



Difference In The Number Of Air Germs In The Treatment Room Based On The Patient's Visit Time

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Abstract

Hospital environmental conditions need attention because the presence of pathogenic microbes can cause disease transmission or infection in the hospital. The hospital is a health service facility that provides services to the community both preventive, curative and rehabilitative. The purpose of this study is to determine the difference in the number of germs. air treatment room based on the time the patient visited Purworejo Hospital. This research is an observational analytic survey

research with cross sectional design and the sampling technique uses purposive sampling. Sampling of air germ numbers using the Microbiology Air Sampler (MAS) lab

oratory by the Yogyakarta Health and Calibration Laboratory staff. Data were analyzed by using the Paired Sample Test to determine the difference in the number of air germs based on the time the patient visited. The results showed that there were differences in the number of air germs in the treatment room based on the time to visit the patient with a value of $p = 0.002$. The percentage increase in the number of air germs during the lowest visiting hours was 79.69% and the highest was 600%, while the average increase was 255.36%. The conclusion of this study is that there are differences in the number of air germs in the treatment room based on the time the patient visits, namely before the visiting time and at the time of the patient's visit, so it is necessary to make efforts to reduce the number of air germs in the treatment room.

Keywords: Air germ count, treatment room, time to visit the patient

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INTRODUCTION

Health problems cannot be separated from environmental problems because they influence each other. A hospital is a health facility that provides services to the community, both preventive, curative and rehabilitative. In a hospital environment that is healthy, clean, safe and comfortable according to environmental health requirements, efforts must always be made so that the hospital environment does not become a place for disease transmission and is protected from environmental pollution. WHO states that indoor air pollution is 1000 times more risky than outdoor air pollution (Rompas, Clara Lourenza, 2019). Environmental Health according to Government Regulation no. 66 of 2014 is "efforts to prevent disease and / or disturbance from environmental risk factors to create a healthy environmental quality from physical, chemical, biological and social aspects" (RI, 2014).

Air is one of the environmental components that can be used as a medium for disease transmission (Pratiwi et al., 2020). Air quality in the hospital room is a problem that needs attention because it will affect human health. Poor air quality can act as an intermediary for disease transmission. IEQ (Indoor Environment Quality) or indoor environmental quality generally refers to the quality of the occupied space determined by several important parameters, namely indoor air quality, thermal comfort, indoor air pollution level, air temperature, relative humidity, air speed and other aspects, such as lighting, noise pollution, and equipment load with certain devices in the room (Tacutu et al., 2016).

Microorganisms are transmitted in the hospital environment through several different routes, the same microorganisms can also be transmitted via more than one route (Jaichenco & Lima, 2019). For example, the coronavirus disease, which is currently a worldwide pandemic, is transmitted through more than one route, namely through direct contact and droplet splash. There are three main routes of transmission, namely by air, through direct and indirect contact (Jaichenco & Lima, 2019). Several factors influence the concentration of bacteria in the air, namely hospital design, ventilation system, temperature, relative humidity, population density and methods of disinfection (Mirhoseini et al., 2015). Lack of fresh air entering the room causes the accumulation of indoor air contaminants (De Robles & Kramer, 2017). Air contributes to the movement and spread of infection and it is estimated that 10-20% of Healthcare Associated Infection (HAIs) are airborne (Frías-De León et al., 2016).

Infectious diseases related to health services or Healthcare Associated Infection is one of the health problems in various countries in the world, including Indonesia and is an agenda discussed in the Asian Pacific Economic Committee (APEC) forum or the Global Health Security Agenda (GHSA) (Ministry of Health of the Republic of Indonesia, 2017). Data from the Centers for



Disease Control and Prevention (CDC) states that in the United States hospitals in 2014 the incidence of HAIs reached 722,000 patients and 75,000 patients died while hospitalized because of HAIs (Sapardi et al., 2018). According to research conducted in two major cities in Indonesia, it is known that the incidence of nosocomial infections reaches 39% -60% (Berliana, 2016).

