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Provision of mouth-care in long-term care facilities: an educational trial

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Abstract – *Objectives:* This randomized clinical trial aimed to assess the effectiveness of a pyramid-based education for improving the oral health of elders in long-term care (LTC) facilities. *Methods:* Fourteen facilities matched for size were assigned randomly to an active or control group. At baseline in each facility, care-aides in the active group participated with a full-time nurse educator in a seminar about oral health care, and had unlimited access to the educator for oral health-related advice throughout the 3-month trial. Care-aides in the control group participated in a similar seminar with a dental hygienist but they received no additional advice. The residents in the facilities at baseline and after 3 months were examined clinically to measure their oral hygiene, gingival health, masticatory potential, Body Mass Index and Malnutrition Indicator Score, and asked to report on chewing difficulties. *Results:* Clinical measures after 3 months were not significantly different from baseline in either group, indicating that education neither influenced the oral health nor the dental hygiene of the residents. *Conclusions:* A pyramid-based educational scheme with nurses and care-aides did not improve the oral health of frail elders in this urban sample of LTC facilities.

Key words: aging; care-aides; clinical trial; dentistry; educational methods in health care; long-term care; nutrition; oral hygiene

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Oral health is generally very poor among residents of long-term care (LTC) facilities, where chronic gingivitis, caries, missing teeth and chewing difficulties, along with discomfort and pain, are commonplace (1–7). Malnourishment of frail elders is also a widespread problem (8, 9). Involuntary weight loss has been associated with poor oral hygiene, dry-mouth and difficulties chewing food when defective teeth and dentures reduce masticatory efficiency, restrict intake of essential nutrients, and limit the selection of nutritious foods (10–13). There is evidence that the likelihood of being either underweight or obese increases when there are fewer than 21 teeth (14, 15), and that the risk of a low Body Mass Index (BMI) triples when frail elders have unhealthy teeth (13). Consequently, there is a growing belief that the risk of undernutrition increases in old age when oral health and function are poor (16).

Little use has been made of theoretical frameworks to support oral health-related education in LTC facilities (17). The education offered to nurses and care-aides consists typically of lectures or seminars presented by visiting dental personnel (18). However, studies on the impact of these educational methods have been inconclusive. Some methods seem to benefit the residents (19, 20), some enhance the knowledge of the nurses (21, 22), whereas others give no noticeable beneficial impact to anyone (23). Moreover, when benefits were noticed, usually they were short-lived (17, 24).

Studies evaluating the impact of educational initiatives on health care almost certainly disrupt the usual routine of the care-givers and the recipients of care during the course of the study, which is a difficulty that has received little attention in reports of clinical trials (25). In a previous exploration of nursing homes, we were told by administrators of several facilities that a full-time member of the nursing staff, rather than an 'outside' dental hygienist, might be less disruptive and more effective as an educator of oral health, and be better situated to tutor and monitor the daily activities of the care-aides (26). This suggestion was bolstered further by evidence indicating that educational programs for adults are more effective when tutors are sensitive to the cultural context of the learners and readily accessible to provide lessons in a natural context (27–29). The 'pyramidal scheme', for example, is an educational method that evolved from the 'helper principle' whereby an educational director or expert at the apex of the pyramid guides local trainers, who in turn, and with different levels of education, guide an even larger group of learners. It was proposed originally by Riessman (30) for training non-professional community organizers to assist social workers, and is based on observations of various self-help organizations in which recipients of help become effective dispensers of help after they get involved in seeking solutions for the problems of their community. Apparently, the helper and the community benefit most when the helper–teacher is from the community, dispenses solutions to the community, and is aware of the local contexts and social relationships of the community. Also referred to as 'tier training', it has been used to help people with learning disabilities and speech anxieties by improving the quality of the interactive instruction and by lowering the cost of training teachers (31). Cultural sensitivity has surfaced as an important factor also when preparing nurses and care-aides for the oral health care needs of disabled elders (32, 33).

