



Canadian Agency for
Drugs and Technologies
in Health

RAPID RESPONSE REPORT: SUMMARY WITH CRITICAL APPRAISAL



TITLE: Routine Dental Care Programs in Long Term Care: A Review of the Clinical Effectiveness and Guidelines

DATE: 25 June 2012

CONTEXT AND POLICY ISSUES

In Canada, approximately 2250 long-term care (LTC) facilities are providing homes and delivering services to senior population.¹ Elders residents of LTC facilities have a vulnerable oral health due to a combination of inadequate daily mouth care, limited access to professional dental care, inadequate facilities for the provision of dental treatment, compromised medical condition, and limited finance.³ It was estimated that almost 65% of Nova Scotia LTC residents did not have any regular dental care provider, and about 36.2% of LTC residents in three regions in Quebec did not have any dental service in the last five years.⁵ As a consequence of the oral neglect LTC residents are exposed to higher risk of swallowing and chewing dysfunction, pain, caries, periodontal diseases and oral lesions, as well as dental prosthetics-related problems.⁶ These symptoms of oral neglect affect one's ability to eat properly affecting nutritional status, body weight and overall resistance to systematic diseases.^{7,8} In Nova Scotia, it was reported that 25% of pre-seniors and seniors living in LTC facilities experienced poor oral health-related quality of life.¹²

Oral health care program in LTC that includes oral health assessment, dental treatment, and daily oral hygiene is thought to improve oral hygiene of residents and reduce their oral discomfort.¹⁴ This report will review the evidence regarding the effectiveness and the clinical guidelines of routine dental care programs in LTC provided by dental professionals, dentists and dental hygienists.

RESEARCH QUESTIONS

1. What are the evidence-based guidelines regarding routine dental care and oral hygiene programs in long-term care?
2. What is the clinical effectiveness of routine dental care and oral hygiene programs in long-term care?

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KEY MESSAGE

Six reports were included in this review. There was suggestive evidence that professional dental care may improve the nutritional status, quality of life, and the general oral health of elder LTC residents. As well, one controlled trial suggested that routine dental care may be effective in preventing respiratory infections in elderly persons in LTC. Evidence-based clinical guidelines provided recommendations for a mixed oral care in collaboration between the nursing home staff and dental professionals.

METHODS

The review was based on a predefined protocol (**Appendix 1**)

Literature Search Strategy

A limited literature search was conducted on key resources including Ovid MEDLINE, PubMed, ECRI (Health Devices Gold), The Cochrane Library (2012, Issue 5), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No methodological filters were applied to limit retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2007 and May 28, 2012.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed for relevance using a predefined checklist (**Appendix 2**). Full texts of any relevant titles/abstracts were retrieved, and assessed using the same screening checklist (**Appendix 2**). The final article selection was based on the inclusion criteria presented in **Table 1**.

Table 1: Selection Criteria

Population	Long-term care residents
Intervention	Scheduled routine dental care and oral hygiene program, including preventive dental check-ups and cleaning
Comparator	No professional dental care
Outcomes	<p>Clinical practice Guidelines</p> <p>Clinical effectiveness:</p> <ul style="list-style-type: none"> • improved overall general health • reduced incidence of septicemia and infection
Study Designs	Health technology assessment, systematic reviews, meta-analysis, randomized controlled trials, non-randomized studies and guidelines

Exclusion Criteria

Duplicate reports were excluded, unless if they reported different outcomes from the same study. Observational studies and non-randomized trials were excluded if they did not have a control group or if the comparative analysis was not reported.

Critical Appraisal of Individual Studies

Critical appraisal of the included studies was based on study design. The Appraisal of Guidelines Research and Evaluation (AGREE) instrument¹⁵ was used to evaluate the quality of the included guideline. The methodological quality of the included randomized controlled trials was evaluated using the SIGN50 checklist for the controlled studies.¹⁶ Non-randomized controlled trials and the observational study included in this review were evaluated using the SIGN50 checklist for the cohort studies.¹⁷

SUMMARY OF EVIDENCE

Quantity of Research Available

A total of 237 potential citations were identified by the search in bibliographic databases, with 223 citations being excluded during the title and abstract screening based on irrelevance to the questions of interest. The full text documents of the remaining 14 articles were retrieved. Five additional articles were identified by the grey literature search. Of the 19 articles, 11 did not meet the inclusion criteria and were excluded,^{14,18-27} leaving 6 articles to be included in this review.^{2,4,9-11,13} A PRISMA diagram demonstrating the study selection process is presented in **Appendix 3**.

Summary of Study Characteristics

Six reports that addressed at least one of the review questions were included in this review, including one clinical practice guideline,² one randomized controlled trial (RCT),⁴ three controlled trials,⁹⁻¹¹ and one retrospective observational cohort study.¹³ Details regarding the study characteristics are tabulated in **Appendix 4**.

Clinical guidelines published by De Visschere et al.² were developed by the Dutch association of nursing home physicians. Original guidelines were published in Dutch language and were not reviewed in this report;²⁸ however, details on the development process and the final results of the guidelines were abstracted from the primary publication by De Visschere,² and were supported by information published in a PhD dissertation.²⁹ The development of the guidelines followed the AGREE criteria,¹⁵ and the recommendations were supported by the scientific evidence, were available, or otherwise based on experts' experience.

