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University College Cork, Ireland
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Title: Changing oral health trajectories: a 10-year cross-sectional comparison of two domiciliary dental care patient groups in nursing homes.

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Key points:

- The oral status and clinical oral treatment needs of first-time patients in mobile dental care in nursing homes were compared between 2010-12 and 2021-23.
- The most recent sample showed less edentulous patients, less untreated caries, and more dental fillings compared to the previous sample.

- Although the individual clinical treatment needs were lower in the most recent sample compared to 2010-12, the overall treatment demands for the mobile dental team were similar because of the higher proportion of dentate patients.
- A decomposition analysis showed that the explanatory variables (age, sex, care dependency and increased reimbursement for healthcare costs) attributed little to the changes in dental status and treatment needs.

Abstract:

Objectives: Since 2010, Gerodent has been a comprehensive oral healthcare program including biannual domiciliary dental care in nursing homes in Flanders, Belgium. Previous research revealed poor oral health among nursing home residents attending the mobile clinic. The objective of this study was to evaluate potential changes in the oral health needs of patients receiving domiciliary dental care, thus providing insights for future cohorts.

Design: This study compares the oral health status and treatment needs of two cross-sectional samples.

Setting and participants: First-time patients attending the mobile dental clinic in nursing homes, collected a decade apart.

Methods: Generalized estimating equations were used to compare both samples (S1: 2010-12, n=1226; S2: 2021-23, n=775). Results were adjusted for age, sex, increased reimbursement for healthcare costs, number of medications and care-dependency. Differences in oral health outcomes were decomposed in a component attributed to the explanatory variables and an unexplained component using the Blinder–Oaxaca decomposition analysis.

Results: There were statistically significant lower edentulism rates in S2 (28%) than S1 (42%; OR 1.82; 95%CI:1.34-2.47). Among dentate patients, S2 had a significantly lower caries prevalence (S1:70% versus S2:53%; OR=0.55; 95%CI:0.44-0.69) and a significantly higher mean of filled teeth (S1:1.5 versus S2:2.8; RR=1.82; 95%CI:1.58-2.09). In the dentate sample, 77% of S1 and 54% of S2 residents required extractions and/or restorations (OR=0.72; 95%CI:0.53-0.98). The decomposition analysis showed that the change in explanatory variables attributed little to the shift in dental status. The explained component accounted for only 13.5% of the total risk difference in edentulism (BCa 95%CI:-0.6%-30.6%).

Conclusion and Implications: From 2021 to -23, more dentate care home residents consulted Gerodent with more natural teeth per person, showing lower levels of untreated disease,

maintaining dental team treatment demands comparable to 2010-12. These findings underscore the continued urgency for structured and accessible dental service provision for nursing home residents.

Introduction

Nursing home residents often experience poor oral health and difficulty accessing oral healthcare services.[1] Access to oral health services for care dependent older adults is often hindered by physical disabilities including mobility impairments, cognitive deterioration, various comorbidities and a low willingness of dental professionals to provide care to them. Poor oral health negatively impacts the quality of life of older adults, affecting their ability to eat, speak, and interact socially. Moreover, it is a risk factor for various systemic diseases such as aspiration pneumonia in frail older adults. [2–5] Domiciliary dental care, defined as dental care provided outside of a dental office, usually in the patient's place of residence, is an established safe and cost-effective alternative to standard care and increases accessibility to professional oral care. [6–10] This form of care is predominantly provided for care dependent older adults (residing in a nursing home or home-dwelling) when their physical or cognitive condition prevents them from visiting a dental practice.

