

Novel Approach to Oral Care for Dependent Adults

Angie Stone, RDH, BS; Shirley Gutkowski, RDH, BSDH

Abstract

Context: Due to the ever-growing list of comorbidities with oral disease—periodontal or enamel-related, dependent adults have an increased need for proper oral care. While dental hygienists are taught that oral care is very much like wound care, oral hygiene is often taught as a cosmetic procedure to medical providers. Certified nursing assistants (CNAs), with minimal instruction, deliver the care. A review of the literature reveals that CNAs are diligent; however, they are fearful of working with the oral cavity and often choose perineal duties over oral care. The field needs alternative methods to dental-biofilm management that do not exploit the dangers and time commitment that CNAs have to confront for care.

Objectives: The study intended to explore the use of xylitol chewing gum, and Recaldent as nontraditional adjuncts to biofilm reduction, to improve residents' oral health as well as caregivers' relationships with oral care in a long-term care facility (LTC).

Design: This study was a pilot study. Six residents were chosen to include two products in their daily routine: xylitol gum and a Recaldent paste. The CNAs were

asked to provide the products as part of their interactions with the residents.

Setting: The setting was the Rock Haven Long Term Care Facility in Rock County, Wisconsin.

Participants: The study included two groups of participants, six residents of the LTC and 22 CNAs who were their caregivers.

Intervention: CNAs offered participating residents (1) xylitol chewing gum (Spry) in the morning at dressing and in the evening at undressing, and (2) a Recaldent cream (MI Paste Plus), after the midday meal and at night before participating residents fell asleep.

Outcome Measures: To monitor changes in dental biofilm, photographs of residents' teeth were taken before the interventions, at the midpoint, and at the end of 12 weeks. CNAs' attitudes toward oral care before and after the study were also monitored through surveys.

Conclusions: Adding xylitol and Recaldent to residents' routine decreased the biofilm on their teeth and increased their quality of life, without creating hardship for the CNAs.

Angie Stone, RDH, BS, is the owner of HyLife, LLC, in Edgerton, Wisconsin. Shirley Gutkowski, RDH, BSDH, is the owner of Cross Link Presentations in Sun Prairie, Wisconsin.

Corresponding author: Angie Stone, RDH, BS
E-mail address: astone@hylifellc.com

The oral care of dependent adults is gaining importance as more people survive life-altering accidents and diseases and live well into their eighth or ninth decade. Dependent adults have teeth and are keeping them longer, reflecting the success of dentistry. This shift to increased numbers of residents with teeth in care facilities has brought about a series of new problems. The presence of teeth brings disease-harboring biofilm.

In addition to the systemic effects of periodontal disease resulting in cardiovascular disease, respiratory issues, and cancer, *Streptococcus pneumoniae* is able to grow in oral biofilm.^{1,2,3} Quality of life is also tied to oral health. Oral malodor is an invisible wall between people, and the resulting reduction in a resident's self-esteem can lead to withdrawal from social interactions, surfacing as isolation.⁴

Reducing oral biofilm can save dollars.⁵ Its management has been shown to reduce respiratory pathogens, *Candida*, and cariogenic bacteria. Retrospective studies by insurance companies have shown that treatment of periodontal disease reduces the downline medical costs of people with diabetes and that instituting an oral hygiene regimen in intubated people can reduce the incidence of ventilator-associated pneumonia (VAP), saving one hospital nearly \$0.5 million for a \$2000 investment in protocol execution.⁶ Yet compliance with oral care even in ICU is low.⁷

Oral care of dependent adults has been studied from numerous aspects: (1) teaching caregivers better tech-

niques, (2) teaching caregivers the reason that oral care is important, (3) setting up systems, and (4) creating a better toothbrush.^{8,11} The emphasis has been on traditional models of removing dental biofilm (plaque), which often has resulted in difficult interactions between residents and staff. Oral care for combative and resistant residents in long-term care facilities (LTCs) is often avoided. Problematic interactions between staff in LTCs and dentistry have also occurred. The trend is shifting, however, toward reducing dental biofilm and improving oral ecology to enhance oral health.^{12,13}

Nevertheless, education for certified nursing assistants (CNAs) regarding oral care remains inadequate.² Oral care is offered as part of the training curriculum but is in the grooming section of textbooks. The information is often archaic, using terms that have been discarded by dental hygienists for decades. Authors who write textbooks for CNAs often update nursing information and do not change their text to reflect changes in dental hygiene. Because of their extensive study in the management of oral health, dental hygienists are uniquely qualified to recommend alternatives to mechanical biofilm removal. The current pilot study raises the following question: Can the oral health and quality of life of dependent adults be improved by using xylitol and Recaldent products, without increasing the workload or responsibility of the CNAs working with them?