Four experimental control trials were included in the review, all of which were conducted in Japan.^{4,9-11} Of these, an RCT evaluated the effect of one year of oral care provided by a dentist three times a week compared to oral cleaning done by the resident himself or with as assistance from the attendant nurse.⁴ The trial included 53 residents with a mean age of 83 years and evaluated the change in body weight, body mass index (BMI), and high density lipoprotein cholesterol (HDL-C) as outcomes for the efficacy of the interventions. Quality of life and activity of daily living were the endpoints for one controlled trial.⁹ The trial compared the outcomes after six weeks between 11 seniors who received dental treatment provided at inclusion to the 14 seniors who did not. However, the provided dental treatment was not detailed in the article. For

the remaining two trials,^{10,11} the emphasis was on the effect of the professional oral care on the incidence of aspiration pneumonia and fever episodes. In one trial,¹⁰ three protocols were evaluated in one LTC facility for each intervention. The first protocol was a weekly oral health care by a hygienist for five months; the second was no professional oral care for the first two months which was followed by three months of a weekly oral care given by a hygienist; the last protocol consisted of a daily rinsing with povidone iodine, after lunch, for the first two months and was continued in the following three months in addition to professional oral care. In the other trial,¹¹ comparison was done between one year of oral hygiene conducted by a hygienist as compared with basic daily oral hygiene conducted by the residents themselves or by their caregivers. The report did not provide further details on the interventions.

The last study was a retrospective observational follow-up that used 5-year data of 139 LTC residents in Vancouver.¹³ The study compared the outcomes of residents who had any dental treatment with those who did not receive care under a comprehensive dental program. The main mission of the program was to provide access to dental care for the providence health care LTC residents and to education for the hospital staff concerning daily care. The study compared the two groups in terms of caries, periodontium, and CODE score. CODE score is an index of clinical oral disease in seniors; it is a database that allows the inputting of clinical information including medical conditions, medications, jaw function, denture quality, oral mucosal status, periodontal health, and tooth status. However, the clinical interpretation of numerical changes of the CODE score is not clear.

Summary of Critical Appraisal

The strengths and limitations of included studies are summarized in **Appendix 5**.

The Dutch guidelines² were developed according to the AGREE criteria,¹⁵ that gave the guidelines their strength and reliability. Furthermore, the recommendations were based on evidence synthesized from the literature, where available, and was based on experts opinion otherwise. Nevertheless, the associated stakeholders for the development of these guidelines did not include patient groups, and the preferences of elder LTC residents were not considered.

The four experimental controlled trials included elders who are representative of LTC residents.^{4,9-11} Although the trial published by Sumi et al. was the only RCT,⁴ the randomization method was not reported and could not be evaluated. Two trials employed hard clinical outcomes including death, incidence of febrile episodes and aspiration pneumonia.^{10,11} This type of outcome is more reflective of the real clinical effects of interventions than surrogate outcomes. The main limitation of the four trials was the absence of blinding due to the nature of the intervention; however, attempts to offset this limitation by masking the evaluation of outcomes and data analysis were not explicitly reported in the evaluated articles. Another limitation was the nature of the intervention which was not detailed in two trials,^{9,11} and in another trial, the intervention consisted of three times a week oral care by a dentist which is not practical or feasible in real life.⁹

The observational study published by Wyatt compared two groups of LTC residents from the same population source.¹³ However, baseline characteristics were not reported, and potential confounders were not evaluated or taken into consideration in the analysis. As in the experimental trials, the interventions in this study were not blinded and blinding of outcome assessment was not specified. Furthermore, the intervention was reported as “dental treatment

of some form” with no further details, and the generalizability of the study intervention and results to a routine dental care is questionable.

Summary of Findings

A summary of study findings and authors’ conclusions are provided in **Appendix 6**.

What is the evidence-based guidelines regarding routine dental care and oral hygiene programs in long-term care?

The included guidelines report included 17 recommendations, 14 of which were given Grade 3 and 4. The attributed grades mean that there was a significant absence of systematic empirical evidence, and most of the recommendations were based on experts’ opinion. The key messages of these recommendations were that every LTC facility should have an institutional oral health care protocol delivered with collaboration between the nursing home staff and dental professionals. Furthermore, oral health care should be integrated and personalized for the individual nursing-care of each individual with a continuous monitoring of the outcomes. Another key message was the emphasis of the continuous theoretical and practical oral health education of nursing staff.

What is the clinical effectiveness of routine dental care and oral hygiene programs in long-term care?

Nutritional status

Sumi et al.⁴ evaluated the effect of oral health care on the nutritional status of elder LTC residents. At the end of one year of the trial interventions, results showed that seniors who had oral care provided by a dentist three times a week had stable weight, BMI, serum albumin and HDL-C. On the other hand, seniors who had their daily oral cleaning performed as per the usual methods of the nursing home had statistically significant reductions in the four outcomes as compared with their baseline values. In this trial, the reduction in weight, BMI, serum albumin and HDL-C was considered as worsening in the nutritional status. However, the article did not report the difference between the intervention groups and therefore comparative conclusions could not be drawn from this trial.

Quality of life and activity of daily living

The effect of dental treatment on the quality of life and the activity of daily living was evaluated by Naito et al.⁹ The trial reported that seniors who received dental treatment at baseline, compared with those who did not, had a statistically significant improvement from baseline in their quality of life score as measured by the general health assessment index. The difference between groups in change from baseline was 6.1 (95% CI; 0.6 to 11.5); however, the clinical significance of this difference is not clear. The activity of daily living was evaluated by four criteria; the changes from baseline were not statistically significant for the feeding, dressing, transfer activities and differences between groups were not reported. Changes from baseline in the expression criteria were statistically significant for both groups; however, the difference between groups was not statistically significant.