Evidence supporting the pyramidal design in dental education is limited to improving oral hygiene among children with cognitive and physical disabilities (34), and to evaluating training materials used to educate managers and staff in several care facilities (35). Consequently, we designed a clinical trial to assess the clinical and psychosocial impact of a pyramid-based educational program for improving the oral health and nutritional status of elders receiving intermediate care in LTC facilities. This paper reports the methods and clinical results of the trial.

Objectives and hypothesis

The objective of the trial was to assess the clinical and psychosocial effectiveness of a pyramidal education for improving the oral health and nutritional status of elders receiving intermediate care in LTC facilities. The trial tested the null hypothesis that active education compared with control education would not improve significantly the clinical status of residents in intermediate care.

Methods

Participants

Our primary units of analysis were 14 LTC facilities identified and selected randomly from a list of 130 facilities in metropolitan Vancouver (36). Initially, we identified 41 facilities from the list of 130 in the area with random numbers, and contacted the administrators by mail. The facilities were matched for size, and distributed randomly to one of two educational methods. We selected the first 14 facilities offering to participate, matched them for size, and assigned them randomly to one of the educational methods (Fig. 1). Fifteen facilities refused, and the other 12 facilities offering to join were not needed based on our estimates of the sample size required for the trial. The chief administrator of each facility in the active 'nurse educator' group appointed a nurse with minimum 3 years of clinical experience to serve as an oral health educator from among the registered nurses on full-time staff. The chief administrators also asked all of the care-aides in each facility to attend the educational seminar. Finally, before the formal seminar was presented to care-aides in each facility, the directors of care helped us to select residents who: (i) were receiving intermediate care[1]; (ii) had natural teeth; and (iii) were cognitively and physically suitable for a clinical examination of the mouth.

Educational methods

Active group

The care-aides in each facility assigned to the active group had access to a nurse educator who was a permanent member of the staff and trained by a dental hygienist to manage the oral health care

[1]Residential care ranges from intermediate to extended care depending on a resident's abilities and challenges. Intermediate care demands some but not full-time nursing care.

