Reducing Dental Plaque Scores in Long-term Care Facilities Using a Checklist and Random Inspections: A Pilot Study

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Abstract

The development and use of tailored interventions in overcoming barriers to optimum health in long-term care facility residents is of the highest importance. One successful approach to improving health outcomes is the use of a checklist by health care providers. Despite the evidence of the success of such checklists in nursing and medicine, there is little evidence on their use in improving dental outcomes. This study investigated whether an intervention comprising the daily use of a checklist for oral care by nursing staff supplemented by random inspections by a charge nurse resulted in lower dental plaque scores in patient participants at a long-term care facility (n = 19) as compared with those at another long-term care facility that did not receive the intervention (n = 13). All participants received a dental cleaning at baseline. At a follow-up examination at 6 to 8 weeks post-baseline, significant differences were observed in the plaque scores between the participants at each location, with the median plaque scores in those undergoing the intervention being less than half of those in the patients that did not (20.8% vs. 52.8%, p<0.001). After adjusting for age in a linear regression model, this difference remained significant. The use of a daily checklist for oral care supplemented by random inspections by a charge nurse was associated with lower plaque scores (p<0.001). These results warrant further research, including prospective studies aimed at establishing how use of both clinical supervision and a checklist for oral health may influence plaque scores in geriatric patients in long-term care facilities over time.

Key words: Dental care — Elderly — Nursing homes — Intervention — Plaque scores
Introduction

Oral health in older individuals living in nursing homes or long-term care facilities (LTFs) is generally worse than that in older adults living among the general population\(^7\). In addition, as individuals get older and the prevalence of dementia and other cognitive disorders increases, they become increasingly dependent on others for the provision of proper oral health care, making it more challenging for staff employed at LTFs. More and more older individuals entering such facilities have retained natural teeth and/or have complex oral prostheses that require increasing levels of care to ensure that they are properly maintained\(^7\). Evidence suggests that various factors, including a shortage of time and staff, caregivers’ low level of knowledge of oral hygiene, and patients’ lack of cooperation influence the level of dental care in LTFs\(^3,16\). Additionally, nursing staff often lack a clear and consistent routine for providing care to patients\(^13\). Due to these and other factors, residents in LTFs may receive less than ideal care, including, but not limited to, insufficient brushing of teeth, improper cleaning of dentures, and the use of fingers instead of a toothbrush by nursing staff to clean the teeth\(^7\). Without proper comprehensive care, oral health in older individuals in LTFs may, therefore, suffer. Poor oral health in LTF residents can have an adverse influence on overall health, as poor oral health increases the risk of malnutrition, aspiration pneumonia, and premature death\(^7\).

Given the adverse effects of less than ideal care in residents in LTFs, the development and use of tailored approaches or interventions to overcome barriers to optimum oral health in this population is therefore of the highest importance. One successful approach to improving health outcomes being used with increasing frequency is the incorporation of a checklist by health care providers. The World Health Organization surgical safety checklist has been shown to successfully improve a variety of patient outcomes under differing circumstances and has already been implemented by hospitals all around the world\(^15,10\). While a search of the literature by the present authors yielded publications describing the introduction of checklists to improve clinical outcomes in oral surgery and endodontics, they do not provide information on their success in improving dental outcomes over time\(^5,8\). The specific aim of the present study was to investigate the effect of a checklist for oral care supplemented by random inspections by a charge nurse on improving oral hygiene. Our hypothesis was that an intervention comprising a checklist for oral care in conjunction with random inspections by a charge nurse would lead to lower plaque scores compared with patients in whom this intervention was absent.

Materials and Methods

This study comprised two phases. In the first phase, focus groups comprising staff and administrators at two LTFs were established. These focus groups were tasked with exploring potential pathways for developing an intervention that would improve the oral health of patients in LTFs. At the meetings of each focus group (6 to 8 participants in each group), open-ended questions were used to explore their perceptions of the barriers to and facilitators of provision of daily oral hygiene care. Two focus groups were conducted at one facility (one with staff and one with administrators), and one at the other (with staff only). A number of questions were posed to each group. Here are some examples of the questions asked: “What barriers exist for delivering oral health care to patients who are resistant or non-compliant? How do you get past these barriers?”; “What systems are in place to ensure that oral hygiene is performed daily?” and “What are some of the advantages and disadvantages of including a new intervention that requires oversight beyond the certified nursing assistants?”

Participants were encouraged by the facilitators to answer and discuss the answers with other focus group members. The focus group
sessions lasted from 45 to 75 minutes. The research team discussed the results using detailed notes made during the focus group sessions. The investigative team then developed a pilot project to be implemented in phase two based on these results.