Fever and pneumonia

The febrile status of elders (fever > 37.8°C) and the incidence of aspiration pneumonia in relation to oral care were evaluated in two trials.^{10,11} In the first,¹⁰ oral care by dental hygienist for five months was associated with an increase of febrile days per month compared with the baseline mean. This increase was not statistically significant. The group who did not receive professional oral care during the first two months showed a statistically significant increase in the mean febrile days per month when compared to baseline. The third group who had povidone iodine rinse for the first two months reported a statistically significant reduction in the mean number of febrile days per month. The interpretation of these results should take into consideration that these are changes in the mean number of days per month and not number of seniors who had febrile episodes. The changes might be misleading since the mean number of days might be the result of febrile episode(s) of single or few elders who could have more vulnerable health status than others; therefore, their results might not be generalizable to all elders in the same intervention group. In the other trial by Adachi et al,¹¹ the group who had oral health care by hygienist showed statistically significant lower monthly percentage of elders with fever episodes than the control group; however, the incidence and difference between groups were reported graphically.

With regards to aspiration pneumonia, Ishikawa et al.¹⁰ reported eight cases by the end of the five months of oral care by dental hygienist with an increase of five cases from the baseline incidence; the statistical significance of this increase was not reported. No cases were reported in the two other intervention groups. Adachi et al.¹¹ reported two deaths (5%) due to aspiration pneumonia in the intervention group, and eight deaths (16.7%) in the control group; the difference between groups was statistically significant.

Oral status

The oral status in relation to dental care was reported in two studies.^{10,13} Ishikawa et al.¹⁰ reported the statistical significance of the changes from baseline in periodontal pocket depth (pd) and dental plaque (debris). Results showed that dental care by a hygienist for five months led to a statistically significant reduction in both the pd and debris as compared to baseline values; however, neither the group receiving no professional care for the first two months nor the group who had povidone iodine rinse showed any statistically significant reduction from baseline. Comparisons between groups were not reported. Wyatt¹³ reported that the treatment group, compared to the control group, had more seniors with an improved CODE score; 19 (23%) versus 3 (5%) with $P = 0.02$. With regards to the caries and periodontal status, the study reported higher percentages of seniors with an improvement in their status in the treatment group, but a higher percentage of seniors with a worsened caries status was also reported in the treatment group. The differences between groups were not reported for the caries and periodontal status.

Limitations

The current review has few design limitations. The main limitation is that the review could not identify a clear and definite definition of a professional routine dental care. Although the review was limited to interventions provided by dentists and dental hygienists, the identified literature included a wide range of professional oral care protocols provided in LTC facilities. This limitation challenges the transfer of findings to the practical application in LTC settings. Another limitation was the population of the included studies who were elder LTC residents. LTC

facilities by definition could have non-elder residents including mentally or physically challenged patients who require continuous health supervision including dental care; the current review focused only on elder residents of LTC facilities. Finally, the review did not evaluate problems that may face the implementation of routine dental care in LTC; such challenges may include limited financial resources, care providers' perception of treating and maintain LTC residents.

The review is also limited by the strengths and limitations of the included studies. Blinding was not feasible for the evaluated interventions and there was no indication of blinding the outcome assessment in the included studies. Furthermore, the evaluated interventions ranged from unrealistic dental care provided three times a week by a dentist to one time treatment. The generalizability of the findings might also be affected by the fact that the four clinical trials included in this review were conducted in Japan; characteristics of the Japanese seniors and LTC facilities might not reflect the Canadian LTC settings.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

Within the limits of this review, the included studies suggested that the dental care may improve the nutritional status, quality of life, and the general oral health of elder LTC residents. Limited evidence from one controlled trial suggested that routine dental care may be effective in preventing respiratory infections in elderly persons in LTC. Evidence-based clinical guidelines provided recommendations for mixed oral care in collaboration between the nursing home staff and dental professionals.

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Appendix 1: Review Protocol

Objectives

The objective of this review is to evaluate the clinical effectiveness of routine dental care and oral hygiene programs in long-term care facilities.

Review Protocol and Study Selection

Studies were chosen for inclusion in the review based on the criteria in the table below.

Table 2: Selection Criteria				
Literature type	Patient Population	Intervention	Comparators	Outcomes
Published HTA/ SR/ MA, RCTs, non-randomized controlled studies, and evidence-based practice guidelines	Residents of long-term care facilities	Professional routine dental care and/ or oral hygiene program including preventive dental check-ups and cleanings	No professional routine dental care Baseline status*	<u>Clinical Effectiveness</u> - Improved overall general health - Reduced incidence of septicemia and infection <u>Guidelines</u>
<p>HTA= Health technology assessment; MA= Meta-analysis; RCT=randomized controlled trial ;SR= Systematic review * Baseline comparisons for longitudinal cohorts with no control groups</p>				

Appendix 2: Title and abstract screening checklist

Reviewer:

