Statement 2) but there was weak evidence to suggest that ongoing support from health professionals combined with active motivation of carers might be effective. Of the six studies where ongoing support was provided, the three interventions finding statistically significant positive outcomes involved regular re-motivation by dentists or care home staff (Zenthöfer et al. 2013), regular monitoring by a dental hygienist (Samson et al. 2009) or the appointment of an oral health coordinator within the home (Pronych et al. 2010). However, it should be noted that only one of these studies had a robust design (Zenthöfer et al. 2013). Of the three studies finding no clear

direction of effect one involved weekly guidance from an occupational therapist (Bellomo et al. 2005), one involved care to residents from a dental hygienist 1-2 times per week (Beck et al. 2008) and the third provided care home staff with the option to recall a dental hygienist for advice (Budtz-Jorgensen et al. 2000).

Evidence Statement 2. Carer education and/or guideline introduction alone versus usual care on clinical oral health measures: education intensity/component effects

23 studies (3 UK^{10,15,20}, 5 USA^{1,5,6,17, 18}, 2 Belgium^{8,9}, 2 Canada^{12,13}, 2 Sweden^{11,22}, 2 Switzerland^{4,14}, and 7 other applicable countries^{2,3,7,16,19,21,23}) looked at whether the length or components of in-service education or protocol/guideline introduction for care home staff will deliver improvements in the oral health of residents when compared to usual care.

There was strong evidence that education intensity (as measured by estimated hours of education) does not appear to be an influential factor. Of the 12 studies showing statistically significant improvements^{1,7,10,11,14-19,21,23} [1 (++) cRCT¹⁰, 2 (+) RCT^{1,23}, 1 (+) cRCT²¹, 1 (-) RCT¹⁶, 1 (+) CBA¹⁴, 2 (-) CBAs^{15,18}, 3 (+) UBAs^{7,11,19} and 1 (-) UBA¹⁷] contact hours ranged from 1-8 h (mean ~ 2.8h) while the contact hours for the 11 studies^{2-6,8,9,12,13,20,21} [1 (++) cRCT⁹, 1 (+) RCT⁴, 2 (+) cRCT^{12, 21}, 1 (-) RCT³, 1 (-) cRCT⁸, 1 (+) nRCT⁶, 2 (+) CBA^{2,22}, 2 (+) UBA^{5,13}] that did not find a significant intervention effect ranged from 0.33-10.5 h (mean ~ 3.3h).

There was weak evidence from 3 studies that ongoing support provided post education from a health professional was effective if this involved active motivation of carers. 3 studies where education was combined with re-motivation or monitoring of carer activity [1 (+) RCT²³, 1 (+) UBA¹⁹, 1 (-) UBA¹⁷] found significant improvements while 3 studies where guidance by health professionals alone was provided [1 (+) RCT⁴, 1 (-) RCT³, 1 (+) nRCT⁶] did not.

All the evidence is applicable to residential homes in the UK since 3 studies were based in the UK and other studies were conducted in countries with similar settings.

¹ Altabet et al. 2003 (+); ² Avenali et al. 2011 (+); ³ Beck et al. 2008 (-); ⁴ Bellomo et al. 2005 (+); ⁵ Boczko et al. 2009 (+); ⁶ Budtz-Jorgensen et al. 2000 (+); ⁷ Chalmers et al. 2009 (+); ⁸ De Visschere et al. 2011 (-); ⁹ De Visschere et al. 2012 (++) ; ¹⁰ Frenkel 2001 (++) ; ¹¹ Isaksson et al. 2000 (+); ¹² Le et al. 2012 (+); ¹³ McKeown et al. 2014 (+); ¹⁴ Mojon et al. 1998 (+); ¹⁵ Nicol et al. 2005 (-); ¹⁶ Peltola et al. 2007 (-); ¹⁷ Pronych et al. 2010 (-); ¹⁸ Pyle et al. 1998 (-); ¹⁹ Samson et al. 2009 (+); ²⁰ Simons et al. 2000 (+); ²¹ van der Putten et al. 2013 (+) ;

²²Wardh et al. 2002 (-); ²³Zenthöfer et al. 2013 (+)

RCT: Randomised controlled trial; cRCT: Cluster RCT; CBA: Controlled before & after; UBA: Uncontrolled before & after

Eight of the education-based studies involved the introduction of a guideline or protocol, supported by education (Altabet et al. 2003, Binkley et al. 2014, Budtz-Jorgensen et al. 2000, Chalmers et al. 2009, de Visschere et al. 2011, de Visschere et al. 2012, Sloane et al. 2013, van der Putten et al. 2013). Two of these were based in homes for adults with disabilities (Altabet et al. 2003, Binkley et al, 2014).

Interventions varied from individualised oral care plans (Altabet et al. 2003, Sloane et al. 2013), locally developed strategy, programme or care plan (Binkley et al. 2014, Budtz-Jorgensen et al. 2000, Chalmers et al. 2009, de Visschere et al. 2011) to supervised implementation of national guidelines (where usual care was the unsupervised presence of those guidelines) (De Visschere et al. 2012, van der Putten et al. 2013). The latter two studies measured the same clinical oral health outcomes and are illustrated in the meta-analyses (Figures 4.1, 4.2, 4.5, 4.6).

Overall, the body of evidence suggested that the introduction of specific guidelines within the care home, supported by education, is likely to be more effective than education alone.

Evidence Statement 3. Guideline or protocol introduction supported by carer education versus usual care on clinical oral health measures

There is moderate evidence from eight studies (3 USA^{1,2,7}, 2 Belgium^{5,6}, 1 each Switzerland³, Australia⁴ and the Netherlands⁸) that guideline or protocol introduction supported by carer education is likely to be more effective than education alone.

Five studies found significant improvements in at least one oral health outcome (1 (+) RCT¹, 1 (+) cRCT⁸, 2 (+) UBA^{2,4}, 1 (-) UBA⁷), one (-) cRCT⁶ recorded a non-significant positive trend and two studies (1 (-)cRCT⁵ and (+) nRCT³) found no evidence in either direction.

Three of the controlled studies (1 (++) cRCT, 1 (+) cRCT⁸ and 1 (-) cRCT⁶) measured the same outcomes and recorded non-significant but positive trends for effect on dental plaque index and a significant combined positive effect size (95% CI) on denture plaque index of 0.33 (0.15 to 0.50).

The evidence is applicable to residential homes in the UK since all studies were conducted in countries with similar settings.

¹ Altabet et al. 2003 (+); ² Binkley et al. 2014 (+); ³ Budtz-Jorgensen et al. 2000 (+) ⁴ Chalmers et al. 2009 (+) ; ⁵ de Visschere et al. 2011 (-); ⁶ de Visschere et al. 2012 ; ⁷ Sloane et al. 2013 (-); ⁸ van der Putten et al. 2013 (+)

RCT: Randomised controlled trial; cRCT: Cluster RCT; nRCT Non randomised controlled trial; UBA: Uncontrolled before & after

Ten studies explored carer education with enhancements (such as ongoing support and motivation or multiple versus single educational sessions) versus education alone (Amerine et al. 2014, Bellomo et al. 2005, Binkley et al. 2014, Lange et al. 2000, MacEntee et al. 2007, Pronych et al. 2010, Pyle et al. 1998, Samson et al. 2009, Wardh et al. 2002, Zenthófer et al. 2013). Interventions varied hugely in components, outcomes and study methodology making synthesis difficult. The Binkley et al. (2014) and Lange et al. (2000) studies were in homes for adults with disabilities.

