antibacterial properties. Arginine added to oral care products can also contribute to a favorable oral environment. A new oral care product made with components of the innate host defenses—lactoferrin, lysozyme, lactoperoxidase system—and other proteins has been shown in a small study to significantly increase 12 taxa associated with dental health.

Modulating Biofilm Growth

Approaches that restrict the enrichment of microbes with acid-producing and acid-tolerating phenotypes will support the maintenance of a beneficial microbiome. Antimicrobial agents should be targeted to the oral biofilms and delivered via oral care products. This will allow them to be present in high concentrations for a relatively short period of time but at sub-lethal levels for a much longer period of time. Many antimicrobials at these lower concentrations can inhibit traits linked to cariogenicity, such as sugar transport, acid production, and glucosyltransferase activity. The potential favorable impact of small but regular inhibitory effects on biofilm composition has been modeled in computer simulations. Further investigation and application are needed.

DISCUSSION

The oral microbiome is natural and offers the host some extremely important benefits. When the composition and activity of the microbiome shift as a result of acid production from the metabolism of fermentable carbohydrates, especially sucrose, dental caries can result. More bacteria with an acid-loving phenotype and the suppression of beneficial species can result. New strategies are needed that will lead to the promotion of the natural microbiota and the reduction of factors that lead to dysbiosis.

Clinical Significance

Evidence suggests that there are ways to manipulate the oral microbiome in a way that can return it to a healthy status. Regular provision of interventions that deliver small but relevant benefits consistently over a prolonged period of time should offer a way to maintain a healthy oral microbiome or turn a dysbiotic one back to a balanced, beneficial profile.

Marsh PD: In sickness and in health—what does the oral microbiome mean to us? An ecological perspective. *Adv Dent Res* 29:60-65, 2018

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ORAL/SYSTEMIC CONNECTIONS

Avoiding ventilator-associated pneumonia

BACKGROUND

Among patients in intensive care units (ICUs), ventilator-associated pneumonia (VAP) is the most common hospital-acquired infection. Oral care is an important part of the protocols followed to prevent VAP from occurring. A new oral care program to prevent more cases of VAP and save costs was developed and tested for its cost-effectiveness.

METHODS

The 5 adult intensive care units of the Clermont-Ferrand University Hospital Center in France saw a total of 3086 patients, with 2030 of them intubated for a total of 2083 stays in the ICU over the 13 months of the study. The study was done in 2 stages, with the first from July 1 to December 31, 2014 and the second from February 1 to August 31, 2015. During the first period, standard oral care was performed 3 times a day with foam swabs and gauze soaked in a diluted antiseptic solution (chlorhexidine 0.5%). The ICU staff was then trained in the new intervention, which was accomplished using non-sterile single-use tools. These included a suctioning toothbrush with a long neck and soft bristles coupled with a suctioning swab for the care of fragile gums and tissues. During the second stage, care was delivered using the new tools 3 times a day, with tooth brushing twice and application of the chlorhexidine solution as used in the first period. Paramedical staff assessed the mouth's condition and quality of oral care provided using an oral assessment guide once a day after care over the course of two 3-month periods. In addition, a physician in each ICU recorded cases of VAP, with the diagnosis based on the physicians' clinical judgment, microbiological findings, and radiographic results. The number of ventilation days/intubation was used to calculate the incidence of VAP and the incidence density (cases per 1000 days of intubation). The medical economic study was conducted from the hospital's point of view and focused on making the use of the new tools a possible change in protocol. The budgetary effect of the new program was measured for each intervention. The financial assessment considered the cost for the new oral health devices and the chlorhexidine solution, along with the cost savings realized by reducing the number of cases of VAP and eliminating the expense of their management.

RESULTS

The patients accounted for 926 stays in the ICU in period 1 and 1157 stays in period 2. The quality of oral care differed significantly between the 2 periods, beginning on the third day of ICU stay. The VAP incidence rate fell significantly in all 5 ICUs. It was 12.8% in the first period and 8.5% in the second. The number of VAP cases per 1000 days of intubation was also significantly reduced, from 35.9 VAP per 1000 days in the first period to 25 VAP per 1000 days in the second period.

The cost of dental supplies for the second period was estimated to be €11,500 per year, whereas the previous oral care procedure cost was €680 per year. The cost for spending a day in the hospital ICU was €2000. Patients who developed VAP spent an additional 20 days in the ICU. Thus the average cost to the hospital for a case of VAP was estimated to be €41,000 (range €39,906 to €42,332).

The new protocol prevented 11 VAP cases per 1000 days of intubation, which amounted to a cost savings of €3.7 million per year. Mean costs for each hospitalization were between €11,000 and €27,000, with higher costs for patients in the medicosurgical and cardiovascular ICUs. For patients who developed VAP, mean costs were between €28,000 and €45,000.

Costs avoided by reducing VAP cases also considered the loss of revenue to the hospital. Because patients who don't develop VAP transfer out of the ICU earlier, their hospitalization and associated hospital revenue are lower than if the patients developed VAP, for an estimated loss of income of €1.8 million. The total cost-effectiveness of the new oral care program was therefore about €1.9 million. Loss of income was compensated by the cost savings related to VAP cases avoided, which were 50% greater than the loss of income.

DISCUSSION

Implementation of the new protocol resulted in a net savings of €1.9 million as well as the avoidance of 11 cases of VAP per year. This included the cost of the supplies. More importantly, the new protocol produced better oral care for the patient that resulted in reduced comorbidity and days spent in the hospital. From the hospital's point of view, the savings more than offset the loss of revenue related to fewer days spent in the hospital because fewer patients developed VAP.

Clinical Significance

The new protocol was not only cost-effective, which is important in these days of cost consciousness, but also resulted in fewer patients developing the care-intensive VAP. This reduces the strain on hospital resources and improves the quality of oral health and life for patients. The investment in new tools to accomplish oral health care for intubated patients appears to be worth it.

Ory J, Mourgues C, Raybaud E, et al: Cost assessment of a new oral care program in the intensive care unit to prevent ventilator-associated pneumonia. *Clin Oral Invest* 22:1945-1951, 2018

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Cognition and periodontitis

BACKGROUND

Mild cognitive impairment (MCI) is cognitive decline that exceeds that expected for the individual's age and educational level but does not interfere extensively with the individual's ability to perform activities of daily living. Persons who are diagnosed with MCI tend to have a higher risk for developing dementia later in life. Both impaired cognitive function and dementia have been associated with various oral health parameters. In addition, persons who have serum markers of peripheral systemic inflammation, which is a hallmark of periodontitis, are at higher risk of developing dementia. The evidence currently available is still unclear about how and whether oral health is related to cognitive impairment. An investigation into the potential association between cognitive function and periodontal parameters and tooth loss was done in a large sample of older adults.

METHODS

The 775 participants in this study ranged in age from 60 to 99 years and were divided into 3 age groups: a young old age cohort of those age 60 to 66 years, an old age cohort of those age 72 to 78 years, and an old-old age cohort of those age 81 years and older. All participants underwent a comprehensive clinical and radiographic examination and completed questionnaires to determine level of education completed. The Mini-Mental State Examination (MMSE) and clock test were done to determine