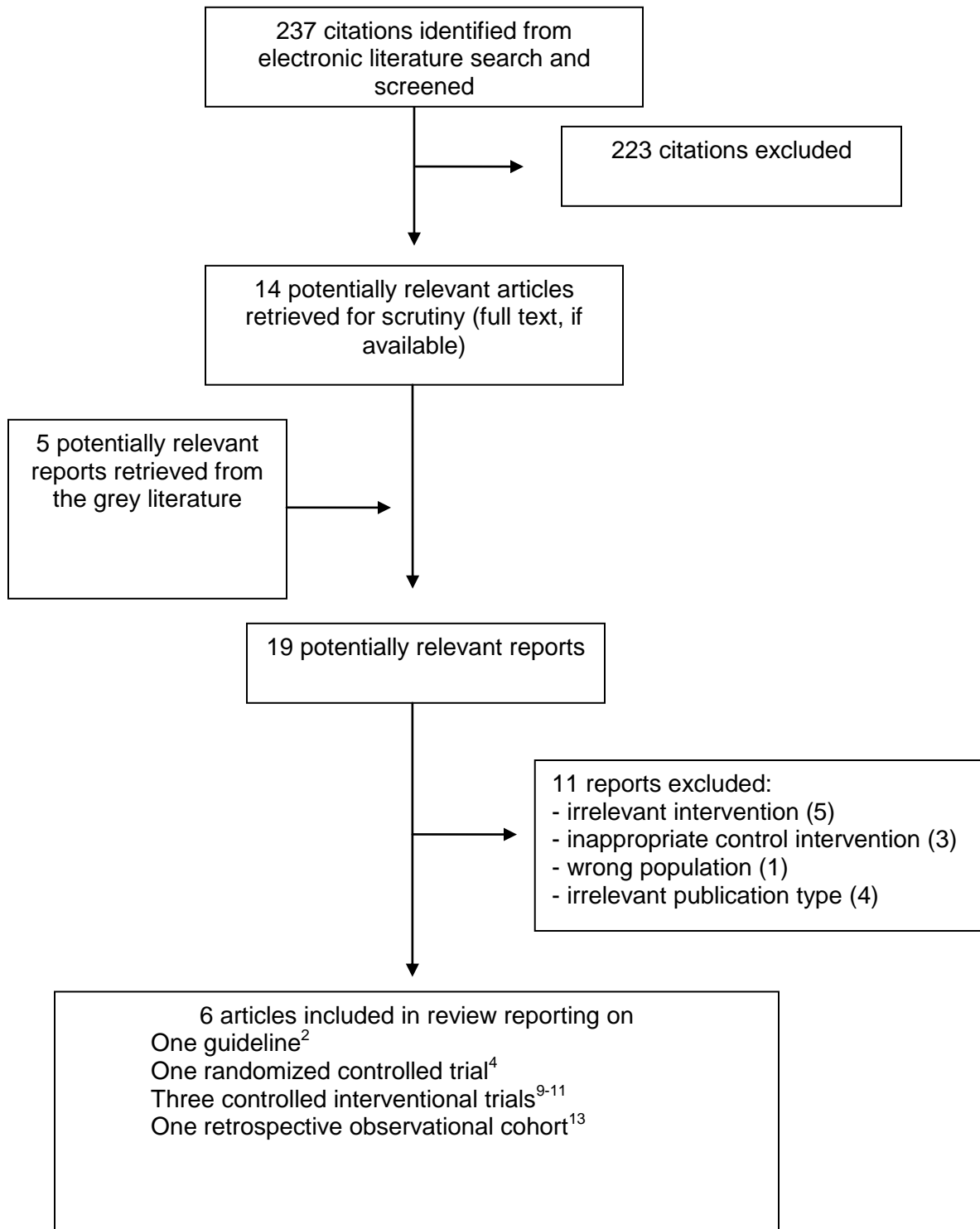
Date:

Ref ID:

First Author (year):

<p>1 What is the STUDY POPULATION in this article?</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Residents of long-term care facilities – elderly subjects (include) <input type="checkbox"/> Residents of long-term care facilities – disabled patients (include)
<p>2 What is the INTERVENTION?</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Professional routine dental care (include) <input type="checkbox"/> Preventive routine dental check-ups by dentists (include) <input type="checkbox"/> Oral hygiene program provided by dental hygienists (include) <input type="checkbox"/> Oral hygiene programs provided by the long-term facility nurses (exclude)
<p>3 What is the TYPE OF STUDY reported in this article?</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Report of a clinical trial (controlled; randomized/non-randomized) (include) <input type="checkbox"/> Meta-analyses/systematic reviews/HTAs (include) <input type="checkbox"/> Report of a controlled prospective or retrospective cohort study (include) <input type="checkbox"/> Report of a controlled cross-sectional study (include) <input type="checkbox"/> Academic/narrative review, comment, editorial, letter, note, patient handout, study design description (exclude) <input type="checkbox"/> All other study designs (exclude) <input type="checkbox"/> Can't decide (include)
<p>Selection decision:</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Include <input type="checkbox"/> Exclude

Appendix 3: Selection of Included Studies



Appendix 4: Characteristics of the Included Publications

Table 3. Characteristics of the Included Clinical Guidelines

Guidelines Objectives	Guideline audience	Methods of development	Outcomes
De Visschere et al. 2010² – Netherlands			
Improve the oral health status of institutionalized older people	<ul style="list-style-type: none"> • Dutch Association of Nursing Home Physicians • All LTC institutions for older people in the Netherlands. <ul style="list-style-type: none"> ○ Recommendations were addressed for LTC nurses 	<ul style="list-style-type: none"> • The guidelines were developed according to the AGREE criteria, • Recommendations were supported by scientific evidence where available or otherwise based on experts' experience. 	<ul style="list-style-type: none"> • Clinical recommendations <ul style="list-style-type: none"> ○ Recommendations were graded from 1 to 4; Grade 1 = best evidence level – Grade 4 = little or no systematic empirical evidence, or working group opinion

AGREE= Appraisal of Guidelines for Research and Evaluation;¹⁵ LTC= long-term care;

