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Dental and Oral Care Model for Inpatients to Prevent the Occurrence of Hospital Acquired Pneumonia (HAP) in the Elderly in the Geriatric Room of Mukomuko Hospital Bengkulu Province

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Abstract

The cause of Hospital Acquired Pneumonia (HAP) is bacteria from dental plaque, colonizing with other pulmonary pathogens. This condition builds rational pathogen respiration in the oral cavity resulting in high-risk pneumonia. The risk group for HAP is over 70 years old, who have serious co-morbidities, malnutrition, decreased consciousness, and chronic obstructive pulmonary disease. Prevention of nosocomial infections requires integrated and programmed actions to reduce the transmission of organisms. This study aims to develop a model of dental and oral health care for inpatients to prevent the occurrence of HAP in the elderly. This study was conducted in the geriatric ward of Mukomuko Hospital, Bengkulu Province, Indonesia. The product test used a quasi-experimental pretest and posttest design. The sample of this study was each 16 respondents in the intervention group receiving dental and oral care and the control group receiving treatment as per the dental health national standard Indonesia Kepmenkes No.284, 2006. The results show that dental and oral care is relevant to prevent HAP with an average value of 88.4 (feasible) (p -value 0.001, and its application is effective in increasing knowledge ($p=0.000$), attitude (0.000), increased brushing skills ($p = 0.000$), gargle skills (p -value 0.000), decreased debris index score ($p = 0.000$), decreased CPIS respondents with ($p = 0.000$) and sputum culture results ($p = 0.000$) compared to the control group. In conclusion, dental and oral health care can increase the skills of maintaining dental oral health, reduce the debris index and CPIS (Clinical Pulmonary Infection Score) for the elderly.

Keywords: CPIS, dental and Oral Health Care, Elderly, HAP

1. Introduction

Nosocomial infections occur worldwide, both in developing and developed countries. Sources from the World Health Organization (WHO) in 2002 mentioned the results of various studies showing that nosocomial infection

is the main cause of morbidity and mortality. It can also increase the severity of illness and emotional stress that reduces the quality of life of the patients. Prevention of nosocomial infections is very important because nosocomial infections can lead to a higher incidence of morbidity and mortality in Covid-19 patients (Warganegara, 2017; Ong et al., 2021). Hospital acquired pneumonia (HAP), also known as nosocomial pneumonia, is transmitted by patients in the hospital 48 – 72 hours after being admitted. HAP extends hospital stay for 7 - 9 days and requires higher treatment costs. The risk group for HAP is over 70 years of age who have serious co-morbidities, malnutrition, decreased consciousness, and chronic obstructive pulmonary disease (Riani & Syafriani, 2019). HAP has the type of bacteria *Streptococcus pneumoniae*, *H. aemophilus influenzae* and various types of bacteria in the mouth. HAP is caused by bacteria originating from dental plaque that colonizes with other pulmonary pathogens. Bacteria in periodontal tissues such as *Porphyromonos gingivalis* bacteria, *Fusobacterium nucleatum* can be associated with respiratory pathogenic bacteria such as *Pseudomonas aeruginosa*, *Klebsiella pneumonia*. Several studies have documented that the oral cavity is a reservoir for respiration of rational pathogens that cause pneumonia in high-risk patients (Sukarman et al., 2015).

The incidence in cases of Community Acquired Pneumonia (CAP) and HAP was 60.1%, 86.7% and Aspiration Pneumonia (AP) accounted for 66.8% of the total pneumonia inpatients. This number is closely related to patients aged 65 years as many as 22 ,1% in 2018 (Suzuki et al., 2021). Nonventilator Hospital Acquired Pneumonia (NV-HAP) risk is noticed higher when the patients stay increases. Different treatments of oral care for intervention and control groups were conducted in which the intervention unit received enhanced oral care, and the control unit received usual oral care. Both of the treatments resulting in the reduction of NV-HAP incidence rate, although the enhanced oral care received better numbers than the usual oral care. In the intervention unit, the reduction of NV-HAP is 85%, and in the control unit is 56% (Giuliano et al., 2021). Meanwhile, the oral care affects 25% of HAP reduction in the patients (Talley et al., 2016). However, the exact treatment to reach the desirable change comes to obstacle. Since a proper oral disease prevention and robust design could be the way to prevent elderly contracting HAP (Kanzigg & Hunt, 2016; Mitchell et al., 2019; Pássaro et al., 2016).