The incidence of HAIs in Indonesia reaches 15.74%, which is above developed countries which reach 4.8 - 15.5% (Sapardi et al., 2018). According to data on the Hospital Infection Rate Incidence at the Purworejo Hospital in 2018, it is known that the infection rate in the operating area is 5.93%. Health Metering Decree No. 129 / Menkes / SK / II / 2008 concerning Minimum Hospital Service Standards stipulates the requirement for the incidence of nosocomial infections, namely $\leq 1.5\%$ (Ministry of Health of the Republic of Indonesia, 2008). One of the causes of hospital infections is the high number of air germs in the treatment room (Lomboan et al., 2020). Researchers are interested in conducting research related to the number of air germs in the inpatient room because so far at Purworejo Hospital there has never been any research on this matter. The purpose of this study was to determine the difference in the number of air germs in the treatment room based on the time to visit the patient, namely before the visiting hour and at the time of visiting.



MATERIALS AND METHODS

This type of research is an observational analytic survey research with a cross sectional design. Research data is collected according to the conditions or situations when the research is taking place, so it is sufficient to collect data once or when the research is carried out regardless of past or future events (Susila & Suyanto, 2018). This research was conducted at Purworejo Hospital from January to March 2020. The population in this study were inpatient rooms at the Purworejo Hospital. The number of samples of the air germ count was 30, namely 15 samples before visiting hours and 15 samples during patient visiting hours. The sampling points were in the VVIP, VIP, Class 1, Class 2 and Class 3 treatment rooms 3 points each.

Officers who collect and check air germs number samples are officers from the Yogyakarta Health and Calibration Laboratory Center. The method used in taking samples of room air germs using the Microbiology Air Sampler (MAS). In addition to taking air germ count samples, at the same time parameters of temperature, humidity, lighting and the number of occupants in the treatment room were also measured. Furthermore, the data were analyzed by using the Paired Sample Test to determine the difference in the number of air germs in the treatment room before and during the patient's visit.



RESULTS

The results of the test room air germ count

Based on Figure 1, the results of the examination of the number of air germs in the treatment room mostly still exceed the required quality standard. The number of inpatient room air germs before visiting hours that meets the requirements is 40% (6 rooms) and does not meet the requirements of 60% (9 rooms) with the lowest number of germs is 100 CFU / m³ in VIP B room, while the number of air germs The highest is 1150 CFU / m³ in the VIP Room C. The number of air germs in the inpatient room during visiting hours that meets the requirements is 20% (3 rooms) and does not meet the requirements of 80% (12 rooms) with the lowest number of germs is 220 CFU / m³ in VIP room B and the highest number of air germs is 7280 CFU / m³. Of the 30 samples of room air germs examined, the total number that met the requirements was 9 rooms (30%), and 21 rooms did not meet the requirements (70%). According to Kepmenkes No. 1204 / Menkes / X / 2004, the required number of germs is 200 - 500 CFU / m³ (Ministry of Health of the Republic of Indonesia, 2004).

