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HEPA WATER PURIFICATION INFLUENCE ON DECREASING GERMS NUMBER IN ISOLATION TREATMENT ROOM KEDIRI REGENCY HOSPITAL

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Abstract

Pure and Fresh, is the air condition that everyone dreams of anywhere and anytime, including sick people in the Hospital Treatment Room. The germ index and room dust content also affect the comfort and health of residents which is a standard quality standard for microbiological and physical parameters for hospital air. This study aims to analyze the effect of HEPA air purification in reducing germ numbers in the isolation treatment room of Kediri Regency Hospital, and the specific purpose of this study is to analyze the difference in the number of airborne germs in the isolation treatment room of Kediri Regency Hospital before and after the use of HEPA air purification, This study uses a pre-experimental design. The sample of this study was 5 class 1 rooms of the Isolation Treatment Room of Kediri Regency Hospital. The sampling technique is total sampling. The Wilcokson test was used for data analysis with a significant level (α) = 0.05. The results of the data analysis showed that there was a difference in the number of airborne germs in the isolation treatment room of Kediri District Hospital between before the use of Air Purification HEPA and after the use of Air Purification HEPA. So the use of Air Purification HEPA has an influence on the number of airborne germs in the isolation treatment room of Kediri Regency Hospital.

Keywords: Air Purification, HEPA, Influence, Decreasing, Germs Number.

Introduction

Pure and Fresh, is the air condition that everyone wants anywhere and anytime, including sick people in the Hospital Treatment Room. A clean environment in hospitals is needed to support the health of patients and to reduce the chances of harm to patients who have weak immune systems (Kemenkes, 2012). Hospital rooms have different functions depending on the type of disease or the severity of the patient, and also depending on different medical procedures, thus requiring air conditioning with different levels of cleanliness (Kemenkes, 2012).

As a reference, the air is declared clean if there are no gases, pollutants and smoke. It is said to be sterile if the total density or concentration of germ numbers in the air does not exceed the specified Germ Number Index (Kemenkes, 2004). Air containing microorganisms can be a medium for disease transmission (airborne disease) this can

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occur without contact with patients or with contaminated objects, transmission is by breathing air. These microorganisms are spread in the air through patients coughing, sneezing, talking and laughing. In this process, saliva and mucus come out in the form of droplets or nuclei (Catur Puspawati, 2020). Based on the air microbiological examination in the second semester of 2020, the Germ Number Index in the isolation room (Jasmine) of the Kediri District Hospital is Isolation A of 46 CFU/m3 and Isolation B of 24 CFU/m3. This figure shows that not all airborne germ numbers in the treatment room, especially the isolation room, meet the existing standards, namely according to the Regulation of the Minister of Health of the Republic of Indonesia Number: 07 of 2019. Regarding Hospital Environmental Health Requirements, which is 35 CFU/m3. Meanwhile, the particulate matter measured based on PM 10 was recorded at 35 g/m3. The data shows the truth of the fact that room air contains pollutants (germs and dust levels) that can interfere with health and must be handled.

Hospitals as a place of health services for the community must meet health requirements, one of which is air quality. Good air quality is defined as air that is free of contaminants, causes of irritation, discomfort or disturbance to the health of occupants. The index of the number of germs and the level of dust (particulate matter) of the room also affects the comfort and health of the occupants, which are the standard quality standards for microbiological and physical parameters for hospital air in accordance with the Regulation of the Minister of Health No. 7 of 2019. To ensure air quality standards, it is necessary to monitor room air quality at least 2 (two) times a year, sampling and inspection of air quality parameters (germs, dust, and gases). (Kemenkes, 2019).

The use of air purification (HEPA Filter) is believed to have an important role in maintaining indoor air quality by reducing small air particles such as smoke and dust. Air purification has several filtration systems in it, one of which is the High Efficiency Particulate Air (HEPA) Filter which is effectively 99.97% capable of filtering very fine particles up to 0.3 m. HEPA air purification is very important in preventing the spread of bacterial and viral organisms in the air (David A. Christopherson, 2020). Air purifying systems are proven to be able to help and optimize the cleanliness of the air and the environment from harmful pathogens such as fungi, bacteria, and viruses (Hamilton Thorne, 2020).