This study aims to develop a model of dental and oral health care for inpatients to prevent the occurrence of HAP in the elderly. The model of dental and oral health care for inpatients to prevent the occurrence of Hospital Acquired Pneumonia (HAP) in the elderly in the geriatric ward of the hospital is carried out by adjusting the characteristics of elderly patients divided into several stages, namely Stage I, Stage II, Stage III.

2. Method

The results of preliminary interviews data with hospitals and dental and oral health workers, especially dental and oral therapists show that so far there has been no model of dental and oral health care for inpatients to prevent HAP in the elderly in the Geriatric Ward of Mukomuko Hospital, Bengkulu Province. Therefore, the dental and oral therapists carry out more activities in outpatients, especially dental clinics. This research is expected to be able to carry out dental and oral health care activities, that with HAP prevention efforts to reduce bacteria contained in the oral cavity, plaque and periodontal tissue as the cause of HAP.

2.1 Research Design

This research design uses Research and Development (R&D). The research and development procedure include 5 (five) main steps, including: 1) Information Collection. 2) Product or model design. 3) Expert validation and revision. 4) Test product or model. 5) Data collection stage of information processed descriptively and qualitatively, in the form of a table concluded from the results of interviews for the need for dental health learning methods and media for elderly patients in the geriatric ward of the hospital. The data of the expert validation test stage and revision was carried out with the Intraclass Correlation Coefficient statistical test to find out the feasibility of the product/model. The data were tested for Shapiro-Wilk normality. The normal data was tested using a paired t-test, and for data that were not normally distributed was tested using the Wilcoxon test. The comparison between the intervention group and the control group was if the data were normally distributed using the independent t-test test, while not normal using the Mann Whitney test.

The independent variable in this study is the model of dental and oral health care for elderly. Meanwhile, the dependent variables are the knowledge, attitude, skills of the elderly in performing dental and oral hygiene, the Debris Index status, and HAP occurrence shown by CPIS (Clinical Pulmonary Infection Score).

The treatment of dental and oral care comprised 3 stages. Stage I was performed by building a trust with elderly, assessment and diagnose, as well as treatment plan. Stage II was the implementation of dental and oral care in a form of 3 days of intervention. Intervention at day 1 to 3 were tooth brushing and gargling with Povidone Iodine 1%. This implementation involved internist, pulmonary specialist, nurses and dental workers. Stage III is the evaluation of the activities by filling out the questionnaire, Debris Index and CPIS checks.

2.2 Sampling Procedures and Subject Characteristics

The population in this study is all the elderly inpatients in Mukomuko Hospital, Bengkulu Province. The sample was selected using purposive sampling technique and divided into two groups, namely 16 samples for the intervention group and 16 samples for the control group. The calculation of the minimum sample adopted Lemeshow & Sastroasmoro as shown in equation (1) (Lemeshow et al., 1997).

$$n1 = n2 = \frac{2(z\alpha + z\beta)^2 s^2}{(x1 - x2)^2} \quad (1)$$

Where

N: sample in each group

$z\alpha$: error level type I = 5%, so $z\alpha$ is 1.96 (95% power)

$z\beta$: error level type II = 5%, so $z\beta$ is 1.96 (95% power)

S: deviation standard

x1: average value from control group effect according to previous study

x2: average value from intervention group effect according to previous study

The previous study resulted in S value of 1.165, mean outcome of control group 9.07 and intervention group 10.93. Therefore, the calculation of minimum sample is as equation (2).

$$n1 = n2 = \frac{2(1.96 + 1.96)^2 s^2}{(9.07 - 10.93)^2} \quad (2)$$

$$n1 = n2 = 12.05 = 13$$

So, the subject is minimum at 13. However, to anticipate drop out of 15%, the calculation was corrected to equation (3) and (4).

$$n = \frac{n}{(1-f)} \quad (3)$$

Where n is sample size, and f is drop out estimation.

$$n = \frac{n}{(1-0.15)} = 15.29 \quad (4)$$

So, the sample size is 16 respondents for each group or 32 respondents for 2 groups.