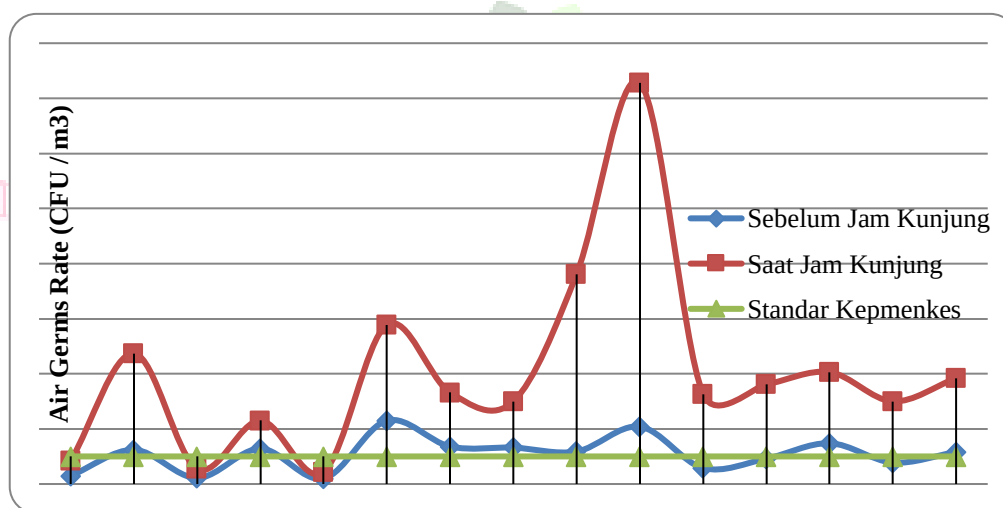


Figure 1: Graph of the Number of Treatment Room Air Germs

Figure 2 shows that at the time of visiting the results of the examination of the sample, the number of air germs in the treatment room showed a significant increase. The increase in the highest number of germs reached 600%, while the increase in the number of the lowest germs was 79.69% and the average increase was 255.36%. There was a significant increase in class 1 and class 2 spaces.

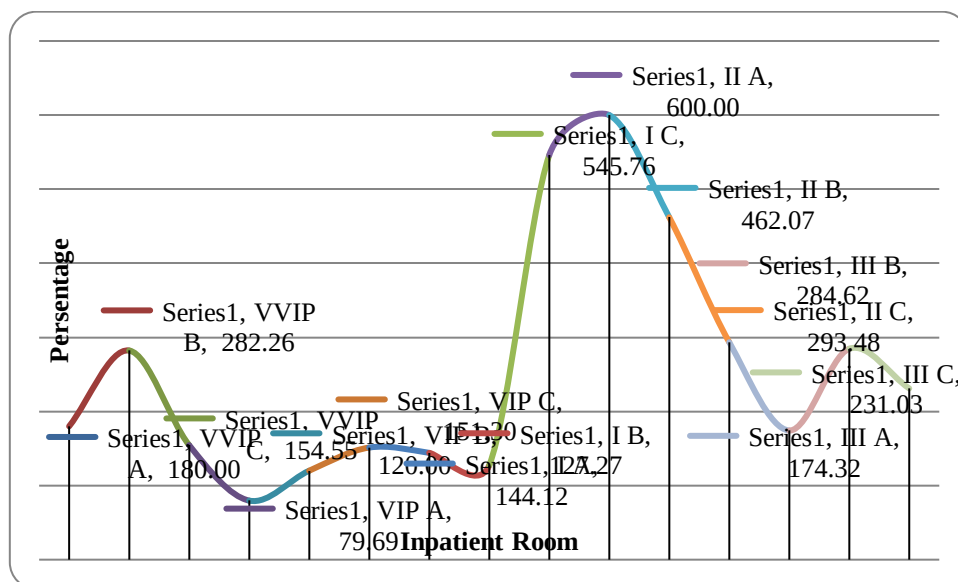


Figure 2: Graph of the Increase in the Number of Air Germs During Visiting Hours

Based on the results of the Paired Sample Test (T-Test) in Table 1, it shows that the value of $p = 0.002$ or $p < 0.05$, which means that there is a difference in the number of air germs in the treatment room before visiting hours and during visiting hours as in the table below..