The goal of phase two was to determine whether the use of a checklist for daily oral care supplemented by random inspections by a charge nurse led to improved oral hygiene as measured by lower plaque scores. Outcomes were compared between the patients at the long-term care facility where the intervention was provided (CF1) and those at the facility where it was not (CF2). Both participating LTFs are located in Washington, DC: CF1 is located in Northeast Washington, DC, while CF2 is located in Northwest Washington, DC. The checklist used for daily oral care is shown in Table 1. The procedures to be checked off by the nursing staff comprised toothbrushing of the patient’s teeth twice a day (displayed on the first row) and cleaning of the patient’s dentures if dentures were

### Table 1 Daily oral health checklist

| Task                          | Monday AM | Monday PM | Tuesday AM | Tuesday PM | Wednesday AM | Wednesday PM | Thursday AM | Thursday PM | Friday AM | Friday PM | Saturday AM | Saturday PM | Sunday AM | Sunday PM |
|-------------------------------|-----------|-----------|------------|------------|--------------|--------------|-------------|-------------|-----------|-----------|-------------|-------------|-----------|-----------|
| Brush teeth (2 times per day) | Time:     | Time:     | Time:      | Time:      | Time:        | Time:        | Time:       | Time:       | Time:     | Time:     | Time:       | Time:       | Time:     | Time:     |
|                              | Initials: | Initials: | Initials:  | Initials:  | Initials:    | Initials:    | Initials:   | Initials:   | Initials: | Initials: | Initials:   | Initials:   | Initials: | Initials: |
| Clean dentures (2 times per day) | Time:     | Time:     | Time:      | Time:      | Time:        | Time:        | Time:       | Time:       | Time:     | Time:     | Time:       | Time:       | Time:     | Time:     |
|                              | Initials: | Initials: | Initials:  | Initials:  | Initials:    | Initials:    | Initials:   | Initials:   | Initials: | Initials: | Initials:   | Initials:   | Initials: | Initials: |
| dentures soaked overnight     | Time:     | Time:     | Time:      | Time:      | Time:        | Time:        | Time:       | Time:       | Time:     | Time:     | Time:       | Time:       | Time:     | Time:     |
|                              | Initials: | Initials: | Initials:  | Initials:  | Initials:    | Initials:    | Initials:   | Initials:   | Initials: | Initials: | Initials:   | Initials:   | Initials: | Initials: |

Replace patient’s toothbrush on (date) (At least every 3 months)

Notes (Note any findings or issues during oral hygiene care, e.g. bleeding gums, crusting at edge of lips.)

- Mon
- Tues
- Wed
- Thurs
- Fri
- Sat
- Sun
present twice a day (displayed on the second row). There was a third row for recording the removal and soaking of the patient’s dentures overnight when dentures were present. To confirm that each check had been carried out as required, there was a space where nursing staff could write the time at which it was performed (under AM. or PM.) and provide his or her initials in the column that represented each day of the week. The checklist was to be replaced weekly, so there was a separate column for each day of the week. In addition, there were additional lines provided below the third row so that nursing staff could describe any unusual findings observed during daily visits, such as bleeding gums or crusting of the edge of the lips. The purpose of the checklist was to ensure that the required procedures were uniformly implemented at the participating location. The checklist was based on a template provided in the “Oral health in the long-term care setting” manual published by the Society for Post-Acute and Long-Term Care Medicine. Ultrasonic dental scalers and dental supplies were purchased so that preventive oral hygiene procedures could be provided at both locations, which constituted the intervention and control groups, and maintained on a consistent basis, even after completion of the study. These dental supplies included items needed for cleaning and maintaining a patient’s dentures, such as denture brushes, denture cleaning tablets, denture cleaning solution, and denture cases, in addition to supplies and equipment for cleaning and maintaining the patient’s natural dentition. Staff at both participating locations underwent the educational component of the study and received the supplies; the difference was that the staff at only one location (CF1) also implemented the new routine, comprising the checklist for procedures and random patient inspections by the charge nurse on duty. The daily checklist at CF1 required two checks, one to be performed in the AM. and the other in the PM. every day of the week. As mentioned earlier, and shown in Table 1, each task was listed separately on the checklist. These tasks comprised brushing of the teeth, cleaning the patients’ dentures, and removing and soaking those dentures if present. There was a space provided on the checklist for the nursing staff responsible for the patient care during each period to place their initials for each service, both in the morning and in the evening.