Until dental hygienists can be employed in settings other than public health and dental practices, other ways of addressing oral biofilm must be utilized. When studies start to reflect the goal of decreasing oral biofilm instead of getting teeth brushed, greater strides will be made in the oral and overall health of dependent adults. And dental hygienists can be included in health care settings.^{43,44}

Materials and Methods

Participants

Six adult residents at the Rock Haven Long Term Care Facility in Rock County, Wisconsin, were identified by the LTC as good candidates for the intervention. Selection was based upon the residents' ability to execute the interventions used in the study. They were between the ages of 55 and 80 years old, with an average age of 68 years. Four were men, and two were women. Participants were all mentally coherent, communicative, and mobile to varying levels. All were able to communicate verbally regarding any assistance that they needed with the activities of daily living (ADL). None of the study's participants were resistant.

The study's second cohort included 22 CNAs who dealt directly with the six residents. The CNAs had been employed at the LTC between 5 and 25 years.

Materials

Xylitol. Xylitol is a five-carbon sugar alcohol that has the ability to reduce oral biofilm.^{14,15} It also has a deleterious

effect on *Streptococcus mutans*, the major culprit in enamel decay.^{14,15,17} Xylitol affects bacteria that are early colonizers and that increase oral pH as well as make it impossible for the slime coating to form. Studies on xylitol have successfully shown that it was helpful in addressing other biofilm diseases; reducing middle-ear infections in children who attend day care¹⁸; and reducing lung infections, sinus infections,^{19,20} and infections in individuals with cystic fibrosis,²¹ sepsis,^{22,23} and chronic skin wounds.²⁴ Xylitol has also been found to increase collagen production²⁵ and bone density.^{26,27} The current study is the first to look at the effect of xylitol on the biofilm of dependent adults and of its use on CNAs' workloads.

Xylitol Chewing Gum. Xylitol is available in many forms. Chewing gum (Spry, 0.75 g xylitol/piece) was used as the vehicle to provide xylitol in the current study. In addition to reducing dental biofilm on tooth enamel and decreasing decay,^{15,16} as a sweetened gum it has other beneficial attributes. Chewing gum increases facial muscle tone and increases ability to taste. While controversial, some studies point to an increased cognition in those chewing gum. Strep bacteria has a propensity to xylitol over other sugars; however, it is unable to metabolize xylitol. Acting in the fructose area of the citric acid cycle, xylitol "gums up the works." This inability to metabolize a major food causes a three-fold benefit with respect to oral health: (1) the bacteria die from starvation, (2) they stop producing the glycocalyx coating, and (3) they generate less acid. The increased pH stimulates enamel repair and enables fluoride to work to repair the teeth.²⁸ An increased pH also creates an environment friendlier to healthy, basophilic bacteria.²⁹

Recaldent. Recaldent in MI Paste Plus is an ingredient that supplies nutrients to the enamel to help heal microscopic breakdown. Recaldent is amorphous calcium and phosphate (ACP) encased in a milk protein, casein phosphopeptide (CPP). In an acid challenge, the casein coating is stripped off, releasing the ACP to increase oral pH and remineralize incipient enamel lesions.³⁰⁻³² The evidence for this remineralization is long standing in general dentistry. The use of Recaldent in MI Paste Plus for dependent adults is new. The added benefit of MI Paste Plus for this group is the ability of the paste to coat the hard and soft tissue and give palliative relief for dry mouth.³³ The composition of Recaldent provides a long-lasting supply of ACP to bind with available fluoride and create acid-resistant enamel. MI Paste Plus has the appropriate balance of ACP to fluoride ions.

2Tone Disclosing Solution. This solution was used to stain the biomass on the teeth and was applied to the residents' teeth with a cotton-tipped applicator or a gloved finger.

