# Research
## Improving the oral health of older people in hospital

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**Objective:** *To determine whether an oral health therapist daily oral hygiene intervention, compared with the same routine performed by nurses with some dental support, can improve the oral health of older inpatients.*

**Methods:** *A prospective study was conducted at two tertiary referral hospitals with three phases: (i) pre-intervention (PI) usual oral care; (ii) oral health therapist intervention (OHTI); and (iii) nurse-led intervention (NI). Oral health was assessed with the Oral Health Assessment Tool.*

**Results:** *Three hundred and fifty nine patients participated across three phases (PI (n = 206); OHTI (n = 77); NI (n = 76)). In the intervention groups, there was a significant decrease in 'unhealthy' oral cleanliness at day 7, OHTI; 86 to 53% (P < 0.001), NI; 80 to 50% (P < 0.001) compared to PI; 78 to 72% (P > 0.14). Movement from 'unhealthy' oral cleanliness at day 1 to 'healthy' at day 7 was significantly higher in the OHTI (35%) and NI (37%) compared to PI (17%) (P < 0.001).*

**Conclusion:** *With support, nurses can improve the oral health of older patients similarly to an oral health therapist.*

**Practice Impact:** This research will impact oral hygiene practices in hospitals as it shows that if nurses are provided education and support to implement oral hygiene techniques, this may lead to better oral cleanliness for older people on acute aged care wards. Improving older patients' oral cleanliness may lead to less hospital-acquired pneumonia.

**Key words:** *dental care, aged, inpatients, oral health, patient care.*

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## Introduction

Studies have assessed the oral health of older people in acute hospitals and found it to be poor [1–3]. This is due to their acute medical illnesses, delirium and pre-existing medical problems, which compromise their ability to independently attend to their oral hygiene [4–6]. Nurses, however, face barriers in assisting patients with their oral hygiene. One major barrier is the lack of an evidence-based oral hygiene routine [7–9].

Evidence suggests poor oral health in older patients increases the risk of aspiration of bacteria from the oral cavity into the lungs, increasing the risk of hospital-acquired pneumonia (HAP) [10]. In turn, HAP impacts morbidity, mortality, length of stay and hospital costs [11].

Studies in long-term care facilities and a geriatric rehabilitation ward found improvements in oral health when there was support from dental professionals and/or nurses who followed a standardised oral care routine [12–15]. One study showed pneumonia incidence was reduced by weekly professional dental support and daily oral care provided by nurses [16]. Most studies conducted in hospitals have focused on patients with swallowing problems due to specific neurological problems [17]. We are unaware of any studies that have investigated the effectiveness of interventions to improve the oral health of older inpatients in acute geriatric wards.

Our aim was to determine whether older inpatients' oral health could be improved by an oral health therapist (OHT) performing a daily oral hygiene routine and then to determine whether the same routine performed by nurses, with support from the OHT, could achieve similar results. Contingent on these results, future research could then investigate whether better oral care by nurses leads to a reduction in HAP.

## Methods

A prospective study was conducted where oral health on days 1 and 7 was assessed during three phases: (i) pre-intervention (PI); (ii) oral health therapist-led intervention (OHTI); and (iii) nurse-led intervention (NI).

### Setting and participants

We have published the PI phase results which determined the oral health of older inpatients in two acute tertiary referral hospitals in Sydney: Concord Repatriation General Hospital (CRGH) and Nepean Hospital [18]. Patients were older than 65 years and under the care of the geriatric

medical team. Intervention phases were conducted at CRGH. The OHTI included patients from two geriatric wards and other wards. The NI patients were from the geriatric wards.

The PI occurred over two four-month periods between April 2013 and March 2014; OHTI over five months from October 2014 to March 2015 and NI over nine months from July 2016 to April 2017. The primary data collectors' work schedule (JG) meant only patients admitted from Sunday to Wednesday were included. The NI phase took longer to complete as only participants from geriatric wards were included.

### Pre-intervention
Usual oral care practices were followed. Neither hospital had a formal oral hygiene policy or procedure.

### Oral health therapist intervention
In Australia, an OHT has dual qualifications in dental hygiene and therapy.

The OHT conducted a standardised oral care routine based on best practice for those with natural teeth (dentate), those with some natural and prosthetic teeth, and those with no teeth (edentulous). The dentate routine involved toothbrushing (one to four minutes) using a small-headed or double-headed toothbrush and 1500 ppm toothpaste (Curasept or Neutrafluor). The denture (partial/full) routine involved checking the gums, brushing one to two minutes with mild soap and water and soaking in plain water overnight. For the edentulous, gums were swabbed with a bicarbonate swab. The routine occurred once per day (Monday–Friday) between 7.30 and 4.00 pm. These interventions were in addition to usual oral care done by nurses. The OHT saw 52 (71%) patients on all five days. The maximum time spent on toothbrushing or denture brushing on each visit was three minutes, with the majority occurring within one to two minutes (Table S1, Supporting information).