Table 4. Characteristics of the Included Experimental Controlled Trials

Study Objectives & Design	Inclusion Criteria, Sample Size, and Patients Characteristics	Interventions, Comparators, and Trial Conducts	Outcomes
Sumi et al. 2010⁴ – Japan			
<p>To evaluate the effect of continuous oral care on nutritional status in older people who require care.</p> <p>This was a randomized controlled trial</p>	<ul style="list-style-type: none"> • Inclusion criteria were not reported • A total of 53 residents, from one LTC. • Mean age 83.2 years • 18 males and 35 females 	<ul style="list-style-type: none"> • Intervention : (n=27) <ul style="list-style-type: none"> ○ A dentist provided oral care three times a week, ○ The oral care consisted of electrical tooth brushing and the use of an antibacterial agent • Control : (n=26) <ul style="list-style-type: none"> ○ Oral cleaning was done following the oral care methods of the nursing home. • The trial continued for one year 	<p>A primary outcome was not defined; the reported endpoints were change from baseline in</p> <ul style="list-style-type: none"> • body weight • BMI • Serum albumin level • HDL-C level
<p>ADL= activities of daily living; BMI= body mass index; FIM= functional independence measure (the FIM is an 18-item, seven-level ordinal scale that measures a patient’s ability to perform common daily tasks. In this trial only four items were assessed: feeding, dressing, transfer, and expression); GOHAI= general oral health assessment Index (GOHAI contains 12 questions, each question has a score from 1 to 5, and the total score for the 12 questions is the GOHAI score); HDL=high density lipoprotein; LTC= long-term care; QoL= quality of life; RCT= randomized controlled trial</p>			
Naito et al. 2010⁹ – Japan			
<p>To determine the effects of dental treatments on the QoL and ADL among institutionalized elder people.</p> <p>This was a controlled trial; allocation to intervention and control groups was stratified by age, gender, and degree of independence</p>	<ul style="list-style-type: none"> • Inclusion criteria: <ul style="list-style-type: none"> ○ Residence in the LTC for at least 30 days ○ Age of 65 years or above. • A total of 30 were allocated; 25 seniors completed the trial. • Mean age 80.9 years • 10 males and 15 females 	<ul style="list-style-type: none"> • Intervention: (n=11) <ul style="list-style-type: none"> ○ Dental treatment. • Control: (n=14) <ul style="list-style-type: none"> ○ No dental treatment during the trial period (six weeks), ○ Subjects in the control group could have the dental treatment after the trial had finished. • The intervention was provided at baseline and outcome data were collected 6 weeks after baseline 	<p>A primary outcome was not defined; the reported endpoints were the difference, between groups, in change from baseline in</p> <ul style="list-style-type: none"> • ADL as evaluated with FIM, four items were evaluated in this trial <ul style="list-style-type: none"> ○ feeding, ○ dressing, ○ transfer, and ○ expression • QoL as evaluated with GOHAI
Ishikawa et al. 2008¹⁰ – Japan			

Table 4. Characteristics of the Included Experimental Controlled Trials

Study Objectives & Design	Inclusion Criteria, Sample Size, and Patients Characteristics	Interventions, Comparators, and Trial Conducts	Outcomes
<p>To evaluate the effect of professional mechanical cleaning of oral cavity on the prevalence of oropharyngeal bacteria in institutionalized dependent elderly</p> <p>This was a controlled trial, allocation was stratified by institution</p>	<ul style="list-style-type: none"> • Inclusion criteria were not specified <ul style="list-style-type: none"> ○ Residents who refused or were unable to cooperate due to physical or mental conditions, or because they were due to discharge for the facility, were excluded from the study. • Three facilities were allocated to one intervention each, with a total of 202 elders. • Mean age 81.8 years • 49 males and 153 females 	<ul style="list-style-type: none"> • Intervention A (facility A): (n=72) <ul style="list-style-type: none"> ○ Professional oral health care once a week from a dental hygienist for five months. • Intervention B (facility B): (n=70) <ul style="list-style-type: none"> ○ Resident did not receive professional care during the first two months. For the following three months, they received professional care once a week from dental hygienist. • Intervention C (facility C): (n=60) <ul style="list-style-type: none"> ○ Residents gargled with 0.35% povidone iodine once a day after lunch for the first two months. For the subsequent three months, they received professional care once a week in addition to gargling. 	<p>A primary outcome was not defined; the reported endpoints were:</p> <ul style="list-style-type: none"> • Changes in oral status during oral health care as evaluated by <ul style="list-style-type: none"> ○ pocket depth (for the dentate elders) ○ debris index • Changes in oropharyngeal flora during oral health care • Changes in febrile days per month and incidence of aspiration pneumonia
<p>ADL= activities of daily living; BMI= body mass index; FIM= functional independence measure (the FIM is an 18-item, seven-level ordinal scale that measures a patient's ability to perform common daily tasks. In this trial only four items were assessed: feeding, dressing, transfer, and expression); GOHAI= general oral health assessment Index (GOHAI contains 12 questions, each question has a score from 1 to 5, and the total score for the 12 questions is the GOHAI score); HDL=high density lipoprotein; LTC= long-term care; QoL= quality of life; RCT= randomized controlled trial</p>			
<p>Adachi et al. 2007¹¹ – Japan</p>			

Table 4. Characteristics of the Included Experimental Controlled Trials

Study Objectives & Design	Inclusion Criteria, Sample Size, and Patients Characteristics	Interventions, Comparators, and Trial Conducts	Outcomes
<p>To evaluate the role of professional oral health care by dental hygienist in reducing respiratory infections in elderly persons</p> <p><u>Two studies were reported</u> The first was a controlled trial conducted among two LTC residents – allocation method was not specified</p>	<ul style="list-style-type: none"> • Inclusion criteria were not specified • 88 seniors were recruited from two LTC • Baseline characteristics were not reported 	<ul style="list-style-type: none"> • Intervention group: (n=40) <ul style="list-style-type: none"> ○ Professional oral health care by a dental hygienist (the care frequency was not reported) • Control group: (n=48) <ul style="list-style-type: none"> ○ Basic daily oral hygiene done by the residents or their caregivers. • The intervention and evaluation continued for one year 	<p>A primary outcome was not defined; the reported endpoints were:</p> <ul style="list-style-type: none"> • Mean febrile days in one year in relation with the oral hygiene condition (not in relation with the intervention groups) • Pneumonia episodes in one year in relation with the oral hygiene condition (not in relation with the intervention groups) • The monthly percentage of elderly with fever (>37.8°C) in relation with the intervention groups • Death due to aspiration pneumonia in relation with the intervention groups