Intervention

Prior to the launch of the study, researchers held a training session to which they invited the CNAs who

Table 1. CNA Protocol

Routine	Gum	Paste	Record
Morning	Chew 2 pieces of gum 5 min		G: Gum
	or Dissolve 3 mints in the mouth		C: Chew D: Dissolve
Mid-morning			Check mark
Lunchtime		Apply paste to gloved fingertip, and smear resident's teeth and inside cheeks	Resistant to attempt
Afternoon			Check mark
Evening	Chew 2 pieces of gum 5 min		G: Gum
	or Dissolve 3 mints in the mouth		C: Chew D: Dissolve
Bedtime		Apply paste to gloved fingertip, and smear resident's teeth and inside cheeks	Resistant to attempt

assisted participating residents with their ADLs. The CNAs were not instructed in brushing and flossing techniques. They were encouraged only to deliver typical oral care for each of the study's residents. During the training session, CNAs also were asked to perform certain duties related to the use of the xylitol.

Xylitol-sweetened Gum. CNAs were asked to deliver two pieces (1.5 g of xylitol) of the gum twice per day to participating residents: at their dressing in the morning and at their undressing in the evening, times when the CNAs were likely to be in attendance.

Recaldent Paste. The CNAs were asked to apply the paste to the oral cavity after the midday meal and the last thing at night before participating residents fell asleep. The research team directed the CNAs to apply the paste using a cotton applicator or a gloved finger. The CNAs, however, found a way around the task of applying the paste with their own gloved fingers: They applied a dab of paste to the resident's finger and asked him or her to move it round in his or her own mouth.

The directions for the interventions are outlined in Table 1. Each participating resident was assigned a shoe-box-sized container that contained an allotment of gum and paste. Each box also contained a pencil and a sheet for the CNA to mark when he or she gave the resident the gum or paste. The honor system was used.

Data Collection

The study ran for 12 weeks, and the debriefing of the staff did not take place until 4 weeks later, due to time and weather constraints. One member of the research team also visited the LTC four times during the 12-week intervention to check in with the care team and the residents to see if they had any questions or concerns during the study.

Participating Residents. To launch the study, participating residents were brought to the dental-treatment

room one at a time. The research team then collected and recorded oral health data, including a subjective evaluation of saliva adequacy and biofilm amount. The research team used these subjective evaluations because the study was a pilot in a LTC, and no laboratories were available to investigate the exact nature of the mass. Due to the absence of laboratory results and to the massive amount of biomass on the teeth, photography was the only way to measure the results. The research team took photos at the beginning of the 12-week intervention; at 6 weeks, midway through the study; and at the end of the study.

The 2Tone disclosing solution was applied to the teeth using a saturated, cotton-tipped applicator. The solution was not rinsed off. Residents were allowed to swallow before the research team took photographs. A gloved clinician, one member of the research team, retracted the residents' lips, and the other member took photos of the disclosed teeth. The photos recorded plaque accumulation on the teeth. Areas of blue staining marked plaque that had been on the residents' teeth for more than 24 hours, while areas of red staining denoted plaque that had been on the teeth for fewer than 24 hours.

Certified Nursing Assistants. The CNAs identified as working with the participating residents were asked to fill out a questionnaire twice, at the beginning and end of the study (Table 2). The questionnaire included a number of questions based on the CNAs' relationships to their own oral care and to their provision of oral care to others. The 22 CNAs responding to the pretest included all CNAs caring for the participating residents. The seven CNAs who took the posttest were those available for the presentation that occurred after the study's completion. Those seven CNAs were among those who had filled out the survey at the study's beginning, but due to the surveys being anonymous, researchers were unable to directly compare the before and after responses of the seven CNAs completing the posttest.

Table 2. Questionnaire

Questions	1 Strongly Agree	2 Agree	3 Neutral	4 Disagree	5 Strongly Disagree
My formal CNA education trained me well to provide oral care to residents.					
My formal CNA education offered guidance on oral issues that need to be reported to a nurse.					
I know what oral issues need to be reported to a nurse when I see them.					
Seeing pictures of oral issues that need to be reported would help me feel more confident about what I should report.					
I am confident that upon reporting an oral care concern that there are resources available to help resolve the issue.					
My formal CNA education offered me oral care options other than brushing and flossing.					
Oral care is not neglected.					
I can brush residents' teeth effectively.					
I feel I can floss residents' teeth effectively.					
Most residents are able to provide their own oral care.					
Most of the residents are cooperative with me when I perform oral care.					
I would like more education regarding how to provide oral care to resistant residents.					
I can supervise residents while they chew gum for 5 min or suck on a candy/mint 2 times/d.					
I have enough time during my shift to help with or provide oral care 3 times/d for each resident.					
I understand that poor oral care affects general health.					
It would be helpful for my facility to hire an oral care specialist.					
Oral care is neglected by nursing staff because it is too difficult to perform.					
Oral care is an important aspect of daily care.					
Oral care is neglected because of resident resistance.					