The inclusion criteria of the subject are those who consented to be respondents by filling out the agreement letter. The age of respondent is 55 years old and above. Besides, the criteria are elderly who still have teeth or do not as a user of dentures, and has no defect in the body and psychology. Meanwhile the exclusion criteria are the elderly who have no inclusion criteria and a healthy elderly.

3. Results

The characteristics of the elderly are that they have varying ages. It is expected that the elderly who will carry out dental and oral health care in the inpatient geriatric ward are the elderly who are cooperative and willing to answer so that they get optimal results, the elderly are generally announced when doing most activities they need the help of other people and the elderly In general, it is difficult to change the mindset that has been ingrained for a long time so that it is difficult to provide new education. Dental and oral health problems in the elderly, especially dental caries, periodontitis, missing teeth so that the elderly mostly wear dentures. There is no policy from the

government, especially in Mukomuko Regency regarding the maintenance of dental and oral health, especially regarding dental and oral health care for the elderly in inpatient and outpatient wards. The role model method with education about dental and oral health by imitating and practicing directly can add insight and change behavior in maintaining dental and oral health. Elderly patients really need a new learning model on how to maintain oral hygiene. Such as dental and oral health care to prevent the occurrence of diseases or problems that occur in the teeth and mouth, so that it can change the mindset in dental and oral health, for example by practicing directly how to brush teeth.

3.1 Univariate Analysis

The analysis is used to analyze each variable from the results study. The results about the characteristics in this study are used to find out general description of the respondents presented in Table 1.

Table 1: Characteristics of respondents

Characteristics	Intervention		Control		p-value
	n	%	n	%	
Age (mean±SD)	64.88±9.57		67.31±10.44		0.810*
Min-Max	55-93		55-87		
Gender					
Male	10	62.5	10	62.5	1.000**
Female	6	37.5	6	37.5	
Working status					
Working	10	62.5	9	56.3	0.719**
Not working	6	37.5	7	43.8	
Medical diagnose					
Pneumonia	5	31.3	0	0.0	
Suspect TB	4	25.	6	37.5	
Asthma bronchial	1	6.3	2	6.3	0.183**
PPOK	4	25	7	43.8	
Others	2	12.5	2	12.5	

Table 1 shows that the age, gender and group diagnose of the respondents are homogeny, shown by the p-value of age is 0.810, gender is 1.000 and working status 0.719.

3.2 Normality Test

Table 2 shows the normality test on knowledge, attitude toward maintaining dental and oral hygiene, skills of tooth brushing and gargling, Debris Index and CPIS on intervention and control group.

Table 2: Normality test results

Variable	p-value	
	Intervention (n=16)	Control (n=16)
Knowledge <i>Pre-Test</i>	0.061	0.332
Knowledge <i>Post-Test</i>	0.065	0.115
Attitude <i>Pre-Test</i>	0.026	0.001
Attitude <i>Post-Test</i>	0.000	0.001
Skill of tooth brushing <i>Pre-Test</i>	0.000	0.001
Skill of tooth brushing <i>Post-Test</i>	0.023	0.028
Skill of gargling Gigi lansia <i>Pre-Test</i>	0.240	0.073
Skill of gargling <i>Post-Test</i>	0.103	0.057
Debris Index <i>Pre-Test</i>	0.017	0.008

Variable	p-value	
	Intervention (n=16)	Control (n=16)
<i>Debris Index Post-Test</i>	0.001	0.000
<i>Clinical Pulmonary Infection Score (CPIS) Pre-Test</i>	0.000	0.000
<i>Clinical Pulmonary Infection Score (CPIS) Post-Test</i>	0.000	0.004

The results of the normality test of the control and intervention group data for the variables of knowledge, attitude, skills of tooth brushing skill and gargling pre-test and post-test using the Shapiro-Wilk test shows different p-value comprising less and more than 0.05. The data on knowledge and skill of gargling pre-test and post-test obtain value of $p > 0.05$, so in conclusion, the data of knowledge and skill of gargling in pre-test and post-test are normally distributed. Hence, the parametric test was performed. While the attitude data, and skill of tooth brushing in pre-test and post-test obtain p value < 0.05 , so the attitude data, and skill of tooth brushing in pre-test and post-test are not normally distributed. Therefore, non-parametric tests were performed.