At CF1, the on-duty charge nurse provided random checks of the patient’s oral hygiene and checked whether the checklist form had been completed at least once a day. The checks were performed daily, but at differing times, so that their occurrence could not be predicted with any certainty by the nursing staff responsible. There were different charge nurses, depending on the day or the specific work shift, and each participating on-duty charge nurse was provided with the details of the study protocol. In effect, the charge nurse would arrive at the ward concerned and perform the checks at times known beforehand only to themselves. The purpose of these
checks was to determine whether the check-list had been completed and daily oral hygiene care performed. Therefore, the charge nurse would also perform an intraoral examination on the participating patient. The goal of this was to encourage the nursing staff to complete the required procedures, as they were unable to predict when the charge nurse, who was their supervisor, might arrive. The time at which the charge nurse had performed each check was determined the following day.

The inclusion criteria for participation in this study were as follows: the patient was able to speak and understand English; the patient had at least 4 remaining teeth, and was not using complete dentures in both arches; the patient or their representative was able to provide informed consent.

The exclusion criteria were as follows: the patient was edentulous; the patient did not speak English; the patient was scheduled to be discharged in the coming month.

1. Outcome variable

The dental outcome, as measured at both locations, was the plaque score in each patient at 6 to 8 weeks after receiving a dental cleaning at baseline. This initial cleaning was provided to ensure that all the patients started with a clean mouth at this time point. The patients were enrolled in a continual process, so the date at which the patient received dental cleaning at baseline was recorded to ensure that the plaque score was measured within 6 to 8 weeks from this time point. The plaque scores were all recorded by one examiner, a dentist who provided dental care to the LTF residents at both locations on a regular basis. Dental cleaning comprised cleaning the teeth with ultrasonic equipment and manual or hand instruments, followed by polishing. Plaque scores were determined using the O’Leary plaque index (11,18). This particular index was chosen as it is valid, reliable, and easy to use by clinicians, not only researchers. This index records the presence of supragingival plaque on all tooth surfaces except the occlusal. It reports plaque scores as a percentage of positive sites present for dental plaque.

In addition to the plaque scores, the age and sex of each patient were also recorded.

Approval from the Institutional Review Board of Howard University was obtained for all phases of this study. The approval number was IRB-16-DEN-07, and approval was obtained on June 23rd, 2016.

2. Statistical analysis

The mean, median, standard deviation, and proportion were determined for each variable. Two sample t-tests were used to determine differences in the means of continuous variables between locations when the assumption of a normal distribution was satisfied; and the Wilcoxon Rank Sum test was used when the assumption of a normal distribution was not satisfied. The median values for the plaque scores were calculated instead of mean values, as these were not normally distributed. A linear regression model was used to investigate the association between plaque scores and location after adjusting for age. The Fisher-Exact test was used for the analysis of the association between sex and plaque scores; and the Wilcoxon Rank Sum test was used for the analysis of the association between study location and plaque scores. In the linear regression, the estimate was the average value of the difference in the predicted value for the plaque score when comparing CF2 with CF1, which served as the reference. In the linear regression analysis, the outcome was the plaque score, the predictor or independent variable was location (intervention as compared with non-intervention), and age was the confounding variable. A p-value of <0.05 was considered statistically significant. The Statistical Analysis System software, version 9.4 (SAS Institute Inc., Cary, NC, USA) was used to perform the analysis. Although this was only a pilot study, the estimated sample size required was calculated. A group sample size of 17 individuals was required to achieve 80% power to reject the null hypothesis of equal means when the population means difference was $\mu_1 - \mu_2 = 1.0 - 0.5 = 0.5$, with a standard deviation for both groups of 0.5, and with a significance
level of 0.05 using a two-sided sample equal variance t-test. The values for \( \mu_1 \) and \( \mu_2 \) were the assumed population mean.

Results

A total of 259 patients were under care at CF1 and 164 patients at CF2. Participating patients were recruited from 2 wards at each facility, and the number of patients on each ward ranged from a minimum of 22 to a maximum of 37. As shown in Table 2, 19 patients were designated to undergo the intervention (CF1) and 13 patients to not do so (CF2). The estimated required sample size was 17 at each location in this pilot study. The mean age of the participants at CF1 was significantly lower than that at CF2 (77.4 yr vs. 85.9 yr, \( p = 0.05 \)), but there were no differences in distribution of the sexes. In accordance with the study hypothesis, there were significant differences in the median plaque scores between the patient participants at the two locations, with the median plaque scores at CF1 being less than half those observed at CF2 (20.8% vs. 52.8%, \( p < 0.001 \)). This difference was both clinically and statistically significant. Given that there were significant differences in age between the patient participants at each location, we adjusted for age in the linear regression model, as shown in Table 3. In the unadjusted model, the plaque scores at CF2 were 34.3% higher than those at CF1. In the model which adjusted for age, the plaque scores in CF2 were 33.7% higher than those at CF1. In Table 3, the line indicating “intervention (ref)” means the intervention group served as the baseline or reference group, as compared to the non-intervention group, which was the comparison. For the unadjusted model, the R-squared was 0.4427; and for the age adjusted model, the R-squared was 0.4436.