Outcome Measures

Because of the nature of this case study, the outcome measures used were subjective photos of disclosed teeth. The team evaluated the density of the disclosing solution color, the general appearance of the disclosed plaque, and the amount covering the teeth. To illustrate, see photos of resident 1. The circle highlights, for the nondental hygienist, the same area. The casual observer can see that the amount of biofilm was less on those teeth after the xylitol/Recaldent applications than before.

The researchers also evaluated the amount of the red-dyed biofilm as compared to the blue-dyed biofilm over time. While everyone can concede that the measurements

were subjective, considering the population, the research-skill level of the researchers and the obvious change in the photographed teeth suggest this study must be repeated.

Results

Participating Residents

The photos show a general reduction in biomass over the 12-week study. At the end of the study, residents 1 and 2 revealed a much smaller mass, and the dye color had changed. For their lower anterior teeth, the mass was dyed red, not coated in blue, which indicated that the plaque had been on the teeth fewer than 24 hours and that the quality of the mass had changed. Early colonizers were still there;

Figure 1. Photos of Resident 1

Wk 0



Wk 6



Wk 12



Figure 2. Photos of Resident 2

Wk 0



Wk 6



Wk 12



Figure 3. Photos of Resident 3

Wk 0



Wk 6



Wk 12



Figure 4. Photos of Resident 4

Wk 0



Wk 6



Wk 12



Figure 5. Photos of Resident 5

Wk 0



Wk 6



Wk 12



Figure 6. Photos of Resident 6

Wk 0



Wk 6



Wk 12



however, the bacterial late arrivers were likely not yet a part of the mass, rendering them nearly as inert as planktonic bacteria.

At week 6 the staff notified the research team that Resident 3's breath was so much better than it was before the study began. It was so much better that he was now able to build friendships with other residents, an important qualitative change. When any tissue breaks down, volatile sulfur compounds are released, and these foul gasses are often noted as fetid oral malodor. In this case, the resident was a social outcast due to his breath; he often ate alone in the dining room. The staff even found it difficult to care for his needs.

Resident 4 had the most missed interventions at 28%. Although his biofilm staining was stunning, illustrating the poor quality of oral care he had been receiving, at the end of the 12 weeks, his 72% compliance rate was still relatively high. For this resident the research team saw a color change. The blue staining was far less intense and some shades of red appeared. These visual changes indicated the mass had decreased, even though the percentage of tooth surface covered with plaque remained similar to baseline. This finding illustrates the difficulty of using any currently used plaque index. The resident's teeth were still covered with plaque; however, the thickness of the mass was observably smaller because of the color change in the disclosing solution.

Table 3. Resident Compliance by Missed Interventions

Totals	AM: Xylitol	Lunch: MI Paste	PM: Xylitol	Bedtime: MI Paste	Total Missed Interventions	% of Interventions Missed/Person
Resident 1	2	11	12	14	57	10%
Resident 2	4	20	20	18	85	16%
Resident 3	4	20	39	40	126	23%
Resident 4	9	19	45	41	154	28%
Resident 5	15	35	23	20	125	23%
Resident 6	19	17	23	36	127	23%
Total missed interventions	53	122	162	169	676	
% missed	10%	22%	30%	31%		

Residents 4 and 5 showed similar results in the reduction of the biomass on their teeth. There were no outstanding features of these residents. Their oral care was poor at the beginning and likely poor at the end; the biofilm on their teeth is visibly less than at the beginning of the study.

Table 3 shows the compliance results in graphic form. The CNAs' compliance was the most outstanding feature of the protocol's use. The study was complex and had a number of interventions; however, most were carried out by the CNA teams.