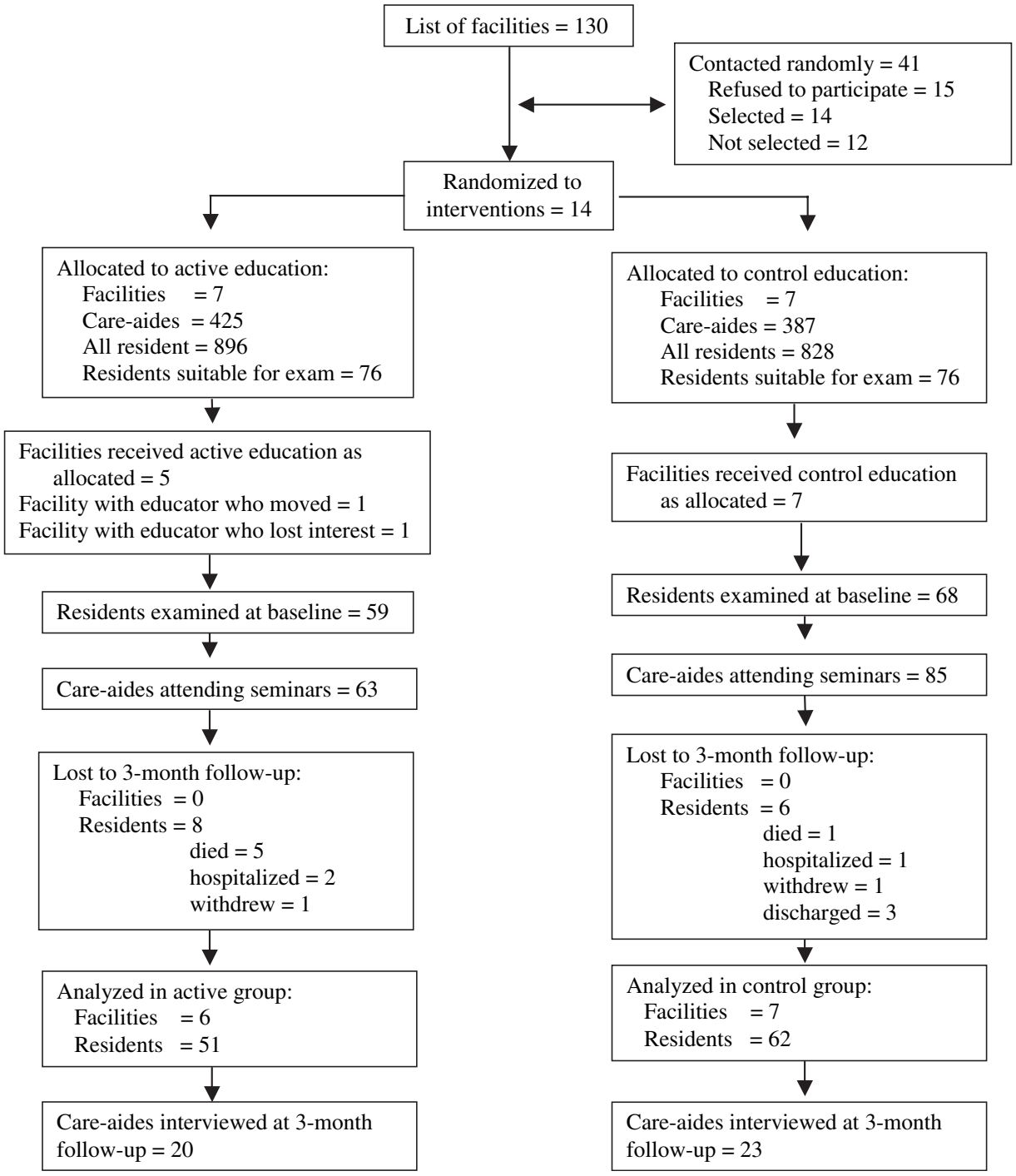

Fig. 1. Flow diagram of the trial.

[2]Wyatt CCL, MacEntee MI. A POWERPOINT presentation entitled 'Mouthcare for Persons in Residential Care'. Canadian Intellectual Property Office Copyright September 15, 1999. Certificate of Registration no. 490280.

[3]Wyatt CCL, MacEntee MI. A manual entitled 'Daily Oral Care for Persons in Residential Care'. Canadian Intellectual Property Office Copyright September 15, 1999, Certificate of Registration no. 479630.

provided by the care-aides. The dental hygienist trained the nurse by discussing an annotated series of clinical photographs[2] and a text[3] summarizing the appearance and management of the more usual oral diseases encountered among frail elders. Subsequently, the nurse had direct access to the dental hygienist by telephone for further information and advice as needed.

The nurse conducted a single 1-h seminar with the care-aides to explain the annotated series of photographs and text, and to demonstrate with educational props (e.g. models of teeth; toothbrushes) how to examine and clean the mouth. All care-aides attending the seminar received a copy of the texts, and were offered access to the photographs for review at any time during the trial. In addition, they were told how they could approach the nurse educator for advice and help on managing the oral health of individual residents during the trial.

The dental hygienist telephoned each nurse educator within 2 weeks of their first meeting to offer additional guidance or information if needed, and to confirm that the educator felt adequately prepared for the seminar. Subsequently, the educators had telephonic access to the dental hygienist for advice on managing specific clinical problems as they arose throughout the trial.

Control group

Education of the control group was based on the typical oral health-related program offered to the staff of nursing homes by dental hygienists in public health service throughout British Columbia (26). This consisted of the same 1-h seminar, photographs, texts and educational props offered to the active group. However, the dental hygienist organized and delivered the seminar directly to the care-aides in each facility but without additional information or follow-up.

Clinical results

An experienced dental hygienist familiar with the clinical criteria examined under good illumination the teeth of residents at baseline before the seminar was held for the care-aides, and again 3 months after. All the data were entered directly to a laptop computer by a research assistant accompanying the examiner. The examiner or assistant did not know the educational method assigned to the facilities, nor did they know the results from the baseline examinations when examining the residents 3 months later. The primary evaluations of clinical impact on the residents were clinical measures of oral debris and gingival inflammation, and secondary evaluations were clinical measures of dietary nourishment and masticatory potential.