For two studies reporting similar interventions and outcomes (dental hygienist monitoring of plaque levels), albeit over very different time periods of three weeks (Lange et al. 2000) and six years (Samson et al. 2009), there was a suggestion that active monitoring of outcomes may enhance effectiveness. However, it should be noted that both had weaker study designs with Lange assessed as a (-) controlled before and after study and Samson as a (+) uncontrolled before and after design.

Evidence Statement 4: Carer education with enhancements versus education alone on clinical oral health measures

There is inconsistent evidence from 10 studies (5 USA^{1,3,4,6,7}, 1 each Switzerland², Canada⁵, Norway⁸, Sweden⁹, Germany¹⁰) as to whether enhanced carer education will deliver improvements in the oral health of residents compared to education alone.

7 controlled studies compared enhanced education with education alone^{1,2,4,5,7,9,10} [1 (++) cRCT⁵, 2 (+) RCT^{2,10}, 4 (-) CBAs^{1,4,7,9}]. Enhancements varied and covered ongoing specialist support and motivation^{1,2,5,9,10}, monitoring (staff accountability)⁴ and multiple training sessions⁷. 2 (-) CBAs^{4,7} reported statistically significant improvements in a range of oral health outcomes while the other 5 studies [1 (++) cRCT⁵, 2 (+) RCT^{2,10}, 2 (-) CBA^{1,9}] did not find a significant intervention effect.

Interventions and outcomes varied hugely, precluding synthesis, but three uncontrolled studies^{3,6,8} [2 (+) UBAs^{3,8}, 1(-) UBA⁶] reported significant pre-post improvements in clinical oral health outcomes following enhanced education interventions which also included environmental changes and reinforcement³, ongoing trainer support and appointment of

an oral health coordinator⁶ or motivation, ward routines and monitoring⁸.

In two studies [1 (-) CBA⁴, 1 (+) UBA⁸] where compliance was actively monitored by a dental hygienist via random dental plaque tests (over 3 weeks)⁴ or reports to management (every 6-18 months over six years)⁸ significant improvements compared to education alone were noted in plaque indices (standard error) in the CBA⁴ which reported changes from baseline to 21 days of 2.13 (0.14) to 0.23 (0.009) in the training plus monitoring group compared to 1.94 (0.17) to 2.12 (0.16) in the training only group. The UBA reported acceptable mucosal plaque scores changes from 36% to 70% over a 6-year period⁸

The evidence is applicable to residential homes in the UK since all studies were conducted in countries with similar settings.

¹ Amerine et al. 2014 (-); ² Bellomo et al. 2005 (+); ³ Binkley et al. 2014 (+) ⁴ Lange et al. 2000 (-); ⁵ MacEntee et al. 2007 (++); ⁶ Pronych et al. 2010 (-); ⁷ Pyle et al. 1998 (-); ⁸ Samson et al. 2009 (+); ⁹ Wardh et al. 2002 (-); ¹⁰ Zenthófer et al. 2013 (+)

RCT: Randomised controlled trial; cRCT: Cluster RCT; CBA: Controlled before & after; UBA: Uncontrolled before & after

From 10 studies (Arvidson-Bufano et al. 1996, Boczko et al. 2009, Fickert et al. 2012, Le et al. 2012, Lin et al. 1999, MacGiolla-Phadraig et al. 2013, Munoz et al. 2009, Paulsson et al. 2001, Poisson et al. 2014, Simons et al. 2000) the impact of carer education on knowledge appears to be positive but weak in the short term but inconsistent in the long-term. The Fickert et al. (2012) and MacGiolla-Phadraig et al. (2013) studies took place in homes for adults with disabilities.

Evidence Statement 5: Carer education alone versus usual care on knowledge immediately post education

There is weak evidence from 4 studies (all USA^{1,2,3,4}) to suggest that carer education can improve residential care staff oral health care knowledge immediately post education.

Three uncontrolled studies [2 (+) UBA^{1,2}, 1 (-) UBA³] reported significant gains in oral health knowledge. One (-) CBA⁴ found that a group of nurses trained for 4 hours made oral health assessments that more closely matched the scores recorded by dentists than a group trained for 1-hour but the difference was not significant.

Interventions varied in both components and length (ranging from 0.5 to 4 h). A range of different outcomes were measured across studies so the overall direction of effect could

not be estimated.

The evidence is applicable to residential homes in the UK since all studies were conducted in countries with similar settings.

¹ Arvidson-Bufano et al. 1996 (+); ² Boczko et al. 2009 (+); ³ Fickert et al. 2012 (-); ⁴ Lin et al. 1999 (-)

CBA: Controlled before & after; UBA: Uncontrolled before & after

Evidence Statement 6: Carer education alone versus usual care on knowledge in the longer term

There is inconsistent evidence from 7 studies (1 UK⁷, 2 USA^{1,4}, 1 Canada², 1 France⁶, 1 Ireland³, 1 Sweden⁵) as to whether oral health knowledge gains are maintained in care home staff in the longer term (two or more months post education). 4 studies [1 (+) cRCT², 1 (+) CBA⁷, 2 (-) UBA^{1,4}] reported no significant evidence of effect while 3 [1 (+) cRCT³, 1 (+) UBA⁵, 1 (-) UBA⁶] found significant gains, at up to three years follow up for 1 (+) UBA⁵; However this study⁵ looked at nurses' perceptions of their knowledge only.

Interventions varied and a range of different outcomes were measured across studies so the direction of effect could not be estimated. Of the 3 studies suggesting benefits in the longer term^{3,5,6}, 2 provided more intensive education for staff with total durations of 9h³ and 2 days (est. 8h)⁶ respectively compared to an estimated average duration of 4.5 hours (range 1-9 h) across all 7 studies reporting longer term outcomes. However, 1 study looked at nurse perceptions only⁵ while another included an unspecified oral health component within a nutrition education intervention⁶.

All the evidence is applicable to residential homes in the UK since 1 study was based in the UK and other studies were conducted in countries with similar settings.

All the studies were carried out in homes for the elderly other than one (+) cRCT³ which took place in a home for adults with disabilities.

¹ Fickert et al. 2012 (-); ² Le et al. 2012 (+); ³ MacGiolla-Phadraig et al. 2013 (+); ⁴ Munoz et al. 2009 (-); ⁵ Paulsson et al. 2001 (+); ⁶ Poisson et al. 2014 (-); ⁷ Simons et al. 2000 (+)

cRCT: Cluster RCT; CBA: Controlled before & after; UBA: Uncontrolled before & after

Electric versus manual toothbrushes

Three studies explored the use of electric versus manual toothbrushes (Carr et al. 1997, Day et al. 1998, Fjeld et al. 2014), one of which (Carr) was in a home for adults with disabilities. In the Fjeld et al. study (2014), of 152 caregivers who responded to the questionnaire, 64.7% (46.5% of carers of patients with dementia) reported that the electric toothbrush was either no different or easier to use than the manual toothbrush. Overall, the electric toothbrush was found to be less time-consuming but 27.6% of carers reported that residents complained about the sound and vibration.