3.3 Bivariate Analysis on The Variables

The bivariate analysis is intended to understand the difference value on the variables. As shown in table 3, the bivariate analysis was conducted based on variables of knowledge, attitude, skills of tooth brushing and gargling, Debris Index, CPIS and culture results.

Table 3: Effectiveness test of Paired and Unpaired Data on Knowledge, Attitude, and Skills of Tooth brushing and gargling, Debris Index, and CPIS

Variable	Group	Mean±SD Pre test	Mean±SD Post test	Delta±SD (Δ)	p-value
1. Knowledge	Intervention	4.44 ± 0.964	8.63±0.957	4.19±1.27	0.000*
	Control	4.56±1.209	6.75±1.183	2.19±1.42	0.000*
		p=0.749***	p=0.000***	p=0.001*****	
2. Attitude	Intervention	24.19±0.981	30.69±1.662	6.5±1.54	0.000**
	Control	25.81±2.994	27.38±.553	1.57±1.03	0.001**
		p=0.025*****	p=0.000*****	p=0.000*****	
3. Skill of tooth brushing	Intervention	22.37±3.612	37.88±2.094	15.51±4.94	0.000**
	Control	26.81±3.885	27.38±2.630	57 ±1.03	0.135**
		p=0.002*****	p=0.000*****	p=0.000*****	
4. Skill of gargling	Intervention	10.19±1.328	25.19±2.167	15±2.60	0.000*
	Control	9.94±1.124	14.50±1.633	4.56±1.50	0.000*
		p=0.570***	p=0.000***	p=0.000*****	
5. Debris Index	Intervention	2.400±0.163	0.319±0.160	2.08±6.89	0.000**
	Control	2.313±0.239	2.075±0.100	0.23±2.72	0.007**
		p=0.405*****	p=0.000*****	p=0.000*****	
6. CPIS	Intervention	6.75±0.577	2.13±0.500	4.62±0.61	0.000**
	Control	6.88±0.500	3.88±0.719	3±1,13	0.000**
		p=0.325*****	p=0.000*****	p=0.000*****	
7. Sputum culture results	Intervention	2.63±1.962	1.44±0.892	1.19±2.00	0.036**
	Control	1.63±1.025	3.06±1.652	1.43±1.59	0.003**
		p=0.149*****	p=0.000*****	p=0.000*****	

*paired test

: Paired t-test *
Wilcoxon **

**Unpaired test on pretest

: Independent t-test ***

***Unpaired test on posttest

: Man-Whitney *****

****Unpaired test of delta data

: Independent t-test *****
Man-Whitney*****

Table 3 shows the different p-value. In the determination of whether the proposed model of dental and oral care for intervention group and dental and oral care based on Permenkes No.284 in 2006, p-value is considered. If the p-value is less than 0.05, then the conclusion is drawn that the model is effective, and vice versa, if the p-value is more than 0.05, the conclusion is that the model is not effective in the prevention of HAP. As shown by the p-value, the dental and oral care is effective to increase the knowledge of maintaining dental and oral health both in intervention and control groups. The same conclusion also comes to the variable of attitude, skill of gargling, Debris Index, CPIS and culture results. Meanwhile, for the skill of tooth brushing, the method is effective only in intervention group. So overall, the proposed dental and oral care show the effectivity on the increase of knowledge, attitude, skill of gargling, Debris Index, and CPIS. The sputum culture results indicate the decline of CPIS. Meanwhile the method on Permenkes No.284 2006 also show the same results, except in the skill of tooth brushing.