### Nurse intervention
Nurses received dental support in the form of education and training in the oral care routines from either the study dentist or OHT. The study dentist and one of the investigators (JG) conducted five education sessions prior to the NI, and the OHT conducted four sessions during the actual intervention. Each session lasted for 30 minutes and focused on the following: (i) oral health in older adults; (ii) implications of poor oral hygiene; (iii) the teeth/denture routines; (iv) demonstration of brushing technique; and (v) dealing with care-resistive behaviours. Fifty-eight nurses were eligible to attend, and 46 nurses (79%) attended: 27 (46%) prior to implementation and 19 (33%) during the study. A senior ward nurse (clinical nurse educator) encouraged staff to attend the sessions. Nurses, regardless of qualification, were eligible for direct

training in the oral care routines on the wards initially by the study dentist and then the OHTs. Individualised direct training occurred with the nurses' patients. Of the 58 nurses, 38 (65%) received direct training in brushing natural teeth and 37 (64%) in denture care. The OHT was also available for advice on patients' behavioural or complex dental needs.

Posters with teeth, dentures and mouth care routines were displayed in bathrooms and patient bays. An individualised dental status chart was displayed at each patient's bedside. Products and equipment were available on the wards for the oral care routines.

### Outcome measures

### *Oral Health Assessment Tool*
The Oral Health Assessment Tool (OHAT) [19] was administered by one person (JG). It is designed for non-dental professionals and can be used with patients who have cognitive impairment [19]. JG was trained to use the OHAT prior to study commencement. In all phases, patients were assessed within 24 hours of admission and at day 7 between 8 am and 10 am (Appendix S1, Supporting information).

The OHAT assesses eight components: (i) lips; (ii) tongue; (iii) gums and tissues; (iv) saliva; (v) teeth; (vi) dentures; (vii) oral cleanliness; and (viii) dental pain. OHAT scores range from '0' healthy, '1' changes from normal to '2' unhealthy. The term 'change' indicates the domain was not normal, but does not appear to require immediate intervention. The 'unhealthy' category implies dental treatment or consultation is needed. To administer, the oral cavity was inspected for 5–10 minutes. Oral cleanliness at days one and seven was the primary outcome of interest as this is considered most sensitive to change over a seven-day period. Total OHAT Scores were derived from the sum of the eight component scores (range 0–16).

### *Patient information*
Data were collected on age, gender, living arrangements, medical history, length of stay (LOS), admission diagnoses, and when the patient last saw a dentist. Preadmission activities of daily living status was assessed using the Katz ADL tool [20] and co-morbidity by the Charlson Co-morbidity Index (CCI) [21]. Information was collected from paper and electronic medical records and discharge letters.

The study was approved by the Sydney Local Health District CRGH Human Research Ethics Committee (HREC/14/CRGH/41CH62/6/2014-032). Individual consent was not required. Patients and families were informed and given the option of not having their data included.

### Data analysis

Analysis was conducted using SPSS 20 for Windows. Initial analysis of OHAT scores (0 = healthy, 1 = changes, 2 = unhealthy) for six of the eight individual OHAT components revealed only a few patients were categorised as 'unhealthy' but many were categorised as 'changes'. Therefore, the 'unhealthy' and 'changes' categories were merged into one category called 'unhealthy'. Each OHAT component was then categorised as 'healthy' or 'unhealthy'. Patients were also categorised into four groups based on seven-day change in each OHAT component: (A) 'healthy' day 1 to 'unhealthy' day 7; (B) 'healthy' day 1 to 'healthy day' 7; (C) 'unhealthy' day 1 to 'unhealthy' day 7; and (D) 'unhealthy' day 1 to 'healthy' day 7.

Categorical data were summarised using numbers and percentages, and numeric data were summarised using means, standard deviations and medians. McNemar's test was used to determine whether there were significant differences in the proportions who were 'healthy' versus 'unhealthy' on OHAT components at day 1 compared with day 7.

Chi-squared tests were used to test for significant differences in outcomes at day 7 between PI, OHTI, and NI phases.