ADL= activities of daily living; **BMI**= body mass index; **FIM**= functional independence measure (the FIM is an 18-item, seven-level ordinal scale that measures a patient’s ability to perform common daily tasks. In this trial only four items were assessed: feeding, dressing, transfer, and expression); **GOHAI**= general oral health assessment Index (GOHAI contains 12 questions, each question has a score from 1 to 5, and the total score for the 12 questions is the GOHAI score); **LTC**= long-term care; **QoL**= quality of life; **RCT**= randomized controlled trial

Table 5. Characteristics of the Included Observational Controlled Studies

Study Objectives & Design	Inclusion Criteria, Sample Size, and Patients Characteristics	Interventions, Comparators, and Study Conducts	Outcomes
Wyatt 2009¹³			
<p>To compare the clinical outcomes of LTC residents who received dental treatment with those who did not receive care under a comprehensive dental programme.</p> <p>This was a retrospective 5-year cohort study</p>	<ul style="list-style-type: none"> • Inclusion criteria for subjects included in the analysis were not explicit; however, the comprehensive dental program was intended to cover all elderly LTC residents in Vancouver hospitals. <ul style="list-style-type: none"> ○ In 2002, a total of 894 residents were seen for an oral health assessment. ○ The mean age was 86 years ○ A total of 515 (58%) residents were recommended for dental treatment by a dentist ○ 234 (26%) received treatment • 139 residents were available, after five years, and received a complete oral health assessment 	<ul style="list-style-type: none"> • Intervention: (n=83) <ul style="list-style-type: none"> ○ Dental treatment of some form • Control group: (n=56) <ul style="list-style-type: none"> ○ No dental treatment beyond an annual examination • The analysis considered a 5-year retrospective follow-up period 	<p>A primary outcome was not defined; the reported endpoints were:</p> <ul style="list-style-type: none"> • Oral health status, as measured by the number of patient who had an improved, not changed, or worsened: <ul style="list-style-type: none"> ○ CODE score ○ Caries status ○ Periodontium status
<p>CODE= index of clinical oral disease in elder, it is a database that allows the inputting of clinical information including medical conditions, medications, jaw function, denture quality, oral mucosal status, periodontal health and tooth status. The article did not report any minimal clinically significant score change in CODE score, this value is important in the clinical interpretation of any score change; LTC= long-term care</p>			

Appendix 5: Critical Appraisal of Included Publications

Critical Appraisal Summary of the included the Publications

Strengths	Limitations
De Visschere et al. 2010² – Guidelines	
<ul style="list-style-type: none"> • The guideline had a definite scope and purpose with specific objectives and population to whom the guideline was meant to be applied on • The development process followed a predefined protocol of literature search and quality evaluation of the included publications. • Recommendations were clearly specified and reported • The guideline reported on potential organizational barriers in applying the recommendations and advised on the monitoring and audit process 	<ul style="list-style-type: none"> • Although the guideline was developed in collaboration between different stakeholders, it was reported if LTC residents' preferences were sought and taken into consideration. • The cost of implementing the recommendations was not analyzed or taken into considerations.
Sumi et al. 2010⁴ – Experimental Controlled Trial	
<ul style="list-style-type: none"> • Participants were randomly allocated to the intervention and control groups; however, the randomization method was not defined 	<ul style="list-style-type: none"> • Due to the nature of the intervention, allocation could not be blinded. The psychological effect of the intervention might have some influence on residents' morale and their eating habits. • The intervention was an oral care provided by a dentist three times a week; this intervention might not be realistic and might not reflect the results of more practical routine dental care. • The primary outcome was not defined, and the sample size was not calculated to achieve a desired power for an outcome difference. • The statistical methods did not specify the analysis method, ITT or PP, nor the methods to deal with missing data. • The article reported the difference from baseline within each group; however, the difference between groups was not reported.
Naito et al. 2010⁹ - Experimental Controlled Trial	
<ul style="list-style-type: none"> • The trial included seniors who were representative to general elderly population for whom the intervention was intended to be used. • The outcomes used were clearly defined • The potential confounders were identified and were considered in the analysis 	<ul style="list-style-type: none"> • Allocation to the intervention and control groups was not randomized • Although the trial intervention could not be blinded, it was not reported if the outcome evaluator were blinded. • The intervention in this trial consisted of dental treatment at baseline only. However, this intervention might not reflect the result of a routine dental care as desired by the current review.
Ishikawa et al. 2008¹⁰ - Experimental Controlled Trial	
<ul style="list-style-type: none"> • Although the inclusion criteria were not reported, the included seniors were representative to the general elderly population for whom the intervention was intended to be used. 	<ul style="list-style-type: none"> • Allocation to the trial interventions was not randomized • Allocation was stratified by facility; however, residents in each facility were not homogenous at baseline. <ul style="list-style-type: none"> ○ Cognitive impairment was highest in facility C (70%) and lowest in facility A (54.2%)