At least two of the studies (Day et al. 1998, Fjeld et al. 2014) received funding support from electric toothbrush manufacturers. The funding source was not stated for Carr et al. (1997).

The results of the meta-analyses for Day et al. (1998) and Carr et al. (1997) are illustrated in Figures 4.1 and 4.2 respectively along with interpretations.

Evidence Statement 7: Electric versus manual toothbrushes on clinical oral health measures

There is moderate evidence from 3 RCTs [1 (++)³, 2 (+)^{1,2}], two in the USA^{1,2} and one in Norway³ that use of an electric versus a manual toothbrush may be beneficial in terms of clinical oral health measures in some population groups, although there were some conflicts in findings.

1 (+) RCT² found significant benefits from using an electric rather than a manual toothbrush in an elderly population, observing a standard mean difference (95% CI) in dental plaque of 0.7 (0.29, 1.66). The other (+) RCT¹ observed benefits from the use of an electric versus manual toothbrush for those adults with disabilities that brushed independently noting an SMD in Gingival Index (95% CI) of 0.69 (0.03, 1.36). For patients who needed assistance with brushing, no difference was observed (-0.03 (-0.96, 0.90)).

1 (++) RCT³ in an elderly population did not observe a statistically significant difference between electric and manual toothbrush groups but the study found that participants who needed assistance with dental hygiene had significantly better results with the electric vs manual toothbrush than those who did not. The mean improvement in oral hygiene index (SD) was 0.58 (0.45) for those needing assistance and 0.12 (0.48) for those that did not ($p < 0.001$).

All the evidence is applicable to residential homes in the UK since studies were conducted

in countries with similar settings.

¹ Carr et al. 1997 (+); ² Day et al. 1998 (+); ³ Fjeld et al. 2014 (++)

RCT: Randomised controlled trial

Chlorhexidine

Chlorhexidine gluconate (0.12% or 0.2%), used as a mouthwash or as a gel for brushing teeth is an effective antiseptic which has the advantage of inhibiting dental plaque formation. The British National Formulary states that it does not however, completely control plaque deposition and is not a substitute for effective toothbrushing. In a clinical setting, chlorhexidine is advised on an individual basis, post-dental surgery, in cases of severe periodontal inflammation or as an adjunct to toothbrushing in the presence of severe oral infection. Rinsing with 10ml twice daily is recommended.

Chlorhexidine is available as an over the counter product. It has been used in clinical dental practice for many years. There are well recognised side effects – mucosal irritation, altered taste sensation, staining of teeth and restorations, tongue discolouration and parotid gland swelling. Recently, following a death attributed to the use of chlorhexidine, the Medicines and Healthcare Regulatory Authority have issued a Medical Device Alert⁹ warning of the dangers of anaphylactic reactions with the product.

Whether Chlorhexidine should be used on a prophylactic basis and as part of a “preventive programme” is unclear. Studies identified in this review tested chlorhexidine in the form of a mouthwash, a toothbrushing gel and incorporated into chewing gum in this context rather than on an individual patient basis.

Thus, whether studies which involve Chlorhexidine (which also often also involved education and training packages for carers) fall within the remit of this review can be debated. The authors have at this time included studies involving chlorhexidine on the basis that the studies were of “population-based” preventive interventions, rather than interventions to determine the efficacy of chlorhexidine as a plaque inhibiting agent.

Nine studies examined the preventive effect of chlorhexidine on the oral health of care home residents. Four studies were conducted in nursing homes (Kullberg et al. 2010, Lopez et al. 2013, Quagliarello et al. 2009, Sloane et al. 2013), two studies were in long-term care settings (Stiefel et al. 1995, Wyatt et al. 2004), one study was conducted in a care home (Lopez-Jornet

⁹ <https://www.gov.uk/drug-safety-update/chlorhexidine-reminder-of-potential-for-hypersensitivity>

et al. 2012), one study was conducted in residential homes (Simons et al. 2001) and one study was carried out in a hospital (Peltola et al. 2007).

Three studies provided educational training to the staff in addition to the use of chlorhexidine (Kullberg et al. 2010, Peltola et al. 2007, Sloane et al. 2013). Two studies provided chlorhexidine oral rinse to the residents (Lopez-Jornet et al. 2012, Wyatt et al. 2004). One study used dental prophylaxis and an oral rinse containing chlorhexidine and sodium fluoride (Stiefel et al. 1995). One study provided chlorhexidine plus oral brushing intervention but altered the frequency across the groups (Quagliarello et al. 2009). One study provided chlorhexidine/xylitol chewing gums (Simons et al. 2001), and one study provided chlorhexidine spray or amine fluoride toothpaste and gel to the residents (Lopez et al. 2013).

Seven of these observed a statistically significant improvement in a range of oral health measures like plaque, gingival, calculus, and denture index scores (Kullberg et al. 2010, Peltola et al. 2007, Quagliarello et al. 2009, Simons et al. 2001, Sloane et al. 2013, Stiefel et al. 1995), and remineralisation (Lopez et al. 2013). Two studies found an insignificant improvement in plaque index (Lopez et al. 2013, Lopez-Jornet et al. 2012) and one study noted that sodium fluoride was more effective in preventing dental caries (Wyatt et al. 2004).

Evidence Statement 8: Chlorhexidine on oral health outcomes - overall effect

There is strong evidence from 8 studies (3 USA^{5, 7, 8}, 2 Spain^{2, 3}, and 1 UK⁶, Sweden¹ and Finland⁴) that a chlorhexidine intervention improves a range of clinical oral health measures in care home residents. 7 studies^{1, 2, 4-8} [1 (++) RCT⁸, 2 (+) RCT^{5, 6}, 1 (-) RCT⁴, 1 (-) CBA², and 2 (-) UBA^{1, 7}] showed a statistically significant improvement in oral health measures while 1 (++) RCT³ and 1 (-) CBA² found an insignificant improvement in some outcomes.

There is weak evidence from 1 study [(+) Canada, RCT⁹] that chlorhexidine was less effective in preventing dental caries than the positive sodium fluoride control.

Due to the variability in outcome measures, it was only possible to include 2 studies in the meta-analysis. Figures 4.1 and 4.2.

A meta-analysis of 2 studies [1 (++) Spain, RCT³ and 1(+) UK, RCT⁶] estimated the effectiveness of chlorhexidine. One study found a large positive effect⁶ with the remaining study³ suggesting a trend towards a small positive effect for dental plaque index (95% CI) of 0.22 (-0.25 to 0.69) but a negative trend for gingival index of -0.26 (-0.73 to 0.21).

All the evidence is applicable to residential homes in the UK since 1 study was based in the

UK and other studies were conducted in countries with similar settings.

¹ Kullberg et al. 2010 – ; ² Lopez et al. 2013 – ; ³ Lopez-Jornet et al. 2012 ++ ; ⁴ Peltola et al. 2007 – ; ⁵ Quagliariello et al. 2009 + ; ⁶ Simons et al. 2001 + ; ⁷ Sloane et al. 2013 – ; ⁸ Stiefel et al. 1995 ++ ; ⁹ Wyatt et al. 2004 +.