Himanshu Mittal's research (2011), on the ability of microorganisms to live in the use of HEPA filters, showed that microorganisms could not survive after 48 hours of normal use of HEPA filters. Furthermore, the results of Dae Hoon Park's research (2011), stated that HEPA Air Filters are able to fight airborne infectious microorganisms, the spread of bacterial and viral organisms in the air. Not many studies have examined the ability of HEPA Air Purification in reducing the number of airborne germs and dust levels in the room. The ability of HEPA Air Purification in cleaning indoor air pollutants makes researchers interested in analyzing HEPA Air Purification in reducing germ numbers and particulate matter levels in the isolation treatment room of the Kediri District Hospital. The germ number index in this study was measured using Plate Count Agar (PCA) media with the volumetric air sampling method before and after HEPA Air Purification, while

the dust content (particulate matter) was measured using Low Volume Air Sampler (LVS) equipment with hydrophobic filter paper with pore size 0.5 m.

Research Method

This study uses a Quantitative Approach Method. The following is the data collection process.

Data Collection Process

Data collection in this study was carried out with the following stages:

1. Sampling (germ count) before the Air Purification HEPA Hospital Grade "NATIF" is turned on.

   This was done after the Air Purification HEPA Hospital Grade "NATIF" had been turned off for 9-10 hours, based on the research of Neti Yuliana (2008) which stated that maximum bacterial growth (log phase) occurred at 3 to 9 hours. Meanwhile, Wahyuning (2018) stated that the maximum bacterial growth (log phase) on Carboxy Methyl Cellulose media occurred at the 8th and 9th hours.

   From the results of the two studies, it was concluded that the effect of using HEPA Air Purification would not give meaning to the room air after being turned off for 9 hours. This 9 hour time is the basis for this research to conduct a sampling of indoor air bacteria after the HEPA Air Purification is turned off.

2. Sampling (germ count) after the Air Purification HEPA Hospital Grade "NATIF" is turned on.

   This is done 2 (two) days after the Air Purification HEPA Hospital Grade "NATIF" is turned on. In accordance with the results of research by Nunu Wati R (2014) which stated that there was E. Coli bacteria in agar media that were stored for 0 days, 2 days, 4 days and 6 days. With the largest number of colonies occurring on day 2. Agus Niar F (2016) stated that the logarithmic growth rate of pseudomonas bacteria occurred on day 2 to day 4 and there had been a slowdown after day 5.

   From the results of these two studies, it can be concluded that the largest number of colonies occurred on day 2, this is what underlies this research to conduct sampling of indoor air bacteria on day 2 after HEPA Air Purification is turned on.

The measurement of variables is carried out in the following way:

The measurement of the number of germs in the air is done by placing a petri dish containing agar media in the isolation treatment room. Petri dishes in volumetric air sampling were left open for 15 minutes so that the agar medium was exposed to room air. After 15 minutes, each dish was covered and labeled. Petri dishes that have been labeled are put into the sample box and taken to the Microbiology Laboratory for microbiological testing. After that, the petri dishes were incubated for 48 hours at 37oC and then the growth was observed. If for 48 hours a positive result is obtained, namely the agar medium is overgrown with microorganisms, then proceed with the calculation of bacteria (germ number) with units of CFU/m3.

Test Statistics

Manual data processing was carried out on the total number of bacterial colonies (germ numbers) in the room without the use of an air purifier, and in a room with the use of an air purifier. The data is presented in tabular form and processing using Microsoft Excel.

In this study, the data obtained from the observations were analyzed statistically using SPSS analysis, namely the paired sample T test to see:

1. Is there a difference in the number of germs between a room without the use of an air purifier, and a room with the use of an air purifier with the interpretation of the results as follows: If the value is significant / P-Value > 0.05; then Ho is accepted if the value is significant / P-Value <0.05; then Ho is rejected.
2. Is there a difference in air dust levels between a room without the use of an air purifier, and a room with the use of an air purifier with the interpretation of the results as follows: If the value is significant / P-Value > 0.05; then Ho is accepted if the value is significant / P-Value <0.05; then Ho is rejected.

In this study, the data obtained from the observations were analyzed statistically using SPSS analysis, namely the paired sample T test if the distribution of the research data was normal, if the distribution of the research data was abnormal then the data were analyzed using the Wilcoxon test.

Results and Discussion

A. Univariate Analysis

An overview of the airborne germ numbers in the isolation treatment room of the Kediri Regency General Hospital can be seen in table 1 below.

