ORIGINAL RESEARCH

Oral Health Knowledge Level of Nursing Staff Working in Semi-Intensive Heart Failure Units

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Purpose: Critical care units, such as heart failure units, house inpatients with a compromised general health status that requires rigorous prevention of further complications. Oral health infections that gain access through the bloodstream or airway might represent such potential complications (eg, endocarditis pneumonia). Avoiding these critical occurrences requires that adequate oral health care be provided by nursing personnel. Here we assessed the knowledge of oral health care practices by nurses working in three Italian heart failure units in Umbria, Italy.

Design: This was a cross-sectional study.

Methods: Forty-four nurses were interviewed using a six-item modified Adams' questionnaire on the topic of oral health care. A multidisciplinary panel of experts established the criteria for answer correctness based on the most relevant dentistry literature evidence and judged each reply. The expected percentage of correctly replying nurses was 75%, and significant differences from this expected probability were calculated with one-sided binomial probability tests. Cronbach's α method was used to establish the questionnaire's internal consistency (reliability).

Results: For five out of six questionnaire items, the percentage of nurses who correctly answered was significantly lower than the expected value of probability. Lack of knowledge was found for usefulness of checking the patients' mouths (p=0.003), the most relevant lesions affecting the mouth (p=0.0001), the tools/solutions for cleaning the mouth and dentures (p= 0.0416), and drugs that affect the mouth and their side effects (p<0.0001).

Conclusion: In this study, few nurses working in heart failure units showed both an adequate willingness to check inpatients and a good knowledge of oral health care (significantly lower than the expected 75%). Further studies that use validated questionnaires and include more participants should be conducted to confirm and elaborate on our preliminary data.

Keywords: nursing education, heart failure, oral health care

Introduction

Cardiovascular diseases are the primary cause of death worldwide, with the highest prevalence for ischemic heart diseases. During the last decade, improved treatment for ischemic heart diseases has enhanced the survival rate of cardiology patients. Among this population, one of the most severe diseases is heart failure.[1] Those affected by heart failure are critical patients with several characteristics in common such as high mean age (79 years), high hospitalization rate (58.2% in the last year) and high medication intake (≥7 drugs daily).[2] Individuals with heart failure are critical patients who need to maintain a good general health status to minimize the risk of

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complications. Among possible complications are those deriving from oral microorganisms due to excessive plaque accumulation caused by poor oral hygiene.[3] The gingival sulcus could represent a potentially permeable site for bacteria to enter the bloodstream, particularly when the gum tissue is inflamed. Indeed, in the case of gingivitis caused by poor hygiene, the risk of bacteremia is almost three-fold higher.[4,5] The risk of general complications when plaque damages the deeper periodontal tissues (periodontitis) has been widely considered in the literature. Periodontitis is related to an increased risk of several cardiovascular diseases including heart infarction (1.28-fold),[6] arterial hypertension (1.64-fold),[7] and endocarditis (3,78-fold).[5] Moreover, Joshy and co-authors reported an increased probability of heart failure disease (1.97-fold) when patients showed very poor oral health status (as measured by ≥20 missing teeth).[8] Another aspect that enhanced the risk of complications among cardiovascular patients (ie, heart failure inpatients) is their poor level of oral hygiene.[9]

Bacterial spread can also occur via the airway. The inner airways (bronchial and alveolar mucosa) may be infected by oral microorganisms through their direct diffusion from the upper airway (mouth), without any blood involvement.[10] A potential relationship between periodontal disease and hospital-acquired infective pneumonia was found,[11] particularly in intensive care units where patients are intubated and mechanically ventilated.[12]