Critical Appraisal Summary of the included the Publications

Strengths	Limitations
<ul style="list-style-type: none"> The outcomes used were clearly defined. The trial used hard outcomes, including the incidence of febrile episodes and aspiration pneumonia. This type of outcome is more reflective to the real effect of interventions than the surrogate outcomes. 	<ul style="list-style-type: none"> Bed-bound residents were more frequent in facility A (27.8%), and equally distributed in facility B and C; 17.1% and 15.0% respectively. Mean numbers of decayed teeth was the highest in facility B (2.4 teeth) and lowest in facility C (0.9 tooth) Denture wearers were more frequent in facility C (63.4%) and least frequent in facility A (27.9%) The trial interventions consisted of a weekly professional oral care by a hygienist, and this might not be realistic or feasible in the actual practice.
Adachi et al. 2007¹¹ - Experimental Controlled Trial	
<ul style="list-style-type: none"> The trial used hard clinical outcomes (death due to aspiration pneumonia). This type of outcome has the advantage over surrogate outcomes in showing the real effect of the intervention 	<ul style="list-style-type: none"> Allocation was not randomized. Baseline characteristics of the included seniors were not reported and could not be compared between groups. Furthermore, the generalizability of the trial population could not be verified. The intervention was described; however, the frequency at which it had been provided was not reported.
Wyatt 2009¹³ – Observational Controlled Study	
<ul style="list-style-type: none"> The two groups were selected from the same population source. Baseline assessment of the outcome was conducted and secured in a database. 	<ul style="list-style-type: none"> Although a clear objective was proposed by the study question; however, the intervention was not clearly defined. The intervention was “dental treatment of some form”, but there were no details about the provided treatment or its frequency. Hence, some doubts may be reasonable about the generalizability of the study intervention and results to a routine dental care. It was not specified whether assessment for the outcomes was blinded to intervention status or not. It was not reported if there was evaluation for the potential confounders.

ITT= intention to treat; LTC= long-term care; PP= per protocol;

Appendix 6: Main Study Findings and Authors' Conclusions

Table 6. Summary of Findings and Authors' Conclusions

Main Study Findings	Authors' Conclusions
De Visschere et al. 2011²	
Recommendations (items from 1 to 16 were reported on page 308 of De Visschere² paper; item 17 was reported on page 99 of Putten²⁹ dissertation)	Evidence Level/ Grade
"1. Provide oral health care systematically to improve the residents' quality of life	C, D/ Grade 3
2. In dentate, especially in removable denture-wearers, try to prevent <i>Candida</i> colonisation of the oral mucosa and the dentures or treat the infection by systematic oral health care.	B/ Grade 3
3. Provide oral health care at least once a day to minimise the risk of remote infections, such as pneumonia	B, C/ Grade 2
4. Using an electric toothbrush may contribute to good oral health care substantially	A2, B/ Grade 2
5. Clean a removable partial or complete denture when the resident goes to sleep and store it dry at night	C/ Grade 3
6. Arrange at least every six months a professional oral examination for dentate residents	B/ Grade 3
7. Arrange at least annually a professional oral examination for residents having no natural teeth and for removable denture- wearing residents	B/ Grade 3
8. In case a resident shows or seems to show (non-verbal) signs of oral pain, try to examine his/her mouth and/or dentures and consult a dentist or a dental hygienist or an elderly care physician when indicated or questionable. Non-verbal manifestations of oral pain may be altered behaviour, decreased appetite, and weight loss	C/ Grade 3
9. In case a resident has bad breath frequently, consult a dentist or a dental hygienist or an elderly care physician.	C, D/ Grade 3
10. In case a resident complains about oral dryness, consult a dentist or a dental hygienist or an elderly care physician	D/ Grade 3
11. Assess the possible oral side effects of prescribed drugs	C/ Grade 3
12. In case a resident complains about or shows (non-)denture related oral soft tissue lesions, consult a dentist or a dental hygienist or an elderly care physician	C/ Grade 4
13. In case a resident shows a sudden caries increment, consult a dentist and request the dentist to prescribe a 0.025-0.01% fluoride rinse daily or a 0.1% fluoride rinse weekly	A2/ Grade 2
14. Consult a dentist or dental hygienist in case of primary root caries lesions and request to apply coatings of sodiumfluoride and/or chlorhexidine	D/ Grade 4
15. Consult a dentist in case of active root caries lesions and request the dentist to restore the lesions.	B/ Grade 3
16. In case daily oral health care in a dentate resident is impossible due to physical and/or behavioural problems, apply 1% chlorhexidine gel once daily or 0.5% chlorhexidine gel twice daily for prevention of periodontal disease. The chlorhexidine should be prescribed by a dentist or a dental hygienist or an elderly care physician"	A2, B/ Grade 3
17. When provision of oral health care daily is not possible (anymore), use a 0.12% chlorhexidine rinse or spray for daily use. In case rinsing or spraying is not possible (anymore), apply 1% chlorhexidine (gel), using, for example, drenched gauzes. The chlorhexidine should be prescribed by a dentist or a dental hygienist or an elderly care physician.	A2/ Grade 3

"None of the recommendations could be based on an evidence level A1 conclusion. Four recommendations were based on evidence level A2. The remaining recommendations were based on expert opinions."