Gerodent, a comprehensive oral healthcare program initiated in 2010 in Flanders, Belgium, offers domiciliary dental care for nursing homes through a mobile dental team of general dentists, oral hygienists, and dental assistants. Oral care is offered to all nursing home residents in long-term stay experiencing difficulties to access regular dental care. Mobile dental equipment is installed within the nursing home. The dental team collaborates with the Gerodontology department at Ghent University, receiving training in oral care for frail older adults. Belgium does not currently offer a formal specialization in geriatric dentistry. Curative

and preventive oral care for the residents is combined with a preventive implementation plan at nursing home level and education for the care staff. [8,11,12] Prior research conducted between 2010 and 2012 revealed a high prevalence of untreated dental disease among the residents who attended the dental domiciliary care program. [13]

This study aims to compare the oral health status and treatment needs of the nursing home residents attending domiciliary dental care in 2010-12, with that of patients a decade later, in 2021-23. The primary rationale for comparing these two distinct samples was to evaluate whether there have been significant changes in the oral health needs of first-time patients presenting at the mobile dental clinic in nursing homes. If such changes are identified, they could hold implications for clinicians and policymakers by providing insights into the oral health requirements of future cohorts of this growing demographic. These findings could serve as evidence to advocate for policies that ensure the provision of adequate oral health care for frail older adults, a service that remains structurally unavailable in many countries. [14]

Materials and methods

Design

This study compared two cross-sectional samples of first-time domiciliary dental care patients residing in nursing homes, with one sample collected from 2010 to 2012 and the other from 2021 to 2023.

Sample

The description of the first sample (S1) was published in 2017 by Janssens B. et al. and consisted of a retrospective analysis of the oral health records of all the nursing home residents

attending the mobile care clinic ‘Gerodent’ for the first time, between October 2010 and April 2012. All first-time patients were included in the initial sample, except for patients with incomplete records due to care-resistant behavior. [13] Data for the current study sample (S2) were collected from the 52 Gerodent nursing homes. These data included all nursing home residents visiting as a patient for the first time, after providing informed consent, between July 2021 and February 2023, and were extracted from their oral health records (CareConnect Dentist, Corilus nv.). If a patient was unable to provide informed consent due to cognitive decline, a legal representative was contacted. The study was approved by the Ethics Committee Ghent University Hospital (B6702020000924). All nursing home residents attended the mobile dental clinic on a voluntary basis, or in case of cognitive impairment, upon request of family members or care staff.

Measures

The oral care records included socio-demographic data, oral health status and oral treatment need(s) assessment. Demographic data comprised age, gender and place of residence (in this case nursing home). The physical and cognitive status of residents was assessed by the care-dependency scale ‘KATZ index of Independence in Activities of Daily Living’ which is mandatory in nursing homes in Flanders. The physical and cognitive capacity of every resident is evaluated based on the following criteria and scored on a scale by a nurse: washing, dressing, transfers, visits to the toilet, continence, help with eating and orientation in space and time. [15] This scale goes from Katz O, nearly physically and cognitively independent to Katz C, dependent for clothing and bathing, for transferring and toileting, and for eating and/or due to incontinence and/or cognitively dependent with disorientation in space and time. Katz Cd is chosen for cognitively dependent persons, officially diagnosed with dementia by a neurologist, psychiatrist or geriatrist. For the analysis, the residents were categorized into three levels of

care dependency: low (KATZ O and A), medium (KATZ B) and high (KATZ C and Cd; Appendix Table 1). The number of medications was extracted from their digital medication record. The eligibility for increased reimbursement for healthcare costs (IRHC) was recorded as a socio-economic explanatory variable. In the Belgian healthcare system, persons with an income below a certain threshold are entitled to IRHC to improve the accessibility of healthcare services.