Among their required tasks, nurses also monitor the hygiene level of hospitalized patients and of supporting them in their practices.[13] In particular, nurses working in the intensive care units are required to have oral hygiene competency to avoid complications related to oral microorganisms.[12] However, the few studies that investigated nurses' willingness to check and manage inpatients' oral hygiene described difficulty in fulfilling these tasks[14,15] and an increased risk of leaving inpatients without adequate support in their daily oral hygiene. Both studies agreed that is important to offer possible solutions to this issue, such as offering nursing personnel training sessions on oral health care and its advantages for patients' general health. Obviously, an analysis of the actual level of nurses' knowledge on oral health topics (and care) is necessary to understand the gaps. This motivated our interest in carrying out a study focused on understanding nurses' educational level of oral health care. The decision to sample nurses working in heart failure units was motivated by the particular importance of this type of cardiology unit. Although classified as a semi-

intensive ward, this setting could be considered an intensive care unit based on the number of critical patients. However, unlike intensive care units where the level of oral health knowledge was previously described,[16,17] this aspect of nurses' training has not been evaluated in heart failure units.

The evaluation of the nurses' competence in oral health care required a specific questionnaire. A validated survey with this scope was not found in the literature. The only available questionnaire was that created by Adams.[18] Although not validated, this tool was chosen because it incorporated the most relevant aspects of nurses' oral health care knowledge. A short six-item version of this questionnaire was adopted after its validation in terms of reliability. It was not possible to test its validity due to the lack of a gold-standard questionnaire dealing with this topic. Therefore, our study represents a preliminary investigation of nurses' oral health care knowledge, but it highlights an undervalued clinical aspect of nursing practice.

Methods
Study Design
Observational cross-sectional study.

Study Population
Forty-four nurses working in three heart failure cardiology units who were caring for both dependent and independent patients gave their informed consent to participate in the study. The nurses worked in the three largest hospitals in Umbria (Italy), where heart failure units were located in the cardiology wards.

Setting
Three cardiology heart failure units were located in the University Hospitals of Perugia and Terni (Umbria)

Study Endpoints
Knowledge of the most relevant aspects of oral health care by nursing personnel and nursing staff working in semi-intensive cardiology heart failure units.

Ethical Committee Approval
After a complete evaluation of this study protocol, the institutional ethics committee (CEAS Umbria, Italy) gave their approval for the trial (protocol no. 14891/18/L on date 15/11/2018) in accordance with the Declaration of Helsinki.

Inclusion and Exclusion Criteria

Nurses working in heart failure units who gave written informed consent for study participation were included. Supporting nurses in clinical practice and temporary nurses working in the heart failure units (<3 months) were excluded.

Data Recording

For this study, Adams' modified six-item questionnaire was used to interview the participating nurses. Each questionnaire was administered by the same dentistry unit nurse (P.A.) to all participating colleagues working in the three chosen cardiology wards during the months of April and May 2019.

The Questionnaire

A modified version of Adams' questionnaire was used in this study.[18] From the original version of Adams' questionnaire, only six items (questions and answers) concerning aspects of oral health care were used. Our modified Adams' questionnaire is shown in Table 1. Five items were essay questions, and one required a dichotomous answer (yes or no). The nurses were asked to answer each of the six questions in a specific pre-printed format. Thirty minutes were allocated to answer all six questions. All completed questionnaires were then returned to the dentistry unit nurse. In addition to oral health care information, both personal and professional data such as age, sex, birthplace, type of employment (temporary or permanent contract), number of years working in the field, and professional qualifications were recorded for each nurse (nursing assistant, licensed practical nurse, registered nurse, or master of science in nursing).

Data Extraction and Analysis

The criteria to assess answer correctness or incorrectness were established (before beginning nurse interviews) by a panel of multidisciplinary experts composed of one nurse (P.A.), two dentistry researchers (G.L. and P.S.), one professor in Dentistry (S.C.) and one professor in Didactic-Education (R. S.). All assessment criteria were established based on the most recent information on oral health and hygiene, as well as on guidelines and practice alerts for nursing personnel managing patients hospitalized in the intensive care unit or residents in long-term care homes.[19–35] All answers were read by the entire multidisciplinary panel. The meaning of each answer was first discussed and then assessed correct or incorrect, relying on the

Table 1 The Shortened Six-Item Version of the Adams' Questionnaire Including the Correct Answers