| Characteristics | Care Facility 1 \( n = 19 \) | Care Facility 2 \( n = 13 \) | \( p \)-value |
|-----------------|-----------------------------|-----------------------------|--------------|
| Age (mean ± SD) | 77.4 ± 12.5                 | 85.9 ± 9.4                  | 0.049\(^a\)  |
| Sex             |                             |                             | 1.000        |
| Male, n (%)     | 5 (26.3)                    | 4 (30.8)                    |              |
| Female, n (%)   | 14 (73.7)                   | 9 (69.2)                    |              |
| Plaque score    | Median: 20.8                | Median: 52.8                | \(<0.001\(^b\) |
|                 | Q1: 14.1                    | Q1: 37.5                    |              |
|                 | Q3: 30.0                    | Q3: 70.0                    |              |

\(^a\)\( p < 0.05; \) \text{t-test}  
\(^b\)\( p < 0.001; \) \text{Wilcoxon rank sum test}  
Q1: First quartile  
Q3: Third quartile

|                      | Estimate | \( p \)-value |
|----------------------|----------|---------------|
| Unadjusted           |          |               |
| Comparison           | 34.3 (19.9, 48.6) | \(<0.001 \) |
| Intervention (ref)   | 0.0      |               |
| Age adjusted         |          |               |
| Comparison           | 33.7 (18.1, 49.3) | \(<0.001 \) |
| Intervention (ref)   | 0.0      |               |

Estimates represent mean values and 95% confidence intervals.
Discussion

The results of this study revealed an association between the scheduled intervention, which comprised the use of a checklist for oral care supplemented by random inspections by a charge nurse, and improved oral hygiene. A search of the literature revealed only a small number of previous studies that have described using clinical supervision of health care providers to improve patient outcomes\(^{15}\). The most relevant study examined the cost effectiveness of team supervision over three years in a hospital in Sweden, and the authors concluded that one of the benefits included improved patient care as measured by higher patient satisfaction and a decrease in complaints\(^8\).

It is plausible to suggest that random inspections at intervals not known to the nursing staff in the present study forced them to be more compliant in ensuring that the oral hygiene of the patients they were responsible for was maintained. This strategy was decided upon based on the results of focus group discussions that included both nursing staff and administrators at the two LTFs involved in the project. In the final analysis, significantly improved plaque scores were observed among the patient participants at the location where the random inspections by a nursing supervisor and checklists were implemented, even after adjusting for age (Table 3). This suggests that the premise that random inspections by a supervisor can lead to more attention to oral hygiene by nursing staff merits further investigation.

Our search of the literature revealed a number of studies that found that use of a checklist by health care providers led to improved health outcomes among patients\(^{1,4,10,17}\). The present study may be one of the first, however, to find that combining random inspections by a supervisor and the use of a checklist improved patient outcomes in the field of geriatric dentistry. Both methodologies have preliminary data to support the rationale for their use, so it is plausible that a combination of both would lead to improved oral hygiene through increased effort on the part of the caregiver. As with any study, the present research had some limitations. Our small sample size would be the most obvious limitation, increasing the possibility that our findings are spurious and due to random variation. It should be mentioned that the study was slightly underpowered to detect a statistically significant difference in plaque scores between the two locations based on sample size calculation. It was possible, however, to detect a difference due to the large difference in plaque scores observed. In addition, only age and sex were taken into consideration as potentially confounding factors, so the present results may have been skewed accordingly. More specifically, no direct measure of cognitive status or functional ability in each patient participant to provide oral self-care was available, so it was not possible to control for these particularly important potentially confounding variables. Moreover, follow-up was only continued for 6 to 8 weeks, thus preventing any inferences to be drawn regarding the long-term success of the intervention. The participating patients and staff at each location were not selected at random, but rather based on availability. Finally, the nursing staff participants were aware that they were part of a study, and this may have influenced their motivation to improve patient care.

In conclusion, the intervention investigated combines two methodologies that have been shown separately to improve patient outcomes. These two methods comprise clinical supervision through random inspections and the use of checklists for health care providers. To the best of our knowledge, this study is the first to provide new evidence on the possible association between implementation of these methods and reduced plaque scores in elderly patients. Moreover, the results revealed a statistically and clinically significant reduction in plaque scores, despite the study limitations. The present results warrant further research, including prospective studies aimed at establishing how the use of both clinical supervision and a checklist for health care providers
may influence plaque scores in geriatric patients in LTFs over time.

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