Data collection

The data from this study were extracted from the electronic dental patient records. The oral health professionals of the Gerodent team, consisting of seven dentists and two oral hygienists, performed the oral assessments. One dentist was active both in the assessments of the initial sample and the most recent sample. They used a fully equipped mobile dental unit with a portable overhead light and a mobile x-ray device (Rextar X-D-041) for the diagnosis of oral disease. The same protocol for both the S1 and S2 samples was used to assess every new patient for oral health status and treatment needs. The oral health status included the presence of natural teeth (maximum of 32 teeth), removable dentures, dental caries, residual roots, filled teeth, implants and crowns or combinations thereof. Dental caries, as well as other outcome variables, were scored at tooth level, with visually obvious dental decay in the dentine of the tooth as threshold. Retained roots were counted as natural teeth, if they were visible in the mouth. The oral treatment need(s) assessment for natural teeth was based on clinical measures and not on the self-perceived needs of the patients (see Appendix 1 for natural teeth treatment need assessment). The total treatment need for natural teeth was the sum of the needed fillings and extractions. For removable dentures, the clinical assessment by the dentist was combined with the subjective experience of the patient, using this self-perceived need as the main criterion (see Appendix 2 for prosthetic treatment need assessment).

Data analysis

Descriptive analyses were performed for all oral health data and explanatory variables of S2. Generalized estimating equations (GEE) were used to compare oral health outcomes between the two separate samples (S1: 2010-12, S2: 2021-23), with the nursing homes as clusters in an exchangeable correlation matrix. Oral health outcomes were oral health status, removable dentures, implants, untreated caries, retained roots, filled teeth and oral health needs assessment for both natural teeth and dentures. Linear, binary logistic or negative binomial models were applied as appropriate. To reduce possible selection bias, a scale weight variable was added to all analyses because of a difference in the causes of missing participants in the samples. In the S1 sample, all patients could be included without informed consent as it was a retrospective study and regulations concerning patient data were less strict in 2012, whereas in the S2 sample, informed consent was asked beforehand. This resulted in the exclusion of 719 possible participants. Inverse Probability Weighting was applied to adjust for the 2021-23 residents who refused consent for research purposes. The results were adjusted for age, sex, IRHC, number of medications and care-dependency.

A decomposition analysis was undertaken to assess the size of the direct quasi-cohort effect in the differences between study groups, opposed to the influences effectuated by the explanatory variables. Therefore, the difference in oral health outcomes between S2 and S1 could be decomposed in a component explained by age, sex, care-dependency and eligibility for increased reimbursement for healthcare costs (IRHC), and an unexplained component using the Blinder–Oaxaca Decomposition or, equivalently by estimating the ATT (Average Treatment effect of the Treated).[16] Because the residences did not fully overlap between S1 and S2, residence (nursing home) was not included in the model.

For the proportion of edentulous residents and the proportion of patients with untreated dental caries, the explained component was estimated by fitting a logistic regression model to the complete cases of S2 and computing the average predicted probabilities standardized to the demographic data of S1 (P_{12}= E[E(Y | S = 1, L) | S = 2]) and for the demographic data of S2 (P2) using the plug-in or standardization method.[17] The unexplained component or ATT was estimated as the difference between the estimated proportion in S1 and $P_{12.}$. For the mean number of teeth, the same workflow was applied using zero-inflated negative binomial regression. Non-parametric bias-corrected and accelerated (BCa) bootstrap 95% confidence intervals around the estimated explained and unexplained components were computed using the R-function "boot" from the package "boot". [18]

SPSS for Windows version 29 (SPSS Inc) and R studio (R Studio Team (2023)) were used for the analysis.

Results

The study samples S1 and S2 consisted of residents from 23 and 52 nursing homes respectively with an overlap of 14 nursing homes. S2 consisted of 771 residents (Table 1) and the number of residents included per nursing home ranged from 1 to 40. S1 consisted of 1226 residents, with more women and more residents with IRHC than S2. No differences were found in age, care-dependency, and number of medications between the two samples.

In S2 the proportion of edentulous patients was considerably lower than in S1 (Table 2) resulting in a higher mean number of natural teeth in S2. Moreover, the proportion of dentate residents with more than 20 natural teeth was higher in S2 than in S1. In both samples, a similar

proportion of residents wore dentures. In the group of denture wearers, significantly fewer full dentures in both jaws were reported in S2 than in S1.