With respect to missed interventions, the table shows that the number of missed interventions increased as the day wore on; the bedtime applications of MI Paste Plus were missed three times as often as those of the first inter-

Table 4. CNA Attitude Shift

Prestudy Questions	Poststudy Questions	Strongly Agree %		Agree %		Neutral %		Disagree %		Strongly Disagree %		No Answer %	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
I enjoy providing oral care to residents		13	43	55	43	19	14	13					
Residents are receptive to oral care		4.5	44	13	28	46	28	32		4.5			
Oral care is a hassle to provide		9	0	9	14	41	44	32	28	4.5	14	4.5	
Oral care is easy		5	28	23	44	36	14	23	14	13			
Oral care is time consuming		0	0	13	29	41	14	41	29	5	28		
Resident's breath smells good		5	43	9	43	13		41		9		23	19
22 responses	7 responses												

vention of the day. The number of missed interventions of gum chewing in the evening was also triple that of the gum offering in the morning. This neglect may be due to a number of factors, including the attitudes of the evening staff, who had no contact with the research team, and to the level of resistance in the residents as the day progressed. It appears that the offering of chewing gum was met with the least resistance by staff and residents as compared to the paste application. The least-missed interventions were the gum chewing in the morning.

There were no negative outcomes from this intervention. The residents who were mildly resistant showed good results in biofilm reduction. There were no reports of gastrointestinal issues, and the CNAs did not mind passing out the gum or applying the paste.

Certified Nursing Assistants

One of the unstated goals of this study was to improve the relationship that the nursing staff had with oral care. Table 4 shows the positive change in attitudes of CNAs over the time of the study.

The answers for the first question, which asked whether or not the caregiver enjoyed giving oral care, changed dramatically since baseline. Only 68% of the CNAs responded positively at the beginning versus 86% at the end. In the first survey, the fourth question, "oral care is easy," was met with strong negative responses. Only 28% of the CNAs responded with "strongly agree" or "agree" at the study's beginning, but that number increased to 72% by its end; conversely, at the end, only 14% chose "disagree," with no responses being "strongly disagree."

The question about oral malodor also changed significantly between the start and end of this study. The answers to another question worth mentioning relate to the change in the CNAs' perception of the residents' receptiveness to oral care. At the beginning, only 4.5% of the CNAs thought that the residents were receptive to oral care, and 44% strongly agreed with that statement at the

end of the 12 weeks.

Discussion

The limitations of the study are obvious. Two dental hygienists unaffiliated with any university or lab have very few resources for measurement. In this study, even traditional plaque indices were inadequate as the mass of biofilm covered nearly the entire dentition. There were no attempts made to find a lab to dry and weigh the amount of biofilm on each resident; in fact, there was no attempt to disrupt the residents' or the CNAs' daily experience at all. The researchers were relying on photographic evidence to show the reduction of biomass on the teeth and the change in quality of the biomass. A university study using the tools necessary to make those measurements would be welcomed.

Because of the decrease in edentulousness (lack of teeth), a crisis in oral health for dependent adults is on the cusp. Traditional methods of removing dental biofilm by novice staff are not enough. The limited amount of education that CNAs get from nurses, who are uneducated in oral care, compounds the barriers to maintaining dependent adults' oral health.^{9,34-37} Thick oral biofilm on natural or prosthetic teeth can dislodge and become aspirated.³⁸ Acute (pneumonia, thrush) and chronic infections plague dependent people (COPD, CVD, arthritis, blood glucose management) and much is attributable to dental biofilm.

Science has given dentistry a respect for xylitol and its ability to shift the oral environment to homeostasis. Nearly all of the studies on the benefits of xylitol for oral health focus on children, but the research team posed the hypothesis that the product's benefits could apply to dependent adults.

The benefits to xylitol lie in the number of exposures to it per day,³⁹ and offering the gum three or more times per day is also helpful in other areas. Gum chewing can (1) increase facial muscle tone, (2) decrease sugar clearance times, and (3) help food to taste better.⁴⁰

Figure 7. Dental Hygienist Medicaid Providers



The dispensing of a gum is palatable to residents in a LTC as well as to the nursing staff, especially when compared to manual biofilm removal. Using sweets to obtain the cooperation of residents is not new to LTCs; residents are routinely administered their medication disguised in either pudding or applesauce. To decrease resistance, sugar is often added to the cup; a simple switch to xylitol for this objective would increase the total grams applied to the teeth.