Table 1: Paired Sample Test Results

	Mean	Lower	Upper	p value
Before visiting hours – During visiting hours	-1484.667	-2330.816	-638.517	.002

Physical Environment Measurement Results (Temperature, Humidity, Lighting)

The temperature measurement results before visiting hours were 22 - 30.8 °C, which according to the requirements was 2 samples or 13.3%, while the temperature during visiting hours reached 22.5 - 31 °C and according to the standard consisted of 2 samples. The rooms that match the standard for temperature parameters are the VVIP C and VIP B rooms. The humidity in the treatment room reaches 52 - 72%, which is according to the standard of 3 samples (20%), while the results of humidity measurements during visiting hours reach 54 - 74%, meet the requirements of 2 samples (13.3%). The light intensity of the treatment room reached 45.27 - 114.9 lux, the results that met the requirements were 4 samples (26.7%, while the results during visiting hours were 55.63 - 157.57 lux with 9 samples (60%). Parameters of temperature, humidity, and lighting



conditions meet the requirements according to Kepmenkes No. 1204 / Menkes / X / 2004, namely for standard temperatures: 22 - 24 °C, humidity: 40 - 60%, and light intensity: 100 - 200 lux.

Table 2: Physical Environment Measurement Results

Sampling Time	Measured Physical Environment Parameters						
	Temperature		Humidity		Lighting		
	TM		TM		TM		
	MS	S	MS	S	MS	S	
Before Visiting Hours	2 sample	13 sample	3 sample	12 sample	4 sample	11 sample	
	13, 3 %	86,7 %	20 %	80% 7 %	26, %	73,3 %	
During Visiting Hours	2 sample	13 sample	2 sample	13 sample	9 sample	6 sample	
	13, 3 %	86,7 %	13, 3 %	86,7 %	60 %	40%	

Result of Space Density Observation (Number of Occupants in the Room)

The number of residents in the treatment room before visiting hours is less than during visiting hours. However, in the VIP room, it seemed constant, there was no decrease or increase in the number of people. The highest room density is seen in the class 2 treatment room.

Table 3: Observation Results of Treatment Room Density

		Total Space Density (person)				
Sampling Time						
		VVIP	VIP I	Klas 2	Klas 3	Klas
Before Visiting Hours		2 - 3	3	2 - 5	4 - 6	5 - 7
During Visiting Hours		2 - 6	6	2 - 7	11	3 - 8



DISCUSSION

The difference in the number of air germs in the treatment room

The results of this study are that there are differences in the number of air germs in the treatment room before the patient's visiting time and the patient's visiting time. In this study, several environmental conditions observed in addition to the number of air germs were temperature, humidity, lighting, and room density or the number of occupants in the treatment room. The number of air germs in the treatment room before visiting the patient reached the lowest number that met the standard, namely 100 CFU / m³ in the VIP B room, this is supported by other conditions that also meet the requirements including the results of temperature measurements, namely 23.9 °C, 60% humidity and 107.6 lux lighting when the lights are off, while the room density consists of 2 people. Thus it can be said that if the physical conditions such as temperature, humidity, and lighting and room density are in good condition, the number of room air germs is also good, meaning that it is according to the required standards. The highest number of germs reached 7280 CFU / m³, namely in the Class II A room, and it turned out that when the measurement was known the temperature reached 30 °C, the humidity reached 71% and the lighting reached 121.1 lux. The total space density is 4 people, the room conditions are not air-conditioned, the windows are open and the lights are on during the day.

Based on the results of temperature and humidity measurements, it can be seen that temperature and humidity mostly exceed the standards required in the Decree of the Minister of Health No. 1204 / Menkes / X / 2004, but the lighting is still within the required limits. Seeing this condition, it can be interpreted that high temperature and humidity affect the high number of air germs in the inpatient room. The increase in the number of occupants in the room or the density of the space from 2 people to 4 people also affects the number of microorganisms in the room. In a study it was stated that humidity, size and concentration of dust particles, temperature, air flow, and the type of microorganisms affect the presence of air germs (Yonata et al., 2020). Conditions of temperature, humidity, and lighting that do not meet the requirements will affect the health quality of medical personnel, such as eye irritation, fatigue, headaches and inadequate concentration of hospital workers (Pratiwi et al., 2020).