In the dentate sample, no differences were found in untreated dental caries, excluding retained roots, between the S1 and S2 samples (Table 3). However, the proportion of patients with retained roots was significantly lower in S2 relative to S1. The proportion of dentate patients with filled teeth was also notably higher in S2 than in S1, resulting in a higher mean number of filled teeth per patient in the dentate sample.

Regarding the oral health needs assessment for natural teeth, a significantly lower extraction need was reported in S2 in contrast to S1 (Table 4). Although no difference was found in the restorative treatment needs, this still resulted in a considerably lower proportion of patients with clinical treatment needs (restorative + extractions) for natural teeth in S2 than S1.
For prosthetic treatment needs, S2 also showed lower demands, with lower needs for repair or rebasing of dentures. Furthermore, all dentate residents were in need of professional dental cleaning and a preventive recall every six months. Edentate residents were asked to return in 12 months for a dental check-up, if there were no treatment requirements.

For the proportion of edentulous patients, the total risk difference between S1 and S2 (P2-P1) was decomposed in a component explained by the demographic variables and an unexplained component (Table 5). The estimated explained component was –1.8% [BCa 95% CI: -3.6% - 0.1%)], and thus the socio-demographic variables age, sex, care-dependency and eligibility for IRHC, were estimated to account for only 13.5% [BCa 95% CI: -0.6% - 30.6%] of the total risk difference. An analogous analysis was performed to decompose the difference in mean number of natural teeth between S1 and S2 (M2-M1). The estimated explained

component was 0.3 [BCa 95% CI: -0.1 to 0.7]. When looking at the subgroup with natural teeth, for the estimated proportion of residents with ≥ 1 untreated dental caries, the estimated component explained by demographic variables is 0.8% [BCa 95% CI: -3.8% to 2.3%]. For none of the above-described outcomes, the estimated component explained by socio-demographic variables is attributing significantly to the total difference between S1 and S2, whereas the estimated unexplained component was significant ($p<0.01$).

Discussion

This study compared two cross-sectional samples, S1 (2010-2012) and S2 (2021-2023), from "Gerodent" domiciliary dental care attendees. Lower numbers of edentulous residents and untreated dental caries, including retained roots, were observed in S2, accompanied by higher numbers of filled teeth and lower clinical treatment needs. The decomposition analyses suggested that changes in explanatory variables accounted for a minor proportion of this evolution.

This study is a relevant contribution to the field as these data in nursing home settings, including the large sample sizes, are very rare. By comparing two similar groups of patients with a 10-year gap, in the same setting, we can see burgeoning trends in dental status and treatment needs of care-dependent older adults.

The literature on nursing home residents receiving domiciliary care is very scarce. In 2024, Allenspach et al. published a cross-sectional retrospective study of Swiss nursing home residents receiving dental domiciliary care, with patient data in periods up to 5 years. The mean number of natural teeth was higher than in the present study. Moreover, while the levels of

218 untreated dental caries (mean 1.9, SD 9.1) in the study of Allenspach were quite comparable
219 with the S2 sample, they found a higher mean number of teeth (mean 14.7, SD, 9.1) and more
220 filled teeth (9.9, SD 6.4 versus mean 2.8, SD 3.9).This might be the result of differences in
221 dental service provision over their life course in the Swiss society. [19]
222 The drop in edentulism aligns with existing literature showing similar trends in industrialized
223 countries. [20–22] In contrast to a meta-regression conducted by Kassebaum et al. (period 1990-
224 2010), which indicated that the prevalence and incidence of untreated dental caries remained
225 unchanged both globally and in Western Europe, our findings show lower levels of untreated
226 caries. However, the study of Kassebaum et al. did not cover the same time period as the present
227 study. [23]
228
229 The observed differences between both cohorts may be attributed to several factors, as also
230 reported in an American context by Ettinger and Marchini. [24] First, the most recent group (born
231 around 1935-45) had a decade more of exposure to fluoride toothpaste, which became
232 widespread in Belgium during the late seventies and early eighties. Water fluoridation was
233 never implemented in the region and cannot have biased the impact of fluoride toothpaste.
234 Second, there was a change in the dental workforce and care provision model. Dental education
235 wase reformed in the late sixties, coinciding with the establishment of the National Institute for
236 Health and Disability Insurance (NIHDI) in 1964. The Belgian NIHDI adhered to the principle
237 of providing health coverage for quasi the whole population, which included reimbursement
238 for basic dental care.[25] In 1976, restructuring of university education for medicine and
239 dentistry resulted in two distinct degrees, leading to a surge in dental students in the eighties,
240 which greatly increased the dental workforce.
241 Third, we can hypothesize a change in service provision by the dental professionals. While
242 caries experience may have been similar between both groups, treatment approaches could have