Primary clinical outcomes

The Geriatric Simplified Debris Index (GDI-S), derived from the Simplified Debris Index and the Simplified Oral Hygiene Index (37), is based on a four-point (0–3) scale to reflect the amount of debris on the facial surface of each tooth. The mean score was dichotomized to 0–1.8 and 1.9–3.0 reflecting either good or poor hygiene (38), and individual scores were summed and divided by the number of individuals in each group.

The Gingival Bleeding Index (GBI) was calculated from a dichotomous 'yes' or 'no' record of gingival bleeding within 10 s of moving a periodontal probe gently around each tooth when inserted 2 mm into the gingival sulcus (39). The GBI score per person was calculated from the ratio of teeth with at least one bleeding site to the number of available teeth, and expressed as a percentage.

Secondary clinical outcomes

The BMI was calculated from the ratio of a resident's weight to height with a score <23 suggesting under-nourishment (40).

The Malnutrition Indicator Score (MIS) as part of the Mini Nutritional Assessment (MNA, 1994) was determined at baseline and at 3 months from anthropometric, general health, and dietary assessments to identify elders who were well-nourished (≥17 points), possibly under-nourished (23–17.5 points), or malnourished (<17 points) (41).

The Eichner Index was calculated from the number of occluding contact zones between posterior teeth in upper and lower jaws, both with and without prosthodontic replacements. It reflects the masticatory or chewing potential on posterior teeth (42), and was reported dichotomously as 'adequate' when there were two or more contact zones bilaterally, or 'inadequate' when there were fewer contact zones.

We also recorded the number of fractured teeth and roots of teeth visible on the surface of the residual ridge expecting that a change in the knowledge and behavior of care-aides following the educational intervention would lead to greater awareness of visible dental abnormalities and an immediate move to eliminate them.

Psychosocial outcomes

A research assistant collected additional information after seeking their consent to the trial by: (i) administering to residents a short questionnaire addressing self-reported complaints about chewing foods such as raw vegetables and meat, and self-assessment of appetite; (ii) conducting open-ended interviews with the care-aides at baseline before

the seminars and at the end of the trial; and (iii) maintaining a log of interactions between the nurse educators and the dental hygienist during the trial. The results of the psychosocial aspects will be reported elsewhere.

Sample size

Secondary analysis of data from a recent study of 39 LTC facilities in the region: (i) revealed that 76% of 369 dentulous residents examined had a Simplified Debris Index >2, so we assumed that an educational method would be clinically beneficial if it reduced by half the distribution of residents with poor oral hygiene (GDI-S = 1.9–3.0). Therefore, assuming a 23% dropout of participants in LTC (43), a one-sided test achieves 80% power at 0.05 significance level with 44 residents, i.e. 22 residents per group (44). Unpublished observations from the same source indicated that 65% of the residents with natural teeth had gingival bleeding on gentle probing, so, with a reduction of at least 25 percentage points (i.e. reducing prevalence to ≤40%) and similar assumptions on dropout and power, we estimated that 114, i.e. 57 residents per group, would be adequate to test for an impact on the BI of the residents. Other published reports (16, 41) suggest that over half of the elders in residential care have an MIS <24, but only 20% of the elders living independently are similarly under-nourished. Assuming a beneficial impact from an education that reduces the distribution of undernourishment by 25% over 3 months, we estimated that a one-sided test achieves 80% power at 0.05 significance with 114 residents, i.e. 57 per group. Finally, we anticipated that each facility would have at least 50 residents – half of them with natural teeth – and that 10 of them at least would consent to the examination. Therefore, we determined that the sample of residents needed for the trial would be available from 14 facilities.

Randomization

We identified with random numbers 41 facilities from the list of 130 facilities in the area, and contacted the administrators by mail. The 14 facilities selected were matched for size, and assigned by a double-blind[4] randomized block design to one of the methods. A person not involved in the education or analysis of results performed the random selections and assignments, and broke the code when all data were collected.

[4]Neither the examiner nor the residents knew the intervention assignments.