### Sample size

In the PI phase, 127 (62%) remained in the 'unhealthy' group at day 7 [18]. This was used to determine sample size for intervention phases. We predicted the interventions should reduce this day 7 proportion to 32% (30% reduction). Therefore, 50 subjects were needed in each intervention phase to have a greater than 80% power to find a statistically significant difference in intervention phase proportions compared to PI phase.

## Results

### Participant characteristics

A total of 875 patients were assessed on admission: PI ($n$ = 575); OHTI ($n$ = 147); and NI ($n$ = 153). One hundred and eighteen patients were excluded because the patient

**Table 1: Comparison of baseline characteristics between pre-intervention (PI), oral health therapist intervention (OHTI) and nurse-led intervention (NI)**

| Characteristics | Level/Statistic | PI ($n$ = 206), $n$ (%) | OHTI ($n$ = 77), $n$ (%) | NI ($n$ = 76), $n$ (%) | P-value† | P-value‡ |
|---|---|---|---|---|---|---|
| Age | Mean (SD) | 85.1 (7.4) | 85.7 (7.4) | 86.0 (6.4) | — | — |
| | Median (IQL) | 85.6 (79.9–90.9) | 87.0 (81.0–91.0) | 86.0 (83.0–91.0) | — | — |
| 65–75 | — | 18 (9) | 9 (12) | 5 (7) | 0.7 | 0.02 |
| 76–85 | — | 73 (35) | 28 (36) | 30 (39) | — | — |
| 86–95 | — | 76 (37) | 35 (45) | 37 (49) | — | — |
| 96+ | — | 39 (19) | 5 (6) | 4 (5) | — | — |
| Gender | — | — | — | — | 0.9 | 1.0 |
| Male | — | 77 (37) | 30 (39)) | 29 (38) | — | — |
| Female | — | 129 (63) | 47 (61) | 47 (62) | — | — |
| LOS | Median (IQL) | 13.5 (9.0–24.0) | 15.0 (10.0–29.0) | 12.0 (9.0–23.0) | — | — |
| 3–6 days | — | 1 (1) | 1 (1) | 0 (0.0) | 0.4 | 0.7 |
| 7–10 days | — | 77 (37) | 27 (35) | 33 (43) | — | — |
| 11+ days | — | 128 (62) | 49 (64) | 43 (57) | — | — |
| Place of residence | — | | | | 0.3 | 0.3 |
| Home and retirement village | — | 139 (67) | 54 (70) | 59 (78) | — | — |
| Hostel/Nursing home | — | 67 (32) | 23 (30) | 17 (22) | — | — |
| Admission Diagnosis | — | — | — | — | — | — |
| Confusion/Delirium | — | 42 (20) | 19 (25) | 12 (16) | 0.7 | 0.4 |
| Falls/Injury | — | 59 (29) | 27 (35) | 24 (32) | 0.7 | 0.6 |
| Immobility | — | 17 (8) | 13 (17) | 13 (17) | 1.0 | 0.04 |
| Cardiac/Respiratory | — | 51 (25) | 13 (17) | 21 (28) | 0.1 | 0.3 |
| Other | — | 78 (38) | 4 (5) | 9 (12) | 0.1 | — |
| Katz ADL Status | — | — | — | — | 0.1 | 0.1 |
| ADL Score 0 (Dependent) | — | 59 (29) | 15 (19) | 15 (20) | — | — |
| ADL Score 1–2 | — | 23 (11) | 13 (17) | 11 (14) | — | — |
| ADL Score 3–5 | — | 41 (20) | 25 (32) | 14 (18) | — | — |
| ADL Score 6 (Independent) | — | 83 (40) | 24 (31) | 36 (47) | — | — |
| Premorbid medical history | — | — | — | — | — | — |
| Neurological | — | — | — | — | — | — |
| Stroke | — | 37 (18) | 15 (20) | 12 (16) | 0.6 | 0.8 |
| Dementia | — | 68 (33) | 26 (34) | 25 (33) | 0.9 | 1.0 |
| Parkinsons | — | 14 (7) | 5 (7) | 3 (4) | 0.5 | 0.7 |
| Other neuro | — | 58 (28) | 9 (12) | 14 (18) | 0.2 | 0.01 |
| CCI total score | — | — | — | — | 0.4 | 0.7 |
| Total score 0–3 | — | 150 (73) | 57 (74) | 63 (83) | — | — |
| Total score 4–5 | — | 40 (19) | 15 (19) | 9 (12) | — | — |
| Total score 6–7 | — | 8 (4) | 2 (3) | 3 (4) | — | — |
| Total score 8–10 | — | 8 (4) | 3 (4) | 1 (1) | — | — |

†Comparison across OHTI and NI phases. ‡Comparison across three study phases. —, Not applicable; CCI, Charlson Co-morbidity Index; LOS, length of stay; PI, pre-intervention.