RCT: Randomised controlled trial; CBA: Controlled before & after; UBA: Uncontrolled before & after

Evidence Statement 9: Chlorhexidine only versus other oral rinses on oral health outcomes

There is inconsistent evidence from 2 studies [1 (++) Spain, RCT¹ and 1 (+) Canada, RCT²] about the effect of a chlorhexidine intervention on the oral health outcome of care home residents when compared to other oral rinse formulation.

1 study [1 (+) RCT²] indicates that at 2 years follow-up the mean increase of carious surfaces was significantly less in the sodium fluoride group with mean (SD) of 0.7 (4.2) compared to the chlorhexidine group with mean of 3.1 (5.8) and the isopropyl group with mean (SD) of 2.9 (4.9).

1 study [1 (++) RCT¹] observed an insignificant improvement of standard mean difference (95% CI) in dental plaque of 0.22(-0.25, 0.69), but a negative effect of chlorhexidine on gingival index with SMD (95% CI) of -0.26 (-0.73, 0.21). The control group used a similar oral rinse as the intervention group but with no chlorhexidine.

All the evidence is applicable to residential homes in the UK since studies were conducted in countries with similar settings.

¹ Lopez-Jornet et al. 2012 ++ ; ² Wyatt et al. 2004 +.

RCT: Randomised controlled trial

Evidence Statement 10: Chlorhexidine or amine fluoride versus usual care*

There is weak evidence from 1 study [(-) CBA, Spain¹] that a chlorhexidine only intervention and an amine fluoride intervention both resulted in a statistically significant remineralisation of decayed dental surfaces when compared with usual care; p = 0.0151.

There was a decrease in plaque index from 2.004 to 1.205 in chlorhexidine group, 2.599 to 2.158 in amine fluoride group and 2.178 to 1.87 in usual care group. There was also a reduction in gingival index from 1.03 to 0.11 in chlorhexidine group, an increase from 1.85 to 2.00 in the amine fluoride group and 1.51 to 1.61 in the usual care group, but there was no significant inter-group difference for both the plaque and gingival index ($p > 0.05$).

This evidence is applicable to residential homes in the UK since the study was conducted in a country with a similar setting

¹ Lopez et al. 2013 –.

*usual care involved participants brushing without toothpaste

CBA: controlled before and after

Evidence Statement 11: Chlorhexidine/xylitol or xylitol only versus usual care

There is moderate evidence from 1 study [(+) UK, RCT¹] that a chlorhexidine/xylitol chewing gum intervention significantly improves plaque and gingivitis scores when compared to usual care in care home residents.

The (+) RCT indicated a significantly lower plaque score with mean (SD) of 0.8 (0.8) in the Chlorhexidine/xylitol group, 1.6 (1.0) in the xylitol only group and 2.6 (0.6) in the control group. It also showed a significantly lower gingival score with mean (SD) of 0.5 (0.7) in the chlorhexidine/xylitol group, 1.6 (1.0) in xylitol only group and 2.2 (1.0) in the usual care group, all significantly different from each other at $p < 0.001$.

This study was conducted in the UK and the evidence is directly applicable.

¹ Simons et al. 2001 +.

RCT: Randomised controlled trial

Evidence Statement 12: Chlorhexidine plus toothbrushing on oral health measures

There is weak evidence from 1 study [(+) RCT, USA¹] that a 3 months intervention of chlorhexidine plus oral brushing in care home residents resulted in a mean reduction in plaque score of 1.45 ± 0.52 ($p < 0.001$) with a measure of dose response relationship.

This study is applicable to the UK since it was conducted in a country with a similar setting.

¹ Quagliarello et al. 2009 +

RCT: Randomised controlled trial

Evidence Statement 13: Chlorhexidine/Sodium fluoride/dental prophylaxis

There is moderate evidence from 1 study [(++) RCT, USA¹] that an intervention involving the use of chlorhexidine and sodium fluoride plus dental prophylaxis in care home residents showed a significant reduction in plaque score (from 1.83 to 1.28, $p < 0.001$), calculus score (1.18 to 0.35, $p < 0.001$), gingivitis score (2.07 to 1.10; $p < 0.001$) and pocket depth (2.78 to 2.26 ($p < 0.001$)). There was no significant difference in Decayed Missing and Filled Surface score (i.e. no impact on dental caries).

This study is applicable to the UK since it was conducted in a country with a similar setting
Stiefel et al. 1995 ++

RCT: Randomised controlled trial

Evidence Statement 14: Chlorhexidine/educational intervention on oral health measures

There is weak evidence from 3 studies [1 (–) UBA, Sweden¹, 1 (–) RCT, Finland² and 1 (–) UBA, USA³] that a chlorhexidine/educational intervention improved some clinical oral health outcomes in care home residents.

In 1 (–) UBA¹ it was observed that a chlorhexidine/educational/electric toothbrush intervention resulted in significant pre-post improvements in plaque and Gingival Bleeding Index (GBI) at 3 weeks follow up. Median difference in plaque score (after vs before education) (95% CI) = -12.0 (-14.0 to -7.0; $p < 0.001$). Median difference in GBI (after vs before education) = -6.0 (-7.0 to -1.0; $p < 0.001$).

In 1 (–) RCT² the chlorhexidine was only used on dentures and this resulted in a significant increase in good denture hygiene in all groups ($p = 0.02$). By subjects, denture hygiene improved in all groups, but this change was most prominent in the group where nursing staff took charge of oral hygiene (56%) compared to the usual care group that had no chlorhexidine intervention (27%) or the group where a dental hygienist took charge of oral hygiene (35%).

In 1 (–) UBA, USA³ the chlorhexidine/educational intervention was combined with a sodium fluoride paste intervention. This study indicated a significant improvement in plaque index for –long-term care (2.5±0.5 to 1.7±0.8; p < 0.001) and gingival index-long term care (1.8±0.5 to 1.4±0.5; p < 0.001) and denture plaque index (2.9±0.9 to 2.1±0.7; p=0.04) at 8 weeks follow-up. There was an insignificant reduction in inflamed or bleeding gums from 64±85 to 60±85; p=0.96) at 8 weeks follow-up.

This evidence is applicable to residential homes in the UK since the studies were conducted in countries with a similar setting.

¹ Kullberg et al. 2010 –; ² Peltola et al. 2007 –; ³ Sloane et al. 2013 –.

RCT: Randomised controlled trial; UBA: Uncontrolled before & after

Chlorhexidine: Adverse events

2 (++) RCTs reported adverse events as a result of chlorhexidine use in elderly care homes (Lopez-Jornet et al. 2012; Stiefel et al. 1995). In one (++) RCT (Lopez-Jornet et al. 2012) the authors reported a significant increase in staining of teeth/dentures and tongue in the chlorhexidine versus placebo groups (p=0.000 at 30 days in both cases) although this was not backed up by data provided in Table 4 of the paper. Data provided suggested that, at 30 days, tongue staining was present in 31.4% of intervention and 22.9% of placebo patients and dental/denture staining was present in 5.7% of intervention and 8.6% of placebo patients.