Table 1
Overview of Germ Numbers and Dust Levels in the Treatment Group

No. Room	Room Name	Number of bacteria (CFU /m^3)	
		Before HEPA	After HEPA
1	Jasmine 1	31	25
2	Jasmine 2	33	10
3	Jasmine 3	35	31
4	Jasmine 4	28	10
5	Jasmine 5	27	18

Table 2
Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Before HEPA	5	30.8000	3.34664	27.00	35.00
After HEPA	5	18.8000	9.25743	10.00	31.00

From table 2, it is known that before the use of HEPA the highest germ number was 35 CFU/m3 and the lowest was 27 CFU/m3 with an average of 30.80 CFU/m3, while after using HEPA the highest germ number was 31 CFU/m3 and the lowest was 10 CFU/m3. with an average of 18.80 CFU/m3.

B. Data Normality Test

An illustration of the distribution of airborne germ numbers in the isolation treatment room at the Kediri Regency General Hospital can be seen in the graph below.

1. Normality of the number of germs in the air before using HEPA

Table 3
Test for Normality of Germ Numbers Before Use of HEPA

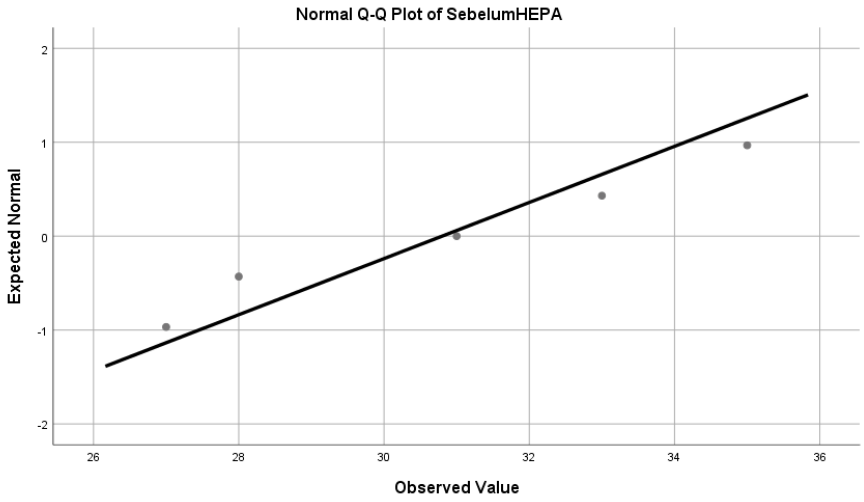
Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Before HEPA	,199	5	,200*	,950	5	,737

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

From Table 3 above, the significant value of P-Value is: 0.737; so that > from the value of : 0.05 ; then Ho is accepted so that it can be concluded that the distribution of the data on the number of germs before the use of HEPA was not normal.

For more details, it can also be seen from graph 4.1, where the distribution of data is outside a straight line so that the distribution of data is not normal.

Graph 1
Normality of Airborne Germ Numbers Before HEPA Use



2. Normality of airborne germ numbers after using HEPA

Table 4
Test for Normality of Germ Numbers Before Use of HEPA

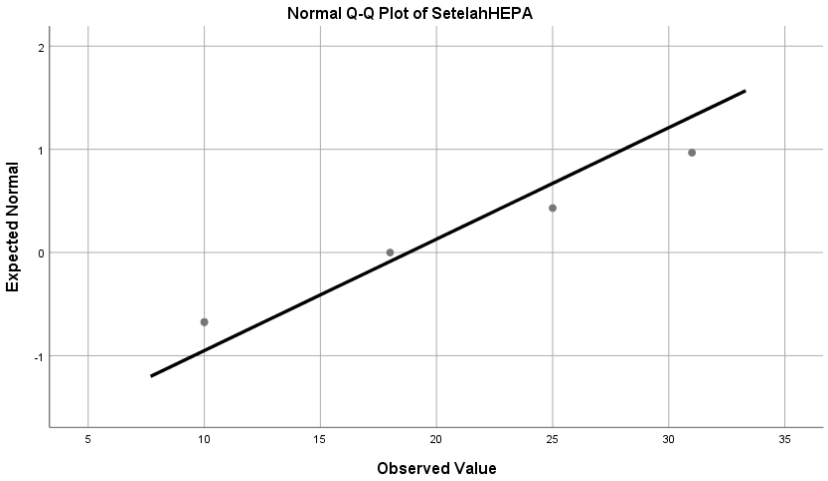
Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
After HEPA	,229	5	,200*	,901	5	,417

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

From Table 4 above, the significant value of P-Value is: 0.417; so that > from the value of : 0.05 ; then Ho is accepted so that it can be concluded that the distribution of data on the number of germs after using HEPA is not normal.