Table 6. Summary of Findings and Authors' Conclusions

Main Study Findings							Authors' Conclusions			
Levels of evidence: A1=Meta-analysis or systematic review of RCTs; A2=Good quality RCT; B=lower quality RCT, or other comparative study (e.g. cohort or case-control study); C=Non-comparative study; D=Expert opinion. Grade 1 = best evidence level Grade 4 = little or no systematic empirical evidence, or working group opinion.										
Sumi et al. 2010⁴										
<ul style="list-style-type: none"> Results reported as mean value (SD) Intergroup difference was not reported P-value was reported for the difference from baseline, the difference value was not reported 							<i>"the intervention of oral care alone can serve to maintain the nutritional status of older people who require care"</i>			
Outcome	Oral care intervention groups, n= 27			Control group, n=26						
	Baseline	Trial end	p-value	Baseline	Trial end	p-value				
Weight, Kg	45.6 (8.9)	45.4 (9.7)	NR	46.4 (12.2)	44.1 (11.5)	<0.05				
BMI	20.9 (3.1)	20.9 (4.0)	NR	20.7 (4.3)	19.7 (3.7)	<0.05				
Albumin g/dl	3.6 (0.4)	3.5 (0.3)	NS	3.7 (0.3)	3.5 (0.4)	<0.005				
HDL-C mg/dl	52.1 (15.4)	49.9 (15.6)	NS	54.1 (11.9)	51.5 (13.2)	<0.05				
Naito et al. 2010⁹ – Japan										
Outcome	Dental treatment group, n=11			Control group, n=14			Difference between groups (95% CI)	<i>"Dental treatments for the institutionalized Japanese elderly improved the oral health-related quality of life and the expression function in the ADL."</i>		
	Baseline, mean(SD)	6 weeks, mean (SD)	change from baseline, mean (p-value)	Baseline mean (SD)	6 weeks mean (SD)	change from baseline, mean (p-value)				
GOHAI	47.9 (9.7)	54.2 (7.3)	6.8 (0.04)	49.7 (9.8)	50.9 (7.9)	0.7 (0.45)	6.1 (0.6, 11.5)			
Feeding	5.8 (1.7)	5.9 (1.7)	NR (0.34)	6.2 (0.9)	6.2 (0.9)	NR (NR)	NR			
Dressing	3.0 (2.2)	3.1 (2.2)	NR (0.34)	5.3 (1.9)	5.0 (2.1)	NR (0.26)	NR			
Transfer	3.0 (2.0)	3.5 (2.3)	NR (0.14)	4.6 (2.5)	4.4 (2.5)	NR (0.34)	NR			
Expression	2.6 (2.3)	4.8 (2.1)	2.2 (0.02)	4.5 (2.6)	5.4 (1.7)	0.9 (0.03)	1.3 (-0.6, 3.1)			
Ishikawa et al. 2008¹⁰ – Japan										
<ul style="list-style-type: none"> Changes from baseline were provided graphically for the oral status and oropharyngeal flora outcomes The statistical significance of the reduction from baseline is reported in this table <i>unless</i> otherwise specified Inter-facilities differences were not reported 							<i>"Weekly professional mechanical cleaning of the oral cavity, rather than a daily chemical disinfection of the mouth, can be an important strategy to prevent aspiration pneumonia in the dependent elderly."</i>			
Outcome	Facility A, N=72		Facility B, N=70			Facility C, N=60				
	Baseline	at 5 months	Baseline	2 months	5 months	Baseline			2 months	5 months
Periodontal pocket depth	NR	SS (n=27)	NR	NS (n=21)	NS (n=21)	NR			NS (n=15)	NS (n=15)
Debris										
Total bacteria	NR	SS (n=24)	NR	NS (n=24)	SS (n=24)	NR			SS (n=19)	SS (n=19)
Streptococci							NS (n=19)			
Staphylococci										
Pseudomonas					Not detected (n= 19)					

Table 6. Summary of Findings and Authors' Conclusions

Main Study Findings									Authors' Conclusions
Candida							NR (n=24)	SS (n=19)	
Black-pigmented									
Febrile days/month, mean (SEM)	0.5 (0.2)* n=61	0.8 (0.2) NS increase	0.5 (0.2)* n=59	1.5 (0.5) SS increase	1.3 (0.3) SS increase	0.4 (0.1)* n= 37	0.1 (0.0) SS (↓)	0.1 (0.1) NS	
aspiration pneumonia	3 cases**	8 cases	1 case**	no cases	no cases	no cases	no cases	no cases	
Adachi et al. 2007¹¹ – Japan									
<ul style="list-style-type: none"> Death due to aspiration pneumonia <ul style="list-style-type: none"> The intervention group: 2 deaths (5%) The control group: 8 deaths (16.7%) Prevalence difference between groups was statistically significant (p-value <0.05) Monthly percentage of elderly with fever (>37.8°C) <ul style="list-style-type: none"> The incidence of fever was higher in the control group and the difference was statistically significant (p <0.05) 									<p><i>“The results suggest that professional oral health care by dental hygienist is effective in preventing respiratory infections in elderly persons requiring nursing care.”</i></p>
Wyatt. 2009¹³ – Canada									
<ul style="list-style-type: none"> The total number of patients included in the analysis was 139 patients 									<p><i>“Although the annual utilisation of a comprehensive dental programme for LTC was limited, residents who did consent and receive care showed an improvement in their oral health status after 5 years.”</i></p>
Outcome	Improved, n(%)	No Change, n(%)	Worsened, n(%)	Statistical testing					
CODE Score				$p=0.02, \chi^2=7.9; df=2$					
Treatment group (n=83)	19 (23)	48 (56)	16 (19)						
Control group (n=56)	3 (5)	38 (68)	15 [†] (27)	NR					
Caries status									
Treatment group (n=65)	21 (32)	30 (46)	14 (22)	NR					
Control group (n=20)	2 (10)	17 (85)	1 (5)						
Periodontium				NR					
Treatment group (n=65)	21 (32)	34 (52)	10 (15)						
Control group (n=20)	4 (19)	13 (65)	3 (14)						

ADL= activity of daily living; BMI= body mass index; CODE= index of clinical oral disease in elder, it is a database that allows the inputting of clinical information including medical conditions, medications, jaw function, denture quality, oral mucosal status, periodontal health and tooth status. The article did not report any minimal clinically significant score change in CODE sore, this value is important in the clinical interpretation of any score change; FIM= functional independence measure (the FIM is an 18-item, seven-level ordinal scale that measures a patient's ability to perform common daily tasks. In this trial only four items were assessed: feeding, dressing, transfer, and expression); GOHAI= general oral health assessment Index (GOHAI contains 12 questions, each question has a score from 1 to 5, and the total score for the 12 questions is the GOHAI score); NR= not reported; NS= not significant; Pd= periodontal pocket depth; SD= standard deviation; SEM= standard error of the mean; SS= statistically significant

* baseline mean was based on the incidence in the preceding two months

** baseline incidence was based on the incidence in the preceding six months

† Calculated by CADTH. This number was misreported (reported as n=30, 27%) in the original publication