Evidence Statement 15: Adverse events from chlorhexidine use

There is moderate evidence from 2 (++) RCTs^{1,2}, one in Spain¹ and one in the USA², of some adverse events attributed to chlorhexidine use in elderly care¹ and adult disability² settings.

In 1 (++) RCT¹ authors reported that adverse effects included staining of teeth/dentures and tongue (p=0.000 at 30 days in both cases). It was also reported that no resident showed mucosal desquamation (breakdown of the lining of the mouth) or alterations in taste sensation.

The other (++) cross-over RCT² reported that, during chlorhexidine use, staining was a major problem for one subject (3%), a minor problem for 19% and no problem for 78%. Taste was a major problem for 11%, a minor problem for 22% and no problem for 67%.

Gagging was a major problem for 11%, a minor problem for 3% and no problem for 86%.

The evidence is applicable to residential homes in the UK since one study¹ was conducted in Spain and the other² in the USA

¹ Lopez-Jornet et al. 2012 ++; ² Stiefel et al. 1995 ++

RCT: Randomised controlled trial

Xylitol

Evidence Statement 16: Xylitol gum on clinical oral health measures

There is moderate evidence from 1 (+) RCT¹ and 1 (–) UBA² that a xylitol chewing gum intervention significantly improves oral health outcome in residents when compared to usual care.

The (+) RCT¹ indicated a significantly lower plaque score with mean (SD) of 1.6 (1.0) in the xylitol only group and 2.6 (0.6) in the control group with no-gum at $p < 0.001$ and a significantly lower gingival indices score with mean (SD) of 1.2(1.0) and 2.2 (1.0) in the xylitol only and control group respectively at $p < 0.001$. The (–) UBA² reported a decrease in biofilm (dental plaque) amongst residents and improved nurses' attitude towards oral care resulting from twice daily chewing of xylitol gum and casein phosphopeptide–amorphous calcium phosphate (CPP-ACP) use but only photographic results were provided.

The evidence is applicable to residential homes in the UK since one study¹ was conducted in the UK and the other² in a country with a similar setting.

¹ Simons et al. 2001 (+); ² Stone et al. 2013 (–)

RCT: Randomised controlled trial; UBA: Uncontrolled before & after

Access to dental treatment/regular check-ups

One of the objectives of the review was to explore the effectiveness of interventions in relation to access to dental treatment and regular check-ups by care home residents. No interventional research was identified that specifically explored this question.

Evidence statement 17: Access to dental treatment/regular check-ups






There was no evidence identified for interventions in care home settings that specifically explored effects on resident access to dental treatment or regular check-ups.





Table 1





Where there are multiple papers for a study, the main study report is highlighted in **bold**.










Elderly populations unless otherwise stated. N=individual residents unless otherwise stated.








RCT: Randomised controlled trial; cRCT: Cluster RCT; CBA: Controlled before & after; UBA: Uncontrolled before & after; ITS: Interrupted time series.





Significant positive effect  ; Non-sig positive effect  ; No evidence in either direction  ; Non-sig negative effect  ; Significant negative effect 






First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
1. Altabet 2003+ (RCT)	Individualised oral care plans. 12 months	USA Residential care facility (disabilities) N=80	<i>Oral hygiene rating – Dental plaque (non standard measure)</i>					Education, practical training plus care plan vs usual care (est. 2h) (good oral health education)
2. Amerine 2014– (CBA)	Education and oral health champion 8 weeks	USA Long term care N=78 (3 facilities)	<i>Oral Health Assessment Tool (OHAT), OHAT scoring ability, Geriatric Oral Health Assessment Index (GOHAI)</i>		 *			Education (1h) vs Education plus onsite support (8hpw) vs usual care *Higher in group with onsite support
3. Arvidson- Bufano 1996+ , Blank 1996	Oral health assessment training for nurses	USA Nursing home N=50	<i>Minimum Data Set (MDS) oral health component</i>					Education only (0.5h) UBA so pre-post measure only




First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
(UBA)	7-10 days							
4. Avenali 2011+ (CBA)	Education for patients in study group and all care givers 6 months	Italy Residential care facility (disabilities) N=36	Plaque (<i>Visible Plaque Index</i>), gingival bleeding (<i>Gingival Bleeding Index</i>)	 *				Education (0.33h) *Significant improvement in plaque index at 4 weeks but not 6 months. Non sig improvement for gingival at both time points
5. Beck 2008–, 2009, 2010 (RCT)	Nutrition/oral health education for nurses 4 months	Denmark Nursing home N=121	Plaque (<i>no index</i>), nutritional status					Education (est [RC]10h) plus dental hygienist support and care (1-2x weekly)
6. Bellomo 2005+ (RCT)	Training/supervised tooth brushing 3 months	Switzerland Care home N=61	Dental Plaque Index (<i>Silness and Løe</i>), Denture Plaque Index (<i>Ambjornsen</i>), oral and denture hygiene, oral self care skills	 *	 *			Education on toothbrushing (est 1h) vs education/weekly guidance by occupational therapist (est 2h) vs control *The most significant pre-post improvements were reported intervention-assisted experimental group but control







First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
								group also improved (no data provided to confirm any trend)
7. Binkley 2014+ (UBA)	Oral health strategy 1 week (post one month intervention)	USA. Group homes for individuals with intellectual/developmental disabilities N=11 homes, 21 carers, 25 residents	Plaque Index (O'Leary), Oral hygiene status (Oral Assessment Guide, OAG), oral hygiene practices					Education, environmental changes & reinforcement (est 4h) UBA so pre-post measure only
8. Boczko 2009+ (UBA)	Education for care givers (certified nursing assistants) Immediately post training	USA Long-term care facility N=112	Knowledge (Oral Health Knowledge Test, OHKT), oral cavity assessment (4 point severity scale)	 *				Education re knowledge test (1h) *Gingival health UBA so pre-post measure only
9. Budtz-Jorgensen 2000+ (nRCT)	Preventive oral health programme 18 months	Switzerland Long-term care facility N=237	Erythema; Denture mucosal lesions					Education (0.75h), hygienist treatment, oral aids, recall for specialist hygienist care; vs usual care
10. Carr 1997 (RCT) +	Electric vs manual toothbrushes	USA Group home	Gingival index (L�oe and Silness), oral hygiene index Greene and	 *				Education and hands on practice (1h) vs usual






First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
	12 months	(disabilities) N=56	Vermillion)					care, then use of electric vs manual toothbrush *But signif. improvement for electric vs manual toothbrush
11. Chalmers 2009+ (UBA)	Introduction of OHAT training and Oral Hygiene Care Plan 6 months	Australia Residential homes (21 homes) N=534	Oral Hygiene Assessment Tool (OHAT – modified Kayser Jones); OHAT use standards, : Plaque Index (Silness and L��e), Oral lesions (WHO)	 *				Education (3h) *At 3 months; no further improvement to 6 months UBA so pre-post measure only
12. Day 1998+ (RCT)	Electric vs manual toothbrushes 6 weeks	USA Long-term care facility N=40	Dental plaque (Silness and L��e)	 *				Education on brushing techniques (est. 1h) and teeth brushing 2x per week *Electric vs manual
13. De Visschere 2011– (cRCT)	Oral hygiene protocol 5 years	Belgium Nursing home N=14 homes	Dental plaque (Silness and L��e), Denture plaque (Augsburger and Elahi)					Oral hygiene protocol (est 7h training) vs usual care
14. De Visschere 2012++, Van der Putten 2010, 2013	National oral care guideline 6 months	Belgium Nursing home N=12 homes x30 patients	Dental plaque (Silness and L��e) Oral hygiene of dentures (Augsburger and Elahi)	 *				Supervised guideline implementation and oral care protocol (est 10.5h)