For more details, it can also be seen from graph 4.1, where the distribution of the data is outside a straight line so that the data distribution is not normal.

Graph 2
Normality of airborne germ numbers after using HEPA



C. Bivariate Analysis

In this study, paired sample T test analysis could not be used because the research data were not normally distributed, so the data were tested using the Wilcoxon test.

Tabel 5
Test Statistik Wilcoxon

Test Statistics[b]	
	Aftrer HEPA – Before HEPA
Z	-2.023[a]
Asymp. Sig. (2-tailed)	.043
a. Based on positive ranks.	
b. Wilcoxon Signed Ranks Test	

From Table 5 it is known that: The results of statistical tests (Wilcoxon) obtained a significant value of 0.043 (p value < 0.05), then H0 is rejected, meaning that there is a difference in the number of airborne germs in the Isolation treatment room of the Kediri District Hospital between before the use of HEPA Air Purification and after the use of water. HEPA Purification. So the use of HEPA Air Purification has an influence on the number of airborne germs in the Isolation treatment room of the Kediri District Hospital.

Discussion

Based on the results of the bivariate analysis, it proved that there was a difference in the number of airborne germs in the Isolation treatment room of the Kediri District Hospital between before the use of HEPA Air Purification and after the use of HEPA Air Purification. The results of the univariate analysis revealed that all the rooms studied had a decrease in the number of airborne germs.

These findings are in line with Hamilton Thorne (2020), stating that the Air purifying system is proven to be able to help and optimize the cleanliness of the air and

the environment from harmful pathogens such as fungi, bacteria, and viruses. According to David A. Christopherson (2020), explained that the use of air purification (HEPA Filter) is believed to have an important role in maintaining indoor air quality by reducing small air particles such as smoke and dust. Air purification has several filtration systems in it, one of which is the High Efficiency Particulate Air (HEPA) Filter which is effectively 99.97% capable of filtering very fine particles up to 0.3 m. HEPA air purification is very important in preventing the spread of bacterial and viral organisms in the air.

Cleaning actions (sweeping and mopping) the isolation treatment room of the Kediri Regency General Hospital, which was carried out 2 (two) times a day, in the morning and afternoon. While the cleaning of walls, ceilings and furniture is carried out once a week or after the room is not occupied by the patient (the patient goes home), then after the room is not occupied by the patient (the patient goes home), the room air is disinfected using drymist equipment with 5% H2O2 material. . The cleaning action factor described above also causes the air quality in the isolation treatment room of the Kediri Regency General Hospital to be good, in the sense of meeting the microbiological parameter quality standards for hospital air in accordance with the Decree of the Minister of Health no. 1204 of 2004 concerning Hospital Environmental Health Requirements where the entire value of germ numbers before or after the use of HEPA Air Purification is still far below the maximum value limit of 200-400 CFU/M3.

Conclusions

Based on the results of the study, it can be concluded that before the use of HEPA, the highest germ number was 35 CFU/m3 and the lowest was 27 CFU/m3 with an average of 30.80 CFU/m3. And after the use of HEPA, the highest germ number was 31 CFU/m3 and the lowest was 10 CFU/m3 with an average of 18.80 CFU/m3. The results of the Bivariate Analysis proved that there was a difference in the number of airborne germs in the Isolation treatment room of the Kediri District Hospital between before the use of HEPA Air Purification and after the use of HEPA Air Purification. The results of the univariate analysis revealed that all the rooms studied had a decrease in the number of airborne germs. The use of air purification (HEPA Filter) is believed to have an important role in maintaining indoor air quality by reducing small air particles such as smoke and dust. Air purification has several filtration systems in it, one of which is the High Efficiency Particulate Air (HEPA) Filter which is effectively 99.97% capable of filtering very fine particles up to 0.3 m. HEPA air purification is very important in preventing the spread of bacterial and viral organisms in the air.

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