Analyses

We used generalized estimating equations using the software R (45) to estimate the effect of the education on primary and secondary outcomes while accounting for clustering within facilities (46). Each result was analyzed separately using an exchangeable working correlation with clusters indicated by the facility. We included the baseline measurement as a covariate in each analysis to account for variation in the clinical variables at baseline. Odds ratios and mean differences, with 95% confidence intervals, were calculated for dichotomous variables and continuous variables, respectively.

The clinical examiner on two occasions during the same day before the second set of examinations identified the GBI for six subjects who together had a total of 100 teeth. Comparison of the scores recorded from each subject produced a kappa statistic of 0.96, and a 95% confidence interval (0.89, 1.00), which indicated a consistent measurement of gingival bleeding.

Results

Recruitment and flow of participants

The directors of care helped to identify 76 residents in facilities within the active group and 90 residents in facilities within the control group by excluding other residents who did not meet the inclusion criteria because of frailty and/or missing natural teeth. Information from the directors indicated that about one-third of the residents excluded from the trial were edentate and two-thirds were very frail. Of the residents selected in facilities randomly distributed to an education, over three-quarters of them or their proxies – 59 in the active group (age: 78.3 years; SD: 10.9); 68 in the control group (79.9 years; SD: 12.1) – gave consent (the others refused consent) for the clinical examination at baseline; and over two-thirds – 51 in the active group (age: 77.4 years; SD: 11.07); 62 in the control group (age: 79.7 years; SD:11.9) – were re-examined after 3 months (Table 1; Fig. 1).

Baseline data

There were no significant differences between groups for any of the baseline measurements of primary and secondary outcomes in the active and

Table 1. Distribution of residents and care-aides participating in the trial

	Residents				Care-aides	
			Examined			
Group facility	Total available	Selected for examination	Baseline	3 months	Total available	Attended seminar
Active group						
A	71	8	7	6	14	8
B	76	13	10	7	53	5
C	132	12	9	8	52	2
D	188	12	8	8	93	10
E	90	10	7	7	28	28
F	188	10	9	8	62	5
G	151	11	9	7	123	5
Subtotal	896	76	59	51	425	63
Control group						
H	130	10	10	10	64	14
I	68	14	11	11	25	10
J	217	15	12	10	106	15
K	100	13	10	9	42	14
L	31	10	8	8	11	9
M	126	14	8	5	25	6
N	156	14	9	9	114	17
Subtotal	828	90	68	62	387	85
Total	1724	166	127	113	812	148

control groups compared by the Wilcoxon rank-sum test and Fisher's exact test for continuous and binary responses, respectively (Table 2a,b).

Participation of the nurse educators

In the active group, one nurse failed to organize the seminar or participate in the follow-up education, and another resigned before holding the seminar, and neither of them was replaced. Consequently, two facilities received no education, although outcomes were assessed and analyzed according to the randomization protocol with intention to treat as part of the active group. Only a small proportion of the care-aides (15% in active group; 22% in control group) attended the seminars (Table 1). The dental hygienist reported that none of the nurse educators contacted her for additional advice or information after their initial meeting and one follow-up telephone call 2 weeks later.

Impact of the education

There were no significant changes in clinical outcomes over the course of the trial that could be attributed directly to the educational programs (Table 3). In the active group, for example, 21% of the 24 residents below the critical BMI score (<23) at baseline appeared above the critical value 3 months later, whereas 15% of the 27 residents above the critical score at baseline fell below this score at second examination. The reduction in

Table 2. Distribution of clinical variables at baseline in the active and control groups

	Education		
Clinical variables	Active (n = 51)	Control (n = 62)	P-value
Body Mass Index <23	47%	39%	0.44
Geriatric Simplified Debris Index <1.9	86%	74%	0.16
1 or 0 occlusal contact zones in Eichner Index (without dentures)	51%	44%	0.45
1 or 0 occlusal contact zones Eichner Index (with dentures)	25%	27%	0.83
Self-reported chewing difficulties[a]	26%	27%	0.99
Mean Malnutrition Indicator Score (SD)	23 (3.2)	23 (3.7)	0.85
Mean Gingival Bleeding Index score[a] (SD)	61 (37)	62 (38)	0.74
Mean number of teeth (SD)	17 (8.0)	17 (7.2)	0.63
Mean number of fractured teeth or root tips[a] (SD)	0.7 (1.4)	1.1 (1.8)	0.56

[a]Data for this variable were not reported by all of the participants.