varied. During the sixties, seventies and eighties, dental professionals might have shifted away from extractions as the primary treatment for dental caries, increasingly favoring restorative treatments. The Belgian government's reduction in adult extraction reimbursement in the eighties likely made this approach less appealing to dentists and patients. The norm of extractions and total dentures, incentivized by reimbursement, likely shifted towards natural teeth retention when reimbursement was expanded to include partial dentures.

The higher proportion of dentate residents, the higher mean number of natural teeth, and the lower levels of pathology observed in the recent sample of nursing home residents seeking mobile dental care, as here presented, is encouraging at first sight. However, due to the higher proportion of dentate patients, the burden of care remains very high and comparable to that of a decade ago. We can even argue that the disease burden and its consequences will disproportionately affect older adults who are most care dependent and have retained their natural teeth, if their oral hygiene and access to care is not provided Moreover, maintaining oral hygiene for natural teeth, including complex restorations, is more difficult compared to dentures, resulting is poor oral hygiene.[26]

The study has limitations in terms of generalizability to all nursing home residents in Flanders as it only represents patients (or their representatives) seeking mobile dental care. A comparison with national data from 2010 and 2021 indicates higher levels of care-dependency (respectively 44% and 48% Katz C/Cd versus S1 55% and S2 51% Katz C/Cd) and slightly lower ages (respectively 86 and 87 years versus S1 and S2 84 years old) in our study samples. [27]

As described earlier, the missing data pattern differs between S1 and S2, making a direct comparison prone to selection bias. The S1 study was retrospective, and it was at that time not

deemed necessary to ask for informed consent to use the patients' data for research purposes, with approval from the Ethical Committee of XXX (B670201318461). To counteract selection bias, Inverse Probability Weighting was applied to S2, matching with S1 on the explanatory variables.

The decomposition analyses revealed a marginal influence of the alterations in explanatory variables on oral health outcomes, implying a substantial cohort effect. However, definitive conclusions should be drawn with caution, as unidentified explanatory variables not incorporated in this study could potentially be important. For example, national data showed a lower diabetes prevalence in nursing homes in 2022 compared to 2010, possibly influencing proportions of tooth loss.[28,29] Moreover, in the decomposition analysis, data missing at random was assumed, i.e. the probability of a value being missing is assumed to be independent of the unobserved variables, given the observed demographic variables. The nursing homes overlap only partially, making it impossible to include the nursing homes as variables in the decomposition analysis.

The findings of the present study underscore the continued urgency for structured and accessible, preventive and curative, dental care for nursing home residents to prevent rapid oral health deterioration, oral pain and negative impacts on their quality of life and well-being. Current evidence also points towards considerable positive impacts of daily oral care on the incidence and severity of and the mortality rates from aspiration pneumonia, thereby leading to fewer hospital admittances. [30–33]

To cover the support that should be given by oral health professionals, literature suggests that dental domiciliary care (DDC) in long-term care settings holds potential as a sustainable

qualitative solution. [34,35] However, policy changes are required to enhance the appeal of DDC for dental professionals, and to make a structured approach feasible, as exemplified in Sweden, Japan, or reforms done in Germany. [36–39]