	Questions	Right Answers
1	Is it necessary to check the mouth of each patient during his hospital admission visit ?	Yes
2	Which factors are necessary to check in order to certify the patient's good oral status?	The patient's chewing, swallowing and speaking functions should be well performed.
3	Which factors are necessary should be evaluated during the patient's oral check ?	Presence of all natural teeth Teeth health status Gingival health status Presence oral mucosal lesions Presence, integrity and hygienic status of partial or complete denture Presence of oral pain and/or burning
4	How many times a day should patient's oral health care be performed by nursing personnel ?	Twice daily
5	Which oral hygiene tools should be used to clean the patient's teeth and oral mucosa or their dental prostheses ?	Fluoride toothpaste Toothbrush Chlorhexidine mouthwash or gels Gauze soaked in the disinfectant solution for moisturizing the lips and washing dental prostheses
6	Which systemic drugs have potential oral health side-effects?	Psychiatric antidepressant and Diuretic antihypertensive drugs reducing the saliva secretion. Antibiotics and Cortisone facilitating opportunistic infection after long term usage

Notes: Adapted with permission from Adams R. Qualified nurses lack adequate knowledge related to oral health, resulting in inadequate oral care of patients on medical wards. *J Adv Nurs*. 1996;24(3):552–560. Copyright © John Wiley & Sons Ltd.[18]

established evidence-based criteria. This adopted criteria for each questionnaire item are reported in Appendix 1.

Statistical Analysis

Statistical analyses were carried out with STATA SE 13 (StataCorp, College Station, TX, USA). Counts and percentage frequencies were used to describe the questionnaire answers. A Wilson method was used for calculating 95% binomial confidence intervals (95% CIs). Continuous variables are described with means and standard deviations. The impacts of age (above and below the mean of 43.7 years),

length of experience distribution (above and below the mean of 17.6 years), and sex on the probability of getting correct answers was tested by Fisher's exact tests. The values of 43.7 and 17.6 for age and service years, respectively, were chosen because they were the mean values of the distributions. This choice was dictated by the need to maximize statistical power and avoid subjective decisions. Cronbach'α was calculated to measure the degree of internal consistency of the six questionnaire items. Item-by-item association was also tested by Fisher's exact tests. Considering the high level of knowledge required of nursing staff working in critical health care, the expected minimal percentage of correct answers was set at 75% after a consensus was reached by the study's entire multidisciplinary panel of experts who have relevant expertise on oral health and mouth care. We used the one-sample proportion test to obtain the minimum required sample size to detect an alternative proportion of 0.75 (null hypothesis: 0.5) with 90% power and a 5% significance level, estimating a sample size of 38 respondent nurses. To evaluate whether the percentage of correct answers was significantly lower than the expected probability of 75%, we performed a one-sided binomial probability test. A p-value of 0.05 was considered significant in all analyses.

Results

Only 2 out of 44 nurses working in three heart failure cardiology wards refused to participate in this study (4.5% drop out rate). The remaining 42 nurses answered all 6 items in the administered questionnaire. The mean age of nursing professionals was 43.7 (SD 5.1) years. Among the entire sample of nurses included in the study (n=42), 23 were female (54.8%), and 20 (47.6%) began their nursing service more than 20 years ago. The mean value of the overall length of service referring to the entire nurses' sample was 17.6 (SD 5.4) years. Age was equally distributed between males and females, 43.5 (SD 5.5) and 44.0 (SD 4.9) years, respectively.

The six items of the modified version of Adams' questionnaire were designed to test the knowledge level of nurses on oral health care. Prior to using the questionnaire for our survey, it was tested on 10 nurses (pilot study) in the heart failure unit at the University Hospital of Perugia to verify the completeness and comprehensibility of each question. All six questions were well understood by the 10 nurses tested, so no modifications were made to the original text.

The first question, concerning the need to check the mouth of each patient during their admission to the cardiology unit, was correctly answered by 23 out of 42 nurses (54.8%, 95% CI=40.0 to 68.8%). The percentage of nurses who gave correct answers was significantly lower than the 75% expected (p=0.003). There was no effect of sex (p=0.076) or length of service (p=0.542) on the frequency of correct answers.