**Table 2: Comparison of changes in oral cleanliness day 1 to day 7 for pre-intervention (PI), oral health therapist intervention (OHTI) and nurse-led intervention (NI)**

| Oral cleanliness† | PI group, n = 206 | | | OHTI, n = 77 | | | NI, n = 76 | | | Overall |
|---|---|---|---|---|---|---|---|---|---|---|
| | Day 1 | Day 7 | P-value‡ | Day 1 | Day 7 | P-value‡ | Day 1 | Day 7 | P-value‡ | P-value§ |
| 1 and 2 = UH¶ | 161 (78) | 149 (72) | 0.14 | 66 (86) | 41 (53) | <0.001 | 61 (80) | 38 (50) | <0.001 | <0.001 |
| 0 = H†† | 45 (22) | 57 (28) | | 11 (14) | 36 (47) | | 15 (20) | 38 (50) | | |

†Based on Oral Health Assessment Tool (Appendix S1, Supporting information), 'change' and 'unhealthy' groups merged into 'unhealthy' category. ‡Comparison within groups (PI, OHTI and NI) phases. §Comparison across three phases. ¶Unhealthy. ††Healthy.

gave a verbal or physical indication of 'no' (n = 14), receiving palliative care or deemed by the medical team as too unwell (n = 25), or for other reasons (n = 79) such as absent from ward. Overall 75% of those assessed at day 1 needed supervision or were dependent for their oral hygiene based on the OHAT activities of daily living checklist.

A total of 359 patients were seen at both day 1 and day 7 (PI (n = 206), OHTI (n = 77) and NI (n = 76)). The groups were similar in sex, LOS, co-morbidity, function and place of residence (Table 1).

### Oral cleanliness status on days 1 and 7

In the PI group, the proportion of patients whose oral cleanliness was 'unhealthy' did not significantly decrease from day 1 (n = 161, 78%) to day 7 (n = 149, 72%) (Table 2). In both intervention groups (OHTI and NI), the proportion categorised as 'unhealthy' decreased significantly from day 1 to 7. The OHTI group decreased from 86 to 53% (P < 0.001) and NI group from 80 to 50% (P < 0.001). The intervention phases showed a significant decrease in the proportion of patients in the 'unhealthy' category at day 7 when compared with the PI group (P < 0.001). When the intervention groups were compared with the PI group restricted to CRGH patients only, it remained significant (P < 0.05) (Table S2, Supporting information).

### Other OHAT categories status on days 1 and 7

For the other OHAT components, in all three phases, a greater proportion were categorised as 'healthy' at day 7: lips; tongue; gums and tissues; and saliva. No improvement was seen in teeth, dentures or mouth pain in any phase (Table S2, Supporting information).

### Oral cleanliness movement from day 1 to day 7

Table 3 shows patient oral cleanliness movement from days 1 to 7 for each phase. Patients who moved from 'unhealthy' oral cleanliness at day 1 to 'healthy' at day 7 were

significantly higher in the OHTI (35%) and NI (37%) phases compared to PI phase (17%) (P < 0.001). When the PI group was restricted to CRGH patients, the same trend was seen but the difference was no longer significant (P = 0.09).

### Other OHAT categories movement day 1 to day 7

A significantly larger proportion moved from unhealthy to healthy in the OHTI and NI phases compared to the PI phase for lips, gums and tissues and saliva. When intervention phases were compared, there was no evidence of a greater improvement for the other OHAT categories (Table S3, Supporting information).

## Discussion

We are unaware of any studies that have investigated improving older patients' oral health on acute geriatric wards. We first determined whether oral cleanliness could be improved in this setting with an oral care routine conducted by an OHT. We could not assume oral health would improve in this setting. We found oral cleanliness could be improved over a seven-day period with a once-daily oral hygiene routine conducted by an OHT. Further, with support from an OHT, nurses could achieve similar improvements. The intervention phases showed a significantly higher proportion of patients moved from unhealthy to healthy oral cleanliness at day 7 compared to in the PI phase. Studies in residential care have shown regular professional dental care alone or in combination with nurse support improves the oral health of older adults [12,22]. Our study is the first to show this in an acute hospital. Oral cleanliness is an important outcome to improve as plaque, oral debris and dental decay are associated with HAP [6,23].