Temperature factor

Room temperature that meets the requirements is in the VVIP C room, which is before the 22 °C visiting hour and 22.5 °C visiting time, for other rooms that exceed the standard. The highest temperature during visiting hours is the class 3 inpatient room while the lowest temperature is in the VVIP C room. The increase in the number of air germs in the treatment room increases due to



the increase in indoor temperature. In a study, it was stated that temperature is closely related to the number of air germs in the hospital because increased temperature can affect the growth of microorganisms (Pratiwi et al., 2020). Microorganisms can survive at certain temperatures, be it the minimum temperature, the optimum temperature, or the maximum temperature according to the conditions of the microorganism. Temperature conditions are influenced by the ventilation conditions of the room. The treatment room in this study has different ventilation conditions, for class 1, VIP, and VVIP, besides natural ventilation, it also uses artificial ventilation, namely AC (air conditioning), while for classes 2 and 3 using artificial ventilation and the addition of a fan. At the time of the study, the room that was not air-conditioned was the position of the windows closed so that the ventilation was not good as a result of the air circulation was not smooth, this caused the indoor temperature to tend to increase. This can be strengthened by the results of research which states that the main factor for microbial growth is temperature with an air velocity of 3.0 m / s (Ningsih et al., 2016).

Rooms that are not air-conditioned to condition the air temperature to stay comfortable, usually with the use of a fan. The use of this fan is actually not good for indoor air quality because the air only rotates in the room so that automatically the dust or small particles that are present also fly around in the air. In a study, it was stated that the number of bacterial colonies in a room that used a fan was more than the number of bacterial colonies in a room that used air conditioning (Iswadi et al., 2014). Every treatment room, whether air-conditioned or not, efforts should be made for smooth air circulation by opening the vents, windows and doors at least once a day or every time a room cleaning process is carried out so that dirty air in the room is replaced by the entry of clean air. Lack of fresh air entering the room will cause the accumulation of indoor air contaminants, which can cause health effects, such as building related illness (BRI) and sick building syndrome (SBS) (De Robles & Kramer, 2017).

Moisture factor

In previous studies, it was stated that the concentration of airborne bacteria in the hospital environment was significantly correlated with relative humidity (Mirhoseini et al., 2015). High humidity can cause the nasal mucous membrane to dry out so that it is less effective in blocking microorganisms (Jayanti et al., 2016)). High humidity and trapped air pollutants can cause SBS (Sattar, 2016). Humidity can be caused by poor ventilation conditions so that air circulation is not smooth. Cross ventilation is very important for the treatment room so that dirty air flows out of the room and clean air enters the room without obstacles. Space building design affects the smooth exchange of air space. The inadequate ventilation system also contributes to the high microbial load (Fekadu & Getachewu, 2015).



In a study, it was stated that room humidity can be caused by lack of light entering the room directly, so that the area exposed to sunlight is limited (Nugroho et al., 2016). The closed window condition causes the lack of sunlight to enter the treatment room so that the room becomes humid, which in turn makes it easier for microorganisms to breed. Poor ventilation and lighting conditions will cause high humidity in the room. In the Decree of the Minister of Health No. 1204 / Menkes / X / 2004 states that the required humidity for the treatment room is 45 - 60% (Ministry of Health of the Republic of Indonesia, 2004).

Lighting factor

The size of the intensity of sunlight entering the room will affect the conditions in the room. If the intensity of sunlight entering the room is less, it can cause microbial growth and the lack of natural lighting can cause the eyes to tire easily. However, if the intensity of sunlight entering the room is too much, the air temperature becomes hot, thereby reducing the comfort of the occupants in the room. The lighting required according to the regulations is 100 - 200 lux (Ministry of Health of the Republic of Indonesia, 2004). At the time of the research, around 65% of the rooms used artificial light (electric lights) for lighting so that the sunlight that should have entered the room was not optimal. At the time of the research, the position of the windows and curtains were also partially closed so that they blocked sunlight entering the room. Low light intensity in indoor conditions suitable for the development of bacteria or germs (Yonata et al., 2020).