The second question focused on which oral physiologic functions should be checked in the mouth and was correctly answered by 32 nurses (76.2%, 95% CI=61.5 to 86.5%). The most neglected observations were the phonatory and smiling functions, which were not relevant to our analysis. There were no statistically significant differences between the measured versus expected percentages of nurses correctly answering (p=0.629). There was no effect of sex (p =0.468) or length of service (p=1.000) on the frequency of correct answers.

In the third question, participants were required to list the most relevant types of lesions affecting the mouth, and only 20 of 42 tested nurses (47.6%, 95% CI=33.4 to 62.3%) correctly answered by describing a complete evaluation on caries, dental loss, gingival inflammation, and oral mucosa lesions. A significantly lower percentage of nurses properly responded than was expected (p=0.0001). Significant differences between the percentages of unlisted lesions were not found. The nurses' lack of knowledge was most evident in their inability to remember all four types of lesions. For this third question, sex (p=0.551) and length of service (p=0.212) did not affect the frequency of correct answers.

The fourth question concerned the adequate frequency of tooth brushing. Half (22/42 nurses, 52.4%, 95% CI=37.7 to 66.6%) indicated once a day and the remaining 20 said twice a day. None of the nurses deemed patient tooth brushing an unnecessary daily hygiene practice. Although neither of the answers might be considered incorrect, twice a day brushing is preferred to once and was assumed as correct. For this question, there was a significantly lower percentage of nurses with the correct answer than was expected (p=0.0001). There was no effect of sex (p=0.757) or length of service (p=0.764) on the frequency of correct answers.

The fifth question, regarding the equipment or tools that should be used to clean the mouth, was correctly and completely answered by 27 out of 42 nurses (64.3%, 95% CI=49.2 to 77.0). The percentage of correctly replying nurses was lower than expected (p=0.0416). The aspects most forgotten by nurses were the use of dental floss (37.1%, 95% CI=48.7 to 25.5%) and prostheses cleaning (23.3%, 95% CI=8.7 to 32%). There was no effect of sex

(p=1.000) or length of service (p=0.754) on the frequency of correct answers.

The sixth question required knowledge of the most relevant drugs affecting the mouth. Only 13 out of 42 nurses (30.9%, 95% CI=19.4 to 46.0%), correctly replied to this question, mentioning at least three out of four types of drugs reported in Appendix 1. A slightly higher level of knowledge was found for cortisone and antibiotic side effects compared to diuretic antihypertensive and psychiatric antidepressants (p=0.03). Overall, nurses who gave correct replies concerning this item were statistically less than the 75% expected value (p<0.0001). There was no effect of sex (p=0.516) or length of service (p=0.360) on the frequency of correct answers.