Moreover, it is imperative to expand the oral healthcare workforce according to the principles of the WHO Global Competency Framework for Universal Health Coverage and WHO global strategy on oral health. [40] Dentists, as highly specialized curative oral care providers, are insufficient in number and ill-equipped to manage this issue due to the high costs and extensive preventive efforts required. Oral healthcare workers performing preventive care at primary care level, like dental hygienists, present a more cost-effective solution. [41–45] However, legislative measures are required to enhance their autonomy and incentivize their work with vulnerable groups, as proposed by the FDI. [46] Nevertheless, the reassessment of existing roles within the oral health workforce, or the potential expansion of this workforce represents a relatively unexplored avenue that warrants further investigation. [47,48]

Conclusions and implications

From 2021 to 2023, the mobile clinic observed a higher proportion of care home residents with natural teeth in comparison to the years 2010-2012. Furthermore, these dentate older adults exhibited a higher mean number of natural teeth, with more restorations and lower levels of untreated dental caries including retained roots. Nevertheless, the treatment demands placed on the dental team remained comparable to those observed in the earlier period of 2010-2012. These findings cannot be attributed to changes in their socio-demographic profile and are more likely to be the result of a cohort effect and underscore the continued urgency for structured and accessible dental service provision for nursing home residents.

Conflicts of interest: There are no conflicts of interest to declare.

References

1. Janssens L, Petrauskiene E, Tsakos G, Janssens B. Clinical and Subjective Oral Health Status of Care Home Residents in Europe: A Systematic Review. J Am Med Dir Assoc. 2023 Jul;24(7):1013-1019.
2. Huppertz VAL, van der Putten GJ, Halfens RJ, et al. Association Between Malnutrition and Oral Health in Dutch Nursing Home Residents: Results of the LPZ Study. J Am Med Dir Assoc. 2017 Nov;18(11):948–54.
3. Niesten D, Witter D, Bronkhorst E, Creugers N. Oral health-related quality of life and associated factors in a care-dependent and a care-independent older population. J Dent. 2016 Dec;55:33–9.
4. Porter J, Ntouva A, Read A, et al. The impact of oral health on the quality of life of nursing home residents. Health Qual Life Outcomes. 2015 Dec;13(1):102.
5. Khadka S, Khan S, King A, et al. Poor oral hygiene, oral microorganisms and aspiration pneumonia risk in older people in residential aged care: a systematic review. Age Ageing. 2021 Jan 8;50(1):81–7.
6. Kerr E, Watson S, McMullan J, et al. General dentists' attitudes and perceived barriers in providing domiciliary dental care to older adults in long-term care facilities or their homes in Northern Ireland: A descriptive qualitative study. Gerodontology. 2022 Sep;39(3):257–65.
7. Angst L, Nüesch N, Grandjean ML, et al. Caries management using silver diamine fluoride and providing domiciliary dental care for dependent older adults: A qualitative study of Swiss dentists. Community Dent Oral Epidemiol. 2023 Jun;51(3):469–82.
8. Janssens B, Vanobbergen J, Petrovic M, et al. The impact of a preventive and curative oral healthcare program on the prevalence and incidence of oral health problems in nursing home residents. PloS One. 2018;13(6):e0198910.
9. Werbrouck A, Schmidt M, Annemans L, et al. Oral healthcare delivery in institutionalised older people: A health-economic evaluation. Gerodontology. 2021 Jan;
10. Spatzier H, Stillhart A, Hillebrecht AL, et al. Cost of providing a mobile dental service for dependent older people. Gerodontology. 2021;(December 2020):1–8.
11. Janssens B, Vanobbergen J, Lambert M, et al. Effect of an oral healthcare programme on care staff knowledge and attitude regarding oral health: a non-randomised intervention trial. Clin Oral Investig. 2017;22(1):1–12.
12. Janssens B, De Visschere L, Van Der Putten GJ, et al. Effect of an oral healthcare protocol in nursing homes on care staffs' knowledge and attitude towards oral health care a