Sunlight is very useful in human life. Striving for the morning sunlight to enter the room (Ministry of Health of the Republic of Indonesia, 2010). Sunlight that enters the room as a lighting source has the ability to kill microbes because it contains ultra violet rays in sunlight (Ningsih et al., 2016). UV light when emitted at a wavelength of 254 nm is able to deactivate germs by damaging their DNA (Kanaan, 2019). Adequate sunlight and natural ventilation can kill germs (Ministry of Health, Republic of Indonesia, 2014). So that sunlight can enter the room, the ventilation system must be good enough.

Things that can be done so that the lighting in the room meets the standards is to open the windows wide, add artificial lighting / lights, change the material and color of the walls and floors with a brighter color, lower the ceiling using a drop ceiling, use the color of the furniture in the same color. brighter (Jayanti et al., 2016).

Space density factor

This difference in the number of germs can be caused by an increase in the number of occupants in the room. During visiting hours, the number of germs increased by an average of 355.40%. In the research that has been done, it can be seen that the number of people who occupy the patient's room or the occupancy density has increased by 158.17%. So the number of air germs



in the room is influenced by the number of occupants of the room. It is stated that the level of pollution in the room by microorganisms is influenced by several factors including the number of people and the activities of the people who occupy the room (Waluyo L., 2013). Another study states that the density of the room or the number of people in the room can affect the number of airborne bacteria, due to the spread of disease in a densely populated room (Sinaga et al., 2014).

Visitors and the patient's family often bring items from home into the patient's room such as mats, pillows, bolsters, and others so that this condition makes the room uncomfortable and looks dirty. This carry-on can cause the transfer or spread of germs from outside the hospital into the hospital. The high room density causes the temperature and humidity conditions to increase so that there is a risk of increasing the number of air germs in the room. Research shows that the largest contribution of physical environmental factors to germ numbers is occupancy density (Wawan, 2016). Space density affects the increase in the number of air germs because the activities of the occupants of the room are supported by conditions of poor air circulation (Rompas, Clara Lourenza, 2019).

Environmental Management Efforts

Efforts to manage the hospital environment need to be done so that the air quality of the treatment room is in good condition according to applicable standards so that the number of air germs in the treatment room can be controlled.

- Formulating an internal hospital policy regarding the management of hospital air quality based on the Minister of Health's Decree so that it can be used as a reference / basis for the activities of the environmental management unit. It is very important to tighten the implementation of policies related to patient visiting time regulations and limiting the number of visitors. The participation of the entire hospital community is very important in the success of policy implementation.
- Striving for good ventilation in the treatment room is important so that air circulation is smooth, be it natural ventilation, mechanical ventilation or mixed ventilation (natural and mechanical). The window design made is a window with 100% openings. For certain rooms, it is necessary to add an air filter or hepa filter system as in the Ministry of Health's regulation (Kemenkes, 2014, airborne).
- Maintenance and cleaning of infrastructure such as exhaust fans, fans, air conditioners and hepa filters is very important so that the room air quality is always in good condition. Maintenance activities are carried out according to a predetermined schedule and monitoring is necessary for their implementation to run according to procedures.
- Increase cleaning service activities so that the quality of the hospital environment is getting better. Cleaning, decontaminating, treatment rooms regularly on schedule and as soon as visiting hours are over. When cleaning windows and doors, you open them so that dust and aerosol in the



room can escape. Open the windows and curtains in the morning so that the morning sunlight can enter the room optimally.

- Tighten the implementation of the rules for visiting patient hours, limiting the number of visitors and length of visits. The number of hospital visitors visiting patients is limited because if the activity is too dense it will cause room pollution by air germs brought by visitors and prevent disease transmission from patient to visitor.

CONCLUSIONS AND SUGGESTIONS

There is a difference in the number of air germs in the treatment room at the time before visiting hours and at the time of visiting. The factors that affect the number of air germs in the treatment room can be caused by temperature, humidity, lighting and space density or the number of visitors in the treatment room. It is necessary to make efforts to manage the hospital environment so that the number of air germs in the treatment room can be controlled.

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