Previous interventions to improve the individuals' oral health in hospitals have concentrated on nurse education with minimal direct training in brushing teeth and dentures

**Table 3: Patient oral cleanliness movement day 1 to day 7 for pre-intervention (PI), oral health therapist intervention (OHTI) and nurse-led intervention (NI)**

| Oral cleanliness | PI (n = 206), n (%) | OHTI (n = 77), n (%) | NI (n = 76), n (%) | P-value† | P-value‡ |
|---|---|---|---|---|---|
| Healthy day 1 to unhealthy day 7 | 22 (11) | 2 (3) | 5 (7) | 0.60 | <0.001 |
| Healthy day 1 to healthy day 7 | 23 (11) | 9 (12) | 10 (13) | | |
| Unhealthy day 1 to unhealthy day 7 | 127 (62) | 39 (51) | 33 (43) | | |
| Unhealthy day 1 to healthy day 7 | 34 (17) | 27 (35) | 28 (37) | | |

†Comparison across OHTI and NI phases. ‡Comparison across three phases.

or managing care resistance [17,24]. These studies did not include dental support. Our study demonstrates the value of providing direct instructions in technique and ongoing dental support and is consistent with previous studies in residential care [14]. Additionally, it demonstrates such support can be provided within an acute ward.

The fact nurses received training on the wards was a key component of the NI phase. Where nurses received training using models and dentures rather than 'real patients', dependent patients' oral health did not improve [25]. These limited improvements may be attributable to no training in technique or in strategies to manage care-resistive behaviours. Our dentist/OHT was available up to nine hours per week to train and educate staff in these areas.

Within hospitals and residential care, there is limited information and knowledge for nurses on older people's dental needs, risk factors for poor oral hygiene and adverse consequences of poor oral hygiene [6,26]. These were addressed in the NI education sessions.

In nursing undergraduate and postgraduate, courses training in oral care techniques and routines appear absent and may explain why nurses report being unable to satisfactorily conduct oral care [7,8,27,28]. This is further exacerbated by inappropriate equipment or limited products on the wards. These tangible barriers are often reported as reasons why oral care may be inadequate or not completed [26,29]. Both intervention phases had appropriate equipment and products available on the ward.

Other studies, including a nurse questionnaire on the NI wards [30], identified patient care-resistive behaviours as a barrier to providing good oral care in this setting [7,8,28]. A key part of the education and direct training sessions was behaviour management strategies.

The study strengths were it was likely to be a representative group, as it was not necessary to obtain individual consent. Patients with cognitive impairment due to their acute illness (delirium) and/or dementia were included. These patients are often at risk of poor oral health but usually not included in studies. The NI direct training enabled nurses to learn and practise oral hygiene skills on the ward whilst completing their usual tasks.

Limitations include the 'before and after' study design. A RCT randomising by ward could have been implemented, albeit with clustering effect issues. Furthermore, the same person conducted all assessments and was not blinded to the three study phases. However, data suggest OHAT assessors tend to score more highly over time as they develop more knowledge of what constitutes poor oral health [15,19]. The pragmatic nature of the study meant participants were not recruited from identical ward

populations and the PI phase included patients from two hospitals. Key baseline characteristics between phases were, however, not significantly different, and when the analyses were restricted to CRGH-only patients, only one comparison changed from significant to non-significant.

No data were collected on how 'direct' training impacted nurses' daily oral hygiene routines, specifically, time spent brushing teeth/dentures.

## Conclusion

Improvements in oral cleanliness of older adults in hospital can be achieved through daily interventions by an OHT. Nurses achieved similar improvements when given direct training in provision of good oral care within their usual practice with dental professional support. A larger study for a longer period is needed to determine whether interventions that improve oral health lead to less HAP.

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## Supporting information

Additional supporting information may be found in the online version of this article at the publisher's website:

**Table S1.** Oral health therapist intervention: Amount of time spent on each intervention (brushing duration).

**Table S2.** Comparison of changes in oral cleanliness restricted to Concord Repatriation General Hospital only and other Oral Health Assessment Tool categories from day 1 to day 7 for pre-intervention, oral health therapist intervention and nurse-led intervention groups.

**Table S3.** Patient oral cleanliness (Concord Repatriation General Hospital only) and other Oral Health Assessment Tool components movement from day 1 to day 7 for pre-intervention, oral health therapist intervention and nurse-led intervention groups.

**Appendix S1.** Oral Health Assessment Tool.