cluster-randomised controlled trial. Gerodontology. 2016;33(2):275–86.
13. Janssens B, Vanobbergen J, Petrovic M, et al. The oral health condition and treatment needs of nursing home residents in Flanders (Belgium). Community Dent Health. 2017;34(34):143–51.
14. United Nations. World Social Report 2023: leaving no one behind in an ageing world. Department of Economic and Social Affairs; 2023 Jan. Report No.: E.23.IV.2.
15. Katz S, Ford AB, Moskowitz RW, et al. Studies of illness in the aged. The index of adl: a standardized measure of biological and psychosocial function. JAMA. 1963 Sep 21;185:914–9.
16. An W, Glynn AN. Treatment Effect Deviation as an Alternative to Blinder–Oaxaca Decomposition for Studying Social Inequality. Sociol Methods Res. 2021;50(3):1006–33.
17. Hernan, M.A. & Robins J.M. Causal Inference: What if [Internet]. (1st ed.). CRC Press; 2023.
18. Thomas J. DiCiccio, Bradley Efron. Bootstrap confidence intervals. Stat Sci. 1996 Sep 1;11(3):189–228.
19. Allenspach P, Srinivasan M. Oral health status of institutionalized older adults receiving domiciliary dental care: A cross-sectional retrospective study. Spec Care Dent Off Publ Am Assoc Hosp Dent Acad Dent Handicap Am Soc Geriatr Dent. 2024 May 14;
20. Mueller T, Naharro M, Carlsson GE. What are the prevalence and incidence of tooth loss in the adult and elderly population in Europe? Clin Oral Implants Res. 2007 Jun;18(3):2–14.
21. Kassebaum NJ, Bernabé E, Dahiya M, et al. Global Burden of Severe Tooth Loss : A Systematic Review and Meta-analysis. JDR Clínical Res Suppl. 2014;93(7):20s–8s.
22. Borg-Bartolo R, Roccuzzo A, Molinero-Mourelle P, et al. Global prevalence of edentulism and dental caries in middle-aged and elderly persons: A systematic review and meta-analysis. J Dent. 2022 Dec;127:104335.
23. Kassebaum NJ, Bernabé E, Dahiya M, et al. Global burden of untreated caries: a systematic review and metaregression. J Dent Res. 2015 May;94(5):650–8.
24. Ettinger RL, Marchini L. Cohort differences among aging populations: An update. J Am Dent Assoc 1939. 2020 Jul;151(7):519–26.
25. Van den Bosch Karel, Willemé Peter. De maatschappelijke betekenis van de gezondheidszorg (The societal impact of health care.). Brussel: Federaal Planbureau i.o.v. RIZIV; 2014 Jan.
26. Janssens LE, Temmerman E, Maertens J, et al. A comparative analysis of oral hygiene