First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
(cRCT)			<i>Tongue plaque (Winkel tongue coating index, WTCI)</i>					training) vs usual care (non-supervised guideline) *Significant for dental plaque initially but not after adjustment
15. Fickert 2012– (UBA)	Caregiver oral health education <i>3 months</i>	USA Community living arrangement or intermediate care facility (disabilities) N=52 caregivers	<i>Knowledge/compliance</i>				 *	Education (6h) *Significant improvement post-test but not at 3 months UBA so pre-post measure only
16. Fjeld 2014++ (RCT)	Electric vs manual toothbrushes <i>2 months</i>	Norway Nursing home N=180	<i>Oral Hygiene Index-Simplified (OHI-S)- debris index & views</i>			 *		Education (est. 1h) on electric vs manual toothbrush. *No usual care control. Significant pre-post improvements in both groups but no significant difference between groups
17. Frenkel 2001++, 2002 (cRCT)	Caregiver oral health education <i>6 months</i>	UK Nursing home N=60 caregivers	<i>Plaque, Gingivitis, Stomatitis, Simplified Oral Hygiene Index (Greene & Vermillion); Oral</i>					Education and toothbrush distribution







First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
			<i>hygiene of dentures (Augsbuger and Elahi)</i>					(1h)
18. Isaksson 2000+ (UBA)	Caregiver oral health education 3-4 months	Sweden Long-term care facility N=170	<i>Oral hygiene (author measure); Denture plaque (Modified Plaque Index, Amjornsen), oral mucosa (Mucosal Index, Mucosal Friction Index)</i>					Education (4h) UBA so pre-post measure only
19. Kullberg 2009, 2010- (UBA)	Caregiver oral health education 3 weeks	Sweden Nursing home N=43	<i>Knowledge, plaque (Silness and Løe), gingival bleeding (Løe and Silness)</i>					Education, support (est 3h) and chlorhexidine gel UBA so pre-post measure only
20. Lange 2000- (CBA)	Caregiver oral health education 3 weeks	USA Residential facility (disabilities) N=34	<i>Plaque (Ramfjord's Periodontal Index)</i>	 *				Education (est 1h) and random daily plaque tests by dental hygienist (accountability) vs education alone. *No usual care control
21. Le 2012+ (cRCT)	Caregiver oral health education 6 months	Canada Nursing home N=80 [75 caregivers]	<i>Knowledge, plaque (Silness and Løe), gingival index (Løe and Silness)</i>	 *			 *	Education (1h video) *Significant pre-post reduction in both groups but not





First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
								between groups.
22. Lin 1999– (CBA)	Caregiver oral health education (nurses) <i>Immediately post training</i>	USA Long-term care facility (dementia) N=68 residents (16 nurses)	<i>Oral health assessment capability by nursing grades</i>				 *	1h education vs education plus 3h training on assessment tool (BOHSE) *Trend for improved correlation with dentists in 4h vs 1h training group
23. Lopez 2013– (CBA)	Fluoride toothpaste/ chlorhexidine spray/ brushing only <i>Six months</i>	Spain Nursing home N=26	<i>Plaque index (Silness and Løe), gingival index (Løe and Silness), General Oral Health Assessment Index (GO-HAI)</i> <i>McLeran Index, Pfeiffer Index [personal capacity]</i>	 *		 **		Amine fluoride toothpaste/fluoride gel vs 0.12% spray chlorhexidine vs toothbrushing without paste *Trend for improvement in amine fluoride group only **Both fluoride and chlorhexidine remineralised caries lesions








First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
24. Lopez-Jornet 2012++ (RCT)	Chlorhexidine mouthrinse twice daily for 1 week 30 days	Spain. Care home N=70	<i>Plaque index (Silness and Loe), gingival index (Loe and Silness), the number of colony-forming units of Candida albicans at the start and end of treatment and the possible adverse effects of chlorhexidine</i>					Chlorhexidine mouthrinse (0.2%) vs placebo
25. MacEntee 2007++ (cRCT)	Caregiver oral health education 3 months	Canada Long-term care facility N=14 facilities	<i>Simplified Oral Hygiene Index (Greene & Vermillion), Gingival Bleeding Index (GBI), Geriatric Simplified Debris Index (GDI-S), masticatory potential</i>					Education (est 1h) and access to nurses vs education alone.
26. Mac Giolla Phdraig+ 2013, 2014 (cRCT)	Caregiver oral health education Av. 9 months	Ireland Community residential unit (disabilities) N=219 caregivers, 76 participants	<i>Knowledge, attitude, behaviour [2014 paper submitted for publication: Modified Gingival Index, Plaque Index]</i>	 *				Education and practical training (est 9h) *Reduction in GI and PI but not significant
27. McKeown+ 2014 (UBA)	Caregiver oral health education 12 months	Canada Long-term care home N=42	<i>Oral/dental assessment (minimum data set RAI-MDS)</i>			 *		Education 0.5-0.75h * Debris reduced (non-significant) but inflammation increased in intervention group




First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
								(significance not reported) UBA so pre-post measure only
28. Mojon 1998+ (CBA)	Caregiver oral health education & dental hygienist provision <i>18 months</i>	Switzerland Long-term care facility (majority with disabilities) N=116	<i>Plaque index (Silness and Loe), caries (WHO)</i>	 *		 **		Education (0.75h) *Plaque worsened in both groups but greater in control **Root caries improvement reported (p=0.01)but no data
29. Munoz 2009– (UBA)	Caregiver (nurse) oral health education <i>2 months</i>	USA Skilled nursing facility N=176	<i>Knowledge, assessment skills</i>				 *	Education (2h) *Non-significant improvement in knowledge but significant improvements in congruency between test assessments UBA so pre-post measure only
30. Nicol 2005– (CBA)	Caregiver oral health education <i>18 months</i>	UK Nursing home N=78	<i>Oral care assistance, denture hygiene, Simplified Oral Hygiene Index [Greene & Vermillion], oral mucosal disease, angular cheilitis, denture stomatitis.</i>					Education 'Making sense of the mouth' (1.5h)

First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
31. Paulsson 1998, 2001+ (UBA)	Caregiver (nurse) oral health education 3 years	Sweden Special housing facility N=2,901/2,882? Nurses - 950 trained	<i>Knowledge, attitudes (perceptions)</i>				 *	Education (4h) *Nurses perceptions rather than test results UBA so pre-post measure only
32. Peltola 2007– (RCT)	Dental hygienist /nurse education /control 11 months	Finland Long term hospital N=130	<i>Plaque index (Silness and Loe), dental hygiene, denture hygiene (no reference)</i>		 *	 *		Dental hygienist vs nurse delivered oral care (incl. chlorhexidine), time (est RC) 1h) versus usual care *Nurse care significantly better than hygienist
33. Poisson 2014– (UBA)	Manager and caregiver nutrition and oral health education 6 months	France Nursing home N=138 homes	<i>Knowledge, home policies</i>				 *	Nutrition education (2 days, est. 8 hours) with unspecified oral health component *oral health screening UBA so pre-post measure only
34. Pronych 2010– (UBA)	(Appointment of oral health coordinator and) caregiver education	USA Nursing home N=3 homes	<i>Oral hygiene (Debris Index – Simplified DI-S)</i>					Education (1h) plus ongoing trainer support and appointment of oral health coordinator.