Table 3. Odds ratios and mean differences with 95% confidence intervals for the effect of the educational program on the clinical outcomes of the trial

Outcomes	Number of subjects	Number of measurements used in analysis	Odds ratio (95% CI)	*P*-value
Binary responses				
Body Mass Index <23	113	226	1.0 (0.3–3.1)	0.49
Geriatric Simplified Debris Index <1.9	113	226	0.8 (0.2–3.8)	0.41
0 or 1 occlusal contact zones in Eichner Index (without dentures)	113	113[a]	1.1 (0.5–2.8)	0.4
0 or 1 occlusal contact zones Eichner Index (with dentures)	113	226	0.4 (0.1–1.7)	0.11
Self-reported chewing difficulties[b]	109	218	1.4 (0.7–2.9)	0.16
			Mean difference (95% CI)	
Continuous responses				
Malnutrition Indicator Score	113	226	−1.1 (−2.9 to 0.7)	0.11
Gingival Bleeding Index score[b]	98	196	−0.2 (−7.3 to 7.0)	0.48
Number of teeth	113	226	−0.1 (−0.4 to 0.2)	0.26
Fractured teeth or roots[b]	94	94[a]	−0.2 (−1.0 to 0.7)	0.35

[a]Baseline measurements were excluded in the analysis of this outcome due to high correlation between baseline and follow-up measurements.
[b]Data for this outcome were not collected from all participants.

self-reported chewing difficulties among the eight residents in the control group who identified chewing difficulties at baseline occurred because three of them had sore teeth that improved, two had dentures adjusted, one recovered from a bladder infection, one recovered partially from a stroke, and another improved for no apparent reason. In summary, clinical changes between examinations do not indicate that the educational method influenced either the oral health or hygiene of the residents.

Discussion

Interpretation of results related to hypothesis and to bias or limitations

We initiated this trial to test the effectiveness of an experienced nurse educating and managing other members of staff to improve the oral health of the residents within the usual routine of the facility. Clearly, the pyramidal scheme involving a full-time registered nurse did not improve the oral health and nutritional status of the residents to a level that was clinically meaningful. Therefore, we cannot reject the null hypothesis.

There are several limitations to the trial influencing the significance of the results. The statistical power of the trial was based on an estimate of the number of residents needed – 57 in each group – but we achieved only 51 residents in the active group. Nonetheless, we feel that this had only a modest impact on the power of our conclusions. Anthropometrics and dietary assessments offer a reasonable indication of nutritional status (15, 19, 47); nonetheless, residents left food uneaten during meals that we could not quantify when calculating the MIS. The anthropometric measurements with both educations changed substantially between examinations, although the extent to which teeth contribute to the change is unclear given the range of food and its preparation in the facilities, and the likelihood that teeth are not essential to digestion (48).

We were unable to conduct the trial without disrupting the social environment of the facilities, which surely produced a Hawthorne effect in both groups. Speaking to administrators and getting signed consents raised expectations; nurses and care-aides were aware of being observed; and administrators tended to protect frail and unstable residents from unnecessary disturbances. Following our previous exploration of oral health-related practices in LTC facilities (26), we were very sensitive to these concerns from the outset and tried to minimize them. As usual, the facilities accommodate elders at various levels of frailty, so we expected that many residents would be unsuitable for the trial, and asked the directors of care to select residents who were physically and cognitively suitable for examination before we approached residents for consent to examine. This

strategy increased the possibility of a selection bias, although the randomization process probably distributed the bias equally to both groups.