In Synthesis
The expected percentage (75%) of correctly replying nurses was only satisfied for the second question (Figure 1). The mean percentage of nurses who replied with correct answers was 54.8% (95% CI=48.8 to 61). The two items where nurses significantly departed from this mean value percentage were the second question with an improved mean value (p=0.005) and the sixth question with an impaired mean value (p=0.003). These percentages of correct replies were completely unrelated to independent variables such as age (lower or higher than the mean of 43.7 years), sex, and length of service distribution (above and below the mean of 17.6 years), with p-values ranging from 0.514 to 1.
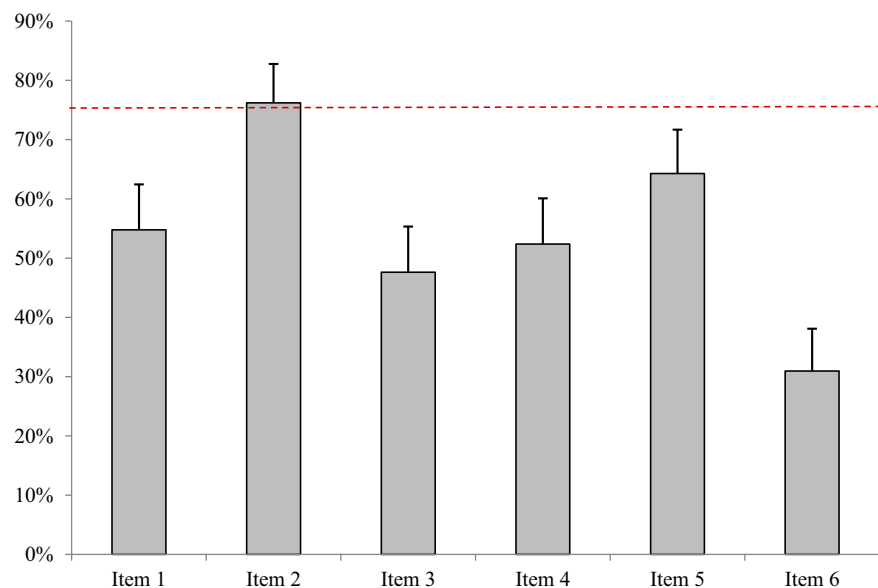
Questionnaire Internal Consistency
These first six items were strongly associated pairwise according to Fisher's exact tests. The second item was the only one that did not correlate with the others. Moreover, the six answers showed a good degree of internal consistency as indicated by a Cronbach'α of 0.75 (95% CI=0.63 to 0.87).

Discussion
To assess the nursing staff's level of knowledge on oral health care, the first objective was to find a valid measurement tool. A specific scale was chosen (a modified six-item version of Adams' questionnaire), and its reliability was evaluated through a Cronbach's α test, which was adopted in our previous questionnaire validation study.[36] This questionnaire showed satisfactory results in terms of internal coherence between its items. Indeed, with the exception of the second question, all the items showed pairwise associations, suggesting the answers would reflect similar levels of nursing knowledge about oral health.

When the nursing staff was evaluated, the answers indicated a low level of oral health care knowledge. Few nurses considered it necessary to perform an oral check of inpatients during their hospitalization. This suggested a lack of willingness to consider mouth hygiene status, as though the mouth were not part of the total patient. Moreover, disinterest in considering the mouth, reflected a general low level of oral health among the nurses.

Figure 1 Percentages of nurses correctly answering each of the six questionnaires items. The red dotted line represents the attendance percentage of those who responded correctly.

Indeed, as demonstrated by the other questionnaire items, a high percentage of nurses answered incorrectly when they were asked about the correct daily frequency of brushing teeth or dental prostheses.

A poor level of nursing competency was found for knowledge of the tools (toothbrush, dental floss or gauze) or products (fluoride toothpaste or chlorhexidine) for cleaning oral tissues. A small sample of nurses correctly replied (lower than 75% expected) when asked to indicate what lesions principally affect teeth, gums, and oral mucosa or to describe the drugs that might induce oral microbiome alterations.

This gap in knowledge, combined with low awareness of the importance of daily management of inpatients' oral hygiene, raised some concerns on the effectiveness of nurses in preventing systemic complications due oral infections. Nurses with a low degree of awareness in oral health care increase the risk for inpatients to be incorrectly supported in their oral hygiene practices in terms of both frequency and quality.[37] Supporting inpatients in their oral hygiene represents a practice where nurses are asked to habitually make independent daily decisions, without any informed supervision. Therefore, as in all other "decision-making" clinical situations, oral health care is based on high levels of knowledge and practical experience.[38] These concerns increase when oral competences were required of nurses working in a semi-intensive (eg, heart failure units) or intensive units where inpatients have a critical general health condition.