First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
	12 months							UBA so pre-post measure only
35. Pyle 1998– (CBA)	Caregiver oral health education (& provision of aids) 6 wks post intervention	USA Long-term care facility N=23 (24 nursing assistants)	Plaque index (Silness and Løe), gingival index (Løe and Silness)					Education (6h = 6 weekly one hour sessions)
36. Quagliarello 2009+ (RCT)	Different frequencies of toothbrushing plus chlorhexidine oral rinse 3 month intervention	USA Nursing home N=52	Plaque (modified plaque score), swallowing	 *				Manual brushing/ chlorhexidine am vs brushing am plus chlorhexidine 2x per day vs manual brushing plus chlorhexidine 2x per day *No usual care control
37. Samson 2009+ (UBA)	Caregiver oral health education 6 years	Norway Nursing home N=88	Mucosal-plaque score (MPS) index					Education (4h), motivation, equipment, ward routines, regular monitoring via report to dental hygienist UBA so pre-post measure only
38. Simons 2000+ (CBA)	Caregiver oral health examination/	UK Care/Nursing home N=18 homes	Plaque index (Silness and Løe), gingival index				 *	Education (1.5h) *Pre-post improvement in

First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
	examination + training 12 months		(L \ddot{o} e and Silness), Root caries index (RCI), Knowledge					knowledge for trained group but no difference in care provided
39. Simons 1999, 2001+, 2002 (RCT)	Chlorhexidine acetate/xylitol chewing gum 12 month intervention (0 months follow up)	UK Residential home N=111	Plaque index (Silness and L \ddot{o} e), gingival index (L \ddot{o} e and Silness), denture stomatitis, angular cheilitis	 *	 *			Two pellets chlorhexidine acetate/xylitol gum (ACHX) twice daily versus xylitol gum only (X) versus no gum (C) *ACHX better than X better than C
40. Sloane 2013– (UBA)	Caregiver oral health education and protocol introduction 8 weeks (6 months extension in one site)	USA Nursing home (dementia/disabilities) N=97 (6 nursing assistants)	Plaque Index for Long-Term Care (PI-LTC), Gingival Index for Long-Term Care (GI-LTC), Denture Plaque Index (DPI; Amjornsen?), Simplified Oral Hygiene Index [Greene & Vermillion]	 *	 *			Education (est RC 10 h) Protocol included 0.12% chlorhexidine gluconate rinse. *No change in scores for inflamed/bleeding gums at 6 weeks but improvement in single home followed up for six months. UBA so pre-post measure only

First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
41. Stiefel 1995+, (RCT)	Chlorhexidine swabbing 36 week intervention, 6 week follow up	USA. Long term care facilities for adults with severe learning disabilities N=44	Plaque, calculus, gingivitis, pocket depth using National Institute of Dental Research National Survey of Adult Dental Health standard indices			 *		Chlorhexidine swabbing 2-5x per week. * Improved calculus and pocket depth but no significant change in DMFS
42. Stone 2013– (UBA)	Xylitol chewing gum and recaldent cream 12 weeks	USA Long-term care facility N=6 (22 nursing assistants)	Knowledge/attitudes (nurses)			 *	 *	Xylitol chewing gum and Recaldent use. *Authors reported decreases in biofilm (plaque) and improved nurse attitude but no data provided UBA so pre-post measure only
43. van der Putten 2013+, 2010 (cRCT)	Supervised national guideline introduction 6 months	Netherlands 12 care homes N=343	Plaque index (Silness and L��e), Oral hygiene of dentures (Augsbuger and Elahi)	 *				Supervised guideline (est. 8h training) vs usual care (non-supervised) *Non-significant after adjustment
44. Wardh 2002a – , 2002b, 2014 (CBA) Also R3	Caregiver oral health education 18 months	Sweden Nursing home N=96	Mucosal plaque score			 *		Basic training (3h) for both groups with special oral health aide (4h) for intervention group

First author, year, design	Intervention summary/study length	Population	Outcomes	Positive/neutral/negative effect at longest follow up period				Notes
				Dental/Gingival	Denture	Gen. oral health	Knowledge	
								*No usual care control
45. Wyatt 2004+ (RCT)	Fluoride/ chlorhexidine/ placebo rinse daily 24 month intervention (0 months follow up)	Canada Long-term care facility N=369	Coronal and root caries (Root Caries Index)			 *		Chlorhexidine gluconate (CHX) versus sodium fluoride (NaF) versus isopropyl alcohol (IP, Control) mouthwash *Significant for NaF only; better than CHX/IP
46. Zenthófer 2013+ (RCT)	Dentist cleaning/ Dental hygiene/ Caregiver tooth cleaning 12 weeks (primary outcome) 36 months (secondary outcome, N=38)	Germany Care home N=106	Plaque Control Record (O'Leary), gingival Bleeding Index (Ainamo/Bay)	 *	 *			Professional cleaning of teeth and education (2h) vs above plus dentist remotivation (at 4, 8 weeks) or staff remotivation (2x per week) vs usual care. *All 3 intervention groups better than control at 12 weeks (no between group differences) but not 36 months

5 Discussion

The aims of this review were to seek evidence as to what approaches, activities or interventions were effective in promoting oral health, preventing dental problems and ensuring access to dental care (including regular check-ups) for adults in care homes. Approaches identified were education/guideline introduction for care home staff, the use of electric versus manual toothbrushes, chlorhexidine and xylitol use.

Despite the large number of relevant studies, the evidence for education or guideline introduction was inconsistent, with no clear indications as to whether intervention intensity (the number of hours of education) or specific components had an effect on clinical oral health outcomes. However, there was some evidence that education combined with active monitoring of compliance by care home staff or specific guideline introduction within the home, might be more effective. Education was found to increase staff knowledge in the short term but evidence for long term retention of this knowledge was inconsistent.

Three studies suggested that the use of an electric rather than a manual toothbrush may be useful but the evidence as to whether this leads to improvements for population groups brushing independently, or for those needing assistance, was conflicting. At least two of the three studies providing the evidence base were funded by electric toothbrush manufacturers.

There was strong evidence for the use of chlorhexidine as an adjunct to other interventions (such as education or tooth brushing) but it is associated with side effects and its value as compared to other treatments such as sodium fluoride or xylitol was unclear.