Fewer care-aides than expected attended the seminars (15% in the active group; 22% in the control group), so the 'coverage efficiency' of the education was low by current standards of evaluating educational programs (49, 53). Our objective was to test the effectiveness rather than the efficacy of the educational interventions, and daily events influencing attendance at seminars are part of the social fabric of every facility (26, 32). Undoubtedly, the recruitment of care-aides to the active group was influenced by the resignation of two nurse educators before the seminars, and by the failure of the administrators to replace them. However, we operated on the principle that the educational methods would be most effective when presented as a 'combination of learning experiences designed to facilitate voluntary adaptations of behavior conducive to learning' (50). The care-aides were not obliged by the terms of their employment to attend lectures or seminars. Others have shown that a more intrusive educational program might have rectified these developments (20, 51); nonetheless, the lack of response from the administrators offers a realistic view of the low priority given to oral health programs despite the early enthusiasm for the trial.

A labor dispute between the staff and their employers during the early stages of recruitment delayed recruitment in some facilities, but we were fortunate that it was resolved before the trial began. The dispute certainly upset the morale of the working environment in all of the facilities during the trial, and probably added to the low attendance at the seminars. A persistent recruitment strategy might have achieved higher attendance, although there is no assurance that it would have enhanced the health care provided or prevented the disengagement of the nurse educators (52).The nurses accepted their role voluntarily and with interest at the beginning, but obviously their interest had waned when two of them resigned early in the trial, and when the others did not contact the dental hygienist as planned for further advice as the trial progressed. The design of the trial permitted the dental hygienist to intrude only when requested by the nurses, so an unplanned intervention would have disturbed the integrity of the trial. Labor disputes along with the diminishing interest of participants are two real events that occasionally influence life in an LTC facility and reduce the effectiveness of educational programs for the staff. The care-aides were not influenced strongly by the formal lecture and the fact that the nurse educators did not contact the dental hygienist after the initial lecture suggests that everyone involved had a sense of self-efficacy. We used 'qualitative' interview techniques to uncover the beliefs and behaviors of the care-aides and nurse educators and to explore the basis for their behaviors (52–54), which we will report elsewhere.

The clinical and behavioral effects after 6 months of an oral health educational session, similar to our control, yielded positive results within a group of nursing homes in Bristol (20, 51), but the homes differed in several important respects from the facilities recruited in Vancouver. The residents in facilities were fewer in Bristol (range: 20–40) compared with Vancouver (range: 31–217) and we know that size influences the culture of care and the implementation of educational methods (26, 32, 33), although not always to favor small facilities (55). The mean oral debris score associated with the active intervention in Bristol was much higher (1.9) at the beginning and at the end of the trial than the mean scores from both the active (1.3) and the control (1.4) groups at baseline in Vancouver, which suggests that reduction of oral debris below a mean score of 1.3 is neither necessary nor clinically practical in this population. The care-aides and nurses who believe that the oral care they provided to the residents is adequate, considering everything else involved in caring for frail elders, might indeed be correct (26) at least in this sample of Vancouver's facilities. The participants in the trial were shown the clinical signs of gingivitis, and told emphatically and simply that bleeding gingiva from our perspective is not an acceptable condition in this population. Clearly, the participants did not remember or accept this directive. However, considering how little we know about the significance of gingivitis to the health of frail elders and the survival of teeth, perhaps, as Brookfield suggests (27), there is reason to challenge the prevailing norms towards bleeding gingiva in deference to the experiences of those most intimately involved with the elders. Moreover, we drew the attention of the participants to the need for a dentist's opinion when they saw fractured teeth or root-tips seen, hoping that more obvious abnormalities would be addressed when a nurse educator was involved. However, both groups responded similarly to this advice.

Recent theories and models of adult education have moved attention away from universal

applications of education and learning, and onto more local, pluralistic and diverse arenas of practice (27–29). It is likely that the organizational structure and labor relations between administrators, nurses and care-aides in many facilities harbor hidden values and assumptions (33), all of which need further exploration before we can create effective educational environments for improving oral health care in the midst of so many conflicting priorities.

Acknowledgments

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Ethical review

The protocol for the methods used in the trial was approved by the Clinical Research Ethics Board according to University Policy no. 89: Research and Other Studies Involving Human Subjects.

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