386 in nursing homes with and without a structured oral healthcare programme. Gerodontology
387 000-000.
388 27. Intermutualistisch Agentschap. IMA-AIM Atlas [Internet]. Brussel; [cited 2023 Dec
389 11]. Available from: https://atlas.ima-aim.be/databanken/?rw=1&lang=nl
390 28. Intermutualistisch Agentschap. IMA-AIM Doelgroepenzorg - België. Diabetes
391 prevalence in care homes. [Internet]. [cited 2024 Dec 2]. Available from: https://atlas.ima-
392 aim.be/databanken/?rw=1&lang=nl
393 29. Ahmadinia AR, Rahebi D, Mohammadi M, et al. Association between type 2 diabetes
394 (T2D) and tooth loss: a systematic review and meta-analysis. BMC Endocr Disord. 2022 Apr
395 13;22(1):100.
396 30. Lesa L, Brunelli L, Valent F, et al. The underestimated burden of aspiration event and
397 pneumonia within hospitals: what happens after dysphagia. Ann Ig Med Prev E Comunita.
398 2021 Dec;33(6):555–63.
399 31. Ortega O, Sakwinska O, Combremont S, et al. High prevalence of colonization of oral
400 cavity by respiratory pathogens in frail older patients with oropharyngeal dysphagia.
401 Neurogastroenterol Motil. 2015;27(12):1804–16.
402 32. Costa N, Hoogendijk EO, Mounié M, et al. Additional Cost Because of Pneumonia in
403 Nursing Home Residents: Results From the Incidence of Pneumonia and Related
404 Consequences in Nursing Home Resident Study. J Am Med Dir Assoc. 2017 May
405 1;18(5):453.e7-453.e12.
406 33. Marusiak MJ, Paulden M, Ohinmaa A. Professional oral health care prevents mouth-
407 lung infection in long-term care homes: a systematic review. Can Hyg Dent JCHD. 2023
408 Oct;57(3):180–90.
409 34. Lundqvist M, Davidson T, Ordell S, et al. Health economic analyses of domiciliary
410 dental care and care at fixed clinics for elderly nursing home residents in Sweden.
411 Community Dent Health. 2015;32(1):39–43.
412 35. Fathi H, Rousseau J, Makansi N, et al. What do we know about portable dental
413 services? A scoping review. Gerodontology. 2021;(December 2020):1–13.
414 36. Smith L, Smith M, Thomson WM. Recommendations for improving dental care for
415 dentate home-based older people: A qualitative New Zealand study. Gerodontology. 2021;1–
416 10.
417 37. Sjögren P, Forsell M, Johansson O. Mobile dental care. Br Dent J. 2010 Jun
418 1;208(12):549–50.
419 38. Kapp S, Herzberg A, Czwikla J, et al. Mundgesundheit bei Pflegebedürftigen – Wie

420 können Versorgungsmaßnahmen ankommen? Gesundh- Sozialpolitik. 2018;72(6):23–9.
421 39. Ishimaru M, Ono S, Morita K, Matsui H, Yasunaga H. Domiciliary dental care among
422 homebound older adults: A nested case-control study in Japan. Geriatr Gerontol Int. 2019
423 Jul;19(7):679–83.
424 40. Dussault G, Kawar R, Castro Lopes S, Campbell J. Building the primary health care
425 workforce of the 21st century - Background paper to the Global Conference on Primary
426 Health Care: From Alma-Ata Towards Universal Health Coverage and the Sustainable
427 Development Goals. Geneva: World Health Organization; 2018.
428 41. World Health Organization. Global strategy on oral health. Seventy-fifth World Health
429 Assembly; 2022 Apr. Report No.: A75/10 Add.1.
430 42. Brocklehurst P, Ashley J, Walsh T, Tickle M. Relative performance of different dental
431 professional groups in screening for occlusal caries. Community Dent Oral Epidemiol.
432 2012;40(3):239–46.
433 43. Macey R, Glenny AM, Brocklehurst P. Feasibility study: assessing the efficacy and
434 social acceptability of using dental hygienist-therapists as front-line clinicians. Br Dent J.
435 2016 Dec 9;221(11):717–21.
436 44. Monaghan NP, Morgan MZ. What proportion of dental care in care homes could be
437 met by direct access to dental therapists or dental hygienists? Br Dent J. 2015
438 Dec;219(11):531–4; discussion 534.
439 45. Hopcraft MS, Morgan MV, Satur JG, Wright FAC. Utilizing dental hygienists to
440 undertake dental examination and referral in residential aged care facilities. Community Dent
441 Oral Epidemiol. 2011;39(4):378–84.
442 46. Glick M, Williams DM, Ben Yahya I, et al. Vision 2030: Delivering Optimal Oral
443 Health for All. Geneva: FDI World Dental Federation; 2021.
444 47. Garcia DT, Lawson JA, Brody ER, et al. A scoping review of the roles, training, and
445 impact of community health workers in oral health. Community Dent Health. 2021 Aug
446 31;38(3):198–208.
447 48. McKenna G, Tsakos G, Watson S, et al. uSing rolE-substitutioN In care homes to
448 improve ORal health (SENIOR): a study protocol. Trials. 2022 Aug 18;23(1):679.