No interventions were identified that specifically explored effects on resident access to dental treatment or regular check-ups. Some guidance for those involved in care provision in this area has been identified within the best practice review (Review 2 in this series) and the review team are already aware that the views of care home staff and dental health professionals on this topic are being identified within the barriers & facilitators review (Review 3).

Comparability of findings with the Coker 2014 systematic review

A recently published well conducted systematic review (Coker et al 2014) examined the effectiveness of educational programmes in dependent older adults residing in long-term care or having extended hospital stays. Unlike this current review, Coker et al. included only randomised and non-randomised controlled studies – eight of which met the inclusion criteria for this review and were included (Budtz-Jorgensen et al. 2000, De Visschere et al. 2012, Frenkel et al. 2001,

MacEntee et al. 2007, Mojon et al. 1998, Nicol et al. 2005, Simons et al. 2000, van der Putten et al. 2013).

In keeping with the findings from this review, Coker et al. noted the range of educational approaches used and concluded that *“none emerged as being desirable over the others, as methodologically strong studies with good intervention integrity were lacking, and a variety of oral health outcomes were used to measure the effectiveness of the interventions, making comparisons across studies difficult”*.

Strengths and limitations of this review

This review was built on a comprehensive search strategy. The literature search included a thorough attempt to identify relevant published and unpublished studies. Four UK-based studies were identified and the remaining 42 of the 46 studies had direct applicability to UK settings.

The quality of studies overall was judged as moderate but the very large number of outcomes used limited the feasibility of meta-analysis in synthesising the results of similar interventions.

Of the 46 studies, 15 had uncontrolled before and after (UBA) designs. 10 of these were well designed but it must be borne in mind that significant pre-post results were not tested against a control group. As detailed above, in some of the controlled studies, significant pre-post effects were noted in both intervention and control groups.

The available evidence was relevant to care home populations in general but no specific data were available to assess variations by gender or other socio-economic factors.

6 References

- Age UK 2014. Later Life in the United Kingdom: June 2014 http://www.ageuk.org.uk/Documents/EN-GB/Factsheets/Later_Life_UK_factsheet.pdf?dtrk=true
- Azarpazhooh, A. & Leake, J.L. 2006. Systematic review of the association between respiratory diseases and oral health. *Journal of Periodontology*, 77, (9) 1465-1482
- Brady, M., Furlanetto, D., Hunter, R.V., Lewis, S., & Milne, V. 2006. Staff-led interventions for improving oral hygiene in patients following stroke. *Cochrane Database of Systematic Reviews* (4) CD003864
- British Dental Association. 2012. Dentistry in care homes – research. London, BDA. http://www.bda.org/Images/dentistry_in_care_homes.pdf
- Department of Health. 2003. National Minimum Standards for Care Homes for Older People. London, The Stationary Office
- Emerson, E., Baines.S., Allerton.L., & Welch, V. 2012, *Health Inequalities & People with Learning Disabilities in the UK*, Learning Disabilities Observatory, Lancaster
- Emerson, E., Hatton, C., Robertson, J., Baines.S., Christie, A., & Glover, G. 2013, *People with Learning Disabilities in England 2012*, Learning Disabilities Observatory, Lancaster.
- Faculty of Dental Surgery, The Royal College of Surgeons of England. 2012. Clinical guidelines and integrated care pathways for the oral health care of people with learning disabilities. London, Faculty of Dental Surgery
- Fuller E, Steele J, Watt R, Nuttall N. (2011) Oral health and function – a report from the Adult Dental Health Survey 2009. The Health and Social Care Information Centre. <http://www.hscic.gov.uk/catalogue/PUB01086/adul-dent-heal-surv-summ-them-the1-2009-rep3.pdf> Accessed 21/01/2015
- Jablonski, R.A., Therrien, B., Mahoney, E.K., Kolanowski, A., Gabello, M., & Brock, A. 2011. An intervention to reduce care-resistant behavior in persons with dementia during oral hygiene: a pilot study. *Special Care in Dentistry*, 31, (3) 77-87
- Miegel, K. & Wachtel, T. 2009. Improving the oral health of older people in long-term residential care: a review of the literature. *International Journal of Older People Nursing*, 4, (2) 97-113
- Naorungroj, S., Slade, G. D., Beck, J. D., Mosley, T. H., Gottesman, R. F., Alonso.A, & Heiss.G. Cognitive Decline and Oral Health in Middle-aged Adults in the ARIC Study. *Journal of Dental Research* 92, 795-801. 2013.
- Office for National Statistics (ONS). 2013. What does the 2011 Census tell us about the "oldest old" living in England & Wales? http://www.ons.gov.uk/ons/dcp171776_342117.pdf
- Office for National Statistics (ONS). 2014. Annual Mid-year Population Estimates, 2013 http://www.ons.gov.uk/ons/dcp171778_367167.pdf
- South Australia Dental Services. 2009. Professional Portfolio [http://www.health.gov.au/internet/main/publishing.nsf/Content/2E625F7A23ED6F71CA257BF0001B5D73/\\$File/ProfessionalPortfolio.pdf](http://www.health.gov.au/internet/main/publishing.nsf/Content/2E625F7A23ED6F71CA257BF0001B5D73/$File/ProfessionalPortfolio.pdf)



South Australia Dental Services. 2009. Better oral health in Care Homes: Staff Portfolio
[http://www.health.gov.au/internet/main/publishing.nsf/Content/2E625F7A23ED6F71CA257BF0001B5D73/\\$File/StaffPortfolio.pdf](http://www.health.gov.au/internet/main/publishing.nsf/Content/2E625F7A23ED6F71CA257BF0001B5D73/$File/StaffPortfolio.pdf)

Wardh, I., Jonsson, M., & Wikstrom, M. 2012. Attitudes to and knowledge about oral health care among nursing home personnel--an area in need of improvement. *Gerodontology*, 29, (2) e787-e792

Weening-Verbree, L., Huisman-de Waal, G., van Dusseldorp, L., van Achterberg, T., & Schoonhoven, L. 2013. Oral health care in older people in long term care facilities: a systematic review of implementation strategies. *International Journal of Nursing Studies*, 50, (4) 569-582



7. Acknowledgements

Thanks are owed to the following individuals who suggested additional studies for consideration:

Dr Caoimhin Mac Giolla Phadraig, Dublin Dental School and Hospital, Trinity College, Dublin, Ireland

Gert-Jan van der Putten, BENECOMO, Flemish-Netherlands Geriatric Oral Research Group, Ghent, Belgium

Professor Dr J Vanobbergen, Community Dentistry and Oral Public Health, Gent University Belgium

Professor Dr Luc De Visschere, Community Dentistry and Oral Public Health, Ghent University Belgium

Professor Mary McNally, Faculties of Dentistry and Medicine, Research Associate, Atlantic Health Promotion Research Centre, Dalhousie University

Nicola Hawkey, Senior Policy Adviser, British Dental Association

Dr Petteri Sjögren, Dental and Quality Director Oral Care AB, Sweden

Dr Robert McCormick, Improving Oral Health of Older Persons Initiative, Kent, Surrey and Sussex

Dr Safak Daghan, Ege University Faculty of Nursing, Public Health Nursing Department Bornova/Izmir

Sheila Welsh, National Older People's Oral Health Improvement Group, NHS Scotland