While xylitol is not a substitute for brushing teeth, it can make the effects of infrequent brushing less dramatic. In this study, the CNAs were asked to commit to their ordinary oral-care regimen in addition to the study's protocols. The architecture of the study did not accommodate tracking of tooth brushing because the researchers wanted to deemphasize the Hawthorne effect—in which a study's participants act differently because they are in the study, rather than because of the intervention, as much as possible.

The photographic results of the study are where the true benefits can be seen. One look at the photos can show the casual observer that the dental biofilm was substantially decreased in each of the six cases, although the observer may also note that the biofilm was still there. In terms of whether or not the study was successful, Table 4 and the photographs of the resident's teeth show that it certainly was. The CNAs' compliance rate of over 70% shows that the interventions were easy to carry out and acceptable to both the resident and the CNAs.

The comments of the LTC staff regarding resident 3 were encouraging, as follows: "Resident 3's breath is so much better! We can actually talk with resident 3 now!" and "Resident 3's breath was so bad that no one wanted to sit with him during meals, and now he's a pleasure to be around. I can't believe the change in resident 3's breath." The change in that resident's malodor was so remarkable that staff pulled one member of the research team aside during visits to make special mention of it. They were more willing to visit his room and provide assistance with activities of daily living because they did not have to deal

with his bad breath. More social contact increases quality of life. The CNAs were very happy to learn of this side benefit. The comments made repeatedly by the staff during the entire 12 weeks of the study made this change worth mentioning in this document.

The researchers had provided in-service training for this group before the onset of the study, where the benefits of xylitol were explained and a discussion was held about how the use of alternative methods for maintaining oral health was the future of oral care. Good oral care for dependent adults depends on the caregivers' willingness to attempt that care. The attitude shift of the CNAs during the study's 12 weeks shows a change in their relationship with oral care. This change illustrates the CNAs' real desire to have patients with good oral health; good care cannot happen if CNAs feel ill-equipped to carry out traditional tasks, or worse, feel as if traditional oral care is distasteful. With respect to the compliance rates for the interventions, the research team found that the missed rate was not always due to the nursing staff being busy or forgetting. Resident 4 was often too ill for oral care or he was adamant about performing his own oral care. The CNAs were concerned about alerting the researchers to these reasons for missing interventions.

At the CNAs' debriefing, everyone seemed encouraged by the photographic results. Being involved with the residents all day and every day, and not knowing what oral biofilm looked like, made it difficult for them to see any decrease in dental biofilm. They were pleased by the ease in applying the paste and offering the gum. Another anecdote about the gum arose during the debriefing at the conclusion of the study. The researchers had recommended that the gum be given at the time of dressing and undressing to be sure a staff member was present during the chewing to reduce the chance of the resident aspirating the gum while unmonitored. The CNAs were asked to have the residents chew the gum for only 5 minutes. Near the end of the study, one of the cafeteria workers noticed a huge wad of gum stuck to the underside of one of the tables. Without context, the worker could not figure out how the gum, let alone so much gum, could have been deposited there. It was discovered that a resident was still chewing the gum when delivered to the cafeteria, and she did not know what to do with it; so she pasted the gum under the table. This shows how very important it is to have monitored gum chewing.

In most states, dental hygienists are required to work under some level of supervision by a dentist, a barrier to practice that keeps dental hygienists from being hired in LTCs because most do not have a dentist on staff. As knowledge of the importance of oral health to the body's other systems evolves, that requirement may change.⁴¹ Some states have expanded dental-hygiene practice acts to include working in LTCs or other designated settings to alleviate problems with dependent people: children or adults.⁴² Thirty-five states now allow dental hygienists be

paid by Medicare directly (Figure 7).

Conclusion

The research team noted a marked decrease in biofilm as recorded by photographs taken during the study. Use of xylitol and Recaldent decreased the amount of biofilm on the residents' teeth, and a protocol of gum and paste applied with a finger was acceptable to the residents and to the CNAs working with them. Morning applications seemed easier than evening applications. Future studies should include more people and more sites. Splitting the study into two parts, one using only xylitol and one using only Recaldent, would increase the validity of findings.

Dental hygienists are well-received in care facilities. Xylitol is likely the future of better oral-biofilm management in children, hospital-bound individuals, and dependent adults. Whether or not dental hygienists attain more autonomy or whether legislation changes to remove stipulations about settings, studies looking at alternative methods of decreasing biofilm in dependent populations should continue.

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