The mean percentage of nurses that correctly replied to the questions was 54.4%, much lower than the expected 75%. However, when the percentages calculated in each of the six items were compared among themselves, no significant differences were found with the exception of both the second and sixth items. The second question concerned the most relevant oral functions, and 76.2% responded correctly. A possible explanation for this high percentage could be that functions such as chewing and swallowing could be seen by nurses with direct practical experience but no dentistry background. Management and feeding of patients with either reduced swallowing and chewing are habitual tasks, increasing nurses' confidence with this issue.[39,40] Conversely, only 30.9% correctly answered the sixth question, which asked which drugs cause oral side effects. This low level of knowledge about the side effects of drugs could be explained by the fact that this type of detailed pharmacologic competence could be not completely expected from the nurses, considering the complexity of their clinical tasks.

The most relevant drugs that affect the oral cavity and microbiome are antibiotics, cortisone, antihypertensive diuretics, and psychiatric antidepressants. The analysis of the nurses' responses on this topic showed that this undesirable effect was better recognized for cortisone and antibiotics than for the other two drug classes. We surmised that this was due to the fact that cortisone and antibiotics taken over an extended period of time can lead to dysmicrobism in the oral cavity and other organs (eg, the genitalia and intestine),[41,42] the detection of which would not require special competence in oral health care. Conversely, antihypertensive diuretics and psychiatric antidepressants cause changes to the microbiome by reducing saliva flow, producing this side effect only in the oral cavity.[32,33] Understanding this problem requires specific oral health care knowledge, which is less expected from nursing personnel.

Our results agreed with those produced by similar investigations on this topic. In these studies (carried out in hospitalized patients or nursing home residents), mouth care performed by nursing personnel was a low priority and was correlated with poor oral health status in patients.[14,43–45] Factors such as excessive workload, limited staff, lack of adequate structure, and limited education on oral health were claimed by nurses as the most relevant reasons to explain their inadequate attention to oral hygiene.[46–48]

These above-mentioned obstacles affecting adequate oral health care underscore the need for better education in this topic. This idea was validated in the literature, which shows that appropriate education policies improve both the knowledge background of nurses[49–51] and their support of inpatients in oral hygiene.[51]

Another positive strategy that has proven useful in supporting nursing staff in oral health management is expanding the professional team to include other specialized figures such as a dental hygienist and dentist. This strategy might also be a psychological comfort for nursing personnel who often claim there are limited chances for positive inter-professional relationships.[52] As a last consideration, the introduction of new, easier dental procedures (ie, the Atraumatic Restorative Technique) and innovative filling materials (ie, glass ionomer cements) might allow for an interdisciplinary professional team (including the nursing staff) to temporarily manage dental

caries in critical inpatients, reducing the risk of general infective complications.[53]

Limitations

The expected percentage of correct answers indicating an adequate level of knowledge of oral health and mouth care topics was set as 75% by a multidisciplinary panel of experts relying solely on their clinical expertise and education. This subjective percentage was based on the fact that the literature did not describe a validated scale to assess the level of nursing education in oral health. In addition, due to the limited sample size, the obtained results should be considered as preliminary data to raise concerns about the degree of oral health knowledge demonstrated by nurses working in heart failure units. A further limitation was due that our study population only consisted of nurses working in cardiology heart failure units in Italy. We are uncertain whether the results would be comparable in other critical care settings in Italy and/or other countries. Further studies should be performed involving nurses working in other critical care hospital departments to investigate possible differences in their oral health knowledge and to explore potential factors that might explain heterogeneity.

Conclusion

This study evaluated nurses' awareness of the relevance of oral hygiene management to avoid additional general health complications in inpatients hospitalized in heart failure units in the Umbria region of Italy. Their level of knowledge in the oral health care field was also evaluated. For this purpose we used a six-item questionnaire adapted from the Adams' questionnaire. Low levels of interest in and knowledge of oral health care among these nurses were found.

These data should be considered preliminary, due to both the small sample size and the use of an incompletely validated questionnaire (only its reliability was demonstrated). However, our data raise concerns about the lack of a nursing role in the prevention of general complications deriving from oral infections, particularly when considering the general health status of critical inpatients. Further studies should be carried out with a larger sample of nurses to assess their oral health knowledge using a questionnaire that is both reliable and valid.

Disclosure

The authors indicate no conflicts of interest in this scientific work.

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