4. Discussion

The results of collecting information concluded that the implementation of dental and oral hygiene in the elderly in the practice of gargling and tooth brushing required special efforts through the implementation of dental and oral health care for the elderly. In its implementation, the guide from dental and oral therapists and nurses is needed. Dental and oral hygiene of the elderly need special attention because it affects general health. Good knowledge about dental and oral hygiene is one way to maintain body condition. It is necessary to assess the knowledge and attitudes of nursing staff towards oral health care. Some nursing staffs believe that the people will tell them when they need help with their daily oral hygiene. The people subsequently feel that they need interproximal help in the tooth brushing process (Croonquist et al., 2020). The role of nursing staffs is very important as nurse is the one who interact with the patient. Besides, nurse also play a role in helping patient in increasing their adaption towards the changes in their body, and motivate the patients to survive (Supriyadi et al., 2011). The increase in knowledge in the elderly is due to the fact that when the education about the maintenance of dental and oral hygiene is given, the elderly pay attention and perform the education well so that the understanding of the elderly about how to maintain oral health increases. The demonstration method is proven to be effective in increasing knowledge in providing counseling materials (Berniyanti et al., 2019; Sari & Permata Putri, 2021).

An increase in attitude occurred in the process of implementing the model of dental and oral hygiene care for the elderly who were given dental and oral health education and guidance on tooth brushing in the morning after breakfast and at night before going to bed. So, the attitude of the elderly towards dental and oral hygiene maintenance increased because of the response that had been given in line with the information. A person's dental and oral hygiene is determined by behavior because behavior is shaped by three domains, namely knowledge, attitude and action. Knowledge received by the subject through stimulation in the first place causes a closed response in the form of attitude (Hetherington, 2017).

Improved skills of tooth brushing and gargling with a model of dental and oral hygiene care of the elderly in the geriatric room of the Mukomuko Hospital, Bengkulu Province is because of the integration of education and simulation as well as demonstration of tooth brushing. It is justified by providing exercises on what the target has learned or in another word is the practice implies that something is always repeated and imprinted in mind. Nevertheless, between the first learning situation and a realistic learning situation are different, so, the upgraded ways are needed as this is intended to create a flawless skill (Deinzer et al., 2018).

The Debris Index score of elderly patients has decreased because elderly patients have been given education and practice brushing their teeth properly and correctly with the aim of removing plaque and debris so as to improve dental and oral hygiene. Dental and oral hygiene is very important to maintain. Measuring dental and oral hygiene is an attempt to determine the state of the integral part of overall body health that is not separated from general body health (Sunarjo et al., 2014). Poor oral and dental hygiene is not a very visible condition and related concerns, such as gingivitis and other dental diseases. Besides, potentially pathogenic bacteria are often present in the oral cavity and hospitalization is very risky to create conditions that favor colonization of the oropharynx (Alghamdi, 2022).

The decline in the Clinical Pulmonary Infection Score (CPIS) model of dental and oral hygiene care has successfully changed the habit of tooth brushing and gargling skills. The decline in the CPIS rate can be seen from the results of sputum culture that were examined in the Microbiology Laboratory of the Faculty of Medicine, UNAND Padang. The results of the pre-test intervention group sample examination show the growth of aerobic bacteria *Klebsiella sp.*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Pseudomonas sp.*, and *Candida albicans*. For the posttest, the culture examination shows no growth of *Pseudomonas aeruginosa*. It is generally a bacterium that is easily found in the environment but is an opportunistic pathogen that infects immunocompromised patients or hospitalized patients and attacks the respiratory tract. In the upper respiratory tract, especially the lungs, these bacteria are more likely to colonize the subgingival biofilm and saliva of patients with chronic periodontitis than patients without periodontitis, causing pneumonia which has the potential to cause deaths (Souto et al., 2014; Caldas et al., 2015).

The conclusion in this study relies on the model of dental and oral health care for inpatients is relevant as it is feasible and its application is effective to improve the skills of tooth brushing and gargling of elderly patients.

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