AIR QUALITY IN THE INPATIENT ROOM OF HOSPITAL X SURABAYA IN 2023

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Abstract. Interactions that occur in hospitals, especially in patient rooms, can cause air pollution. Poor air quality can cause a decline in the health of patients in hospital rooms. The purpose of this study was to determine the air quality in the inpatient room of hospital X Surabaya. Type of descriptive research with the object of research 4 rooms. The variables used were temperature, humidity, occupancy density and air germ count. Sampling of temperature, humidity and occupancy density occurred at one point in each room, while sampling of airborne germs occurred at two points in each room. The rooms included rooms G1, G2, G3 and G4. This study used analysis univariate. This study obtained results with an average temperature of 30.5 ℃, humidity of 59.2%, and occupancy density of 9.4 m^2 / TT. The results of the airborne microbial count revealed 3 rooms that were classified as at risk of spreading the disease, namely room G3 at the first point, room G3 at the second point, and room G4 at the first point. Air temperature and germ count was not met the requirements while humidity and occupancy density have met the requirements. Researchers provide advice for agencies to provide natural ventilation in the form of windows that can be opened and closed optimally.

Keywords : Air quality, Air physical and microbiological parameters, Inpatient room

1 INTRODUCTION

Infectious diseases and non-communicable diseases are common in the current era, so a place of service is needed to prevent and treat these diseases. The hospital functions as a primary healthcare facility that provides inpatient, outpatient, and emergency services needed by the general public. Usually, patients are transferred to the inpatient ward of the hospital when they need further treatment (Hiwar, W. et al., 2021) (Rahardhiman, A., et al., 2020)

Inpatient rooms have the potential for disease spread or contamination due to interactions between medical staff, patients and non-medical staff (Basinska, M et al., 2019). Contamination can occur directly or indirectly, through vectors and through the air (Rompas, C.L et al., 2019). Air has an influence on the spread of bacteria and viruses in the environment (Saito, K.J et al., 2022) (Baures, E et al., 2018).

Physical parameters, chemical exposure and microbiological contamination affect indoor air quality (Ginting, D.B et al., 2022). Air quality monitoring is necessary to ensure that the indoor air quality is not poor, which affects the health of patients (Mayasari, A et al., 2022).The supervision can be done by microbiological air and physical air supervision (Asif, A et al., 2018). Checking the number of germs in the air is a way to monitor air microbiology (Leung, M. et al., 2006). Environmental conditions that do not meet the requirements can cause an increase in air germs, which include

occupancy density, indoor hygiene, season, temperature, lighting and humidity that do not meet the requirements (Praptiwi, J et al., 2020) (Ikhtiar, M., et al., 2017).

Indoor air quality can be influenced by the density of occupancy and activities within (Nurlaela, N et al., 2022). A building area that is not proportional to the number of occupants will cause overcrowding (Zairinayati, Z dan Putri, D.H, 2020). In addition, the density of occupancy affects the temperature and spread of bacteria in the room because the more occupants in the room causes the room temperature to get hotter and the occupants are uncomfortable (Nurlaela, N et al., 2022) (Bonadonna et al., 2021).

Temperature has a large influence factor on the number of germs with a factor of 85.84. (Onklay, N et al., 2020). Hot temperatures can be reduced by adequate ventilation so that the air exchange in the room is perfect, and natural ventilation should be 15% of the floor area so that air circulation is smooth (Zulfa, L et al., 2022) (Settimo, G et al., 2020).

Insufficient ventilation has an influence on temperature and humidity on the presence of airborne germs in the hospital (Zulfa, L et al., 2022). Low humidity causes SBS (Sick Building Syndrome) symptoms, such as throat irritation, eye irritation, and coughing and humidity above 60% can be an ideal place for pathogenic microorganisms and allergens (Bahri, B et al., 2022) (Amri, U.S et al., 2022) (Yuliarti, O.A et al., 2020). There is a relationship between temperature (p-value = 0.001) and humidity (p-value = 0.021) on the number of airborne germs in the hospital (Yonata, Q.U et al., 2020)

2 RESEARCH METHODS

This research a descriptive method research with the object of research as many as 4 inpatient rooms of Hospital X Surabaya, namely rooms G1, G2, G3 and G4. Collection techniques by researchers were carried out by means of measurements, documentation and laboratory examinations. Data analysis was done with descriptive table explanation. The research variables were temperature, humidity, occupancy density and air germ count. Temperature measurements were taken using a thermometer, humidity using a hygrometer, occupancy density using a digital meter and air germ counts using a Microbiology Air Sampler (MAS). Temperature, humidity and air germ count measurements were taken once per room, while air germ count sampling was done at 2 points per room.

Air germ count sampling tools and materials

a) Microbiological water sampler (centrifugal implactor)
b) Petridish dish
c) Cool box
d) Gloves
e) Mask
f) Stationery for marking petridish dishes and recording results
g) Agar media
h) Alcohol 70

Preparation of Nutrient Agar for airborne germ count sampling:

a) Weigh NA media as much as 2.8 grams
b) Dissolve into 100 ml distilled water
c) Heat on a hotplate until homogeneous
d) Sterilize in an autoclave at 121 ℃ for 1 hour
e) Pour into petridish dish

3 RESULT

Table 1. Test Results of Physical Air Quality Parameters of Inpatient Room G Hospital X Surabaya Year 2023

Variable	Room Name	Results	Description
Temperature	G1	30,3	not eligible
	G2	30,5	not eligible
	G3	30,8	not eligible
	G4	30,6	not eligible
Humidy	G1	57,1	qualified
	G2	56.9	qualified
	G3	59	qualified
	G4	58,6	qualified
Residential Density	G1	10,4	qualified
	G2	9	qualified
	G3	7,2	qualified
	G4	10.9	qualified

Table 1. shows that temperature measurements in four rooms wasn't meet the requirements set out in regulation of the minister of health No.7 of 2019 concerning Hospital Environmental Health because it was less than the standard of 32-34℃. The results of humidity measurements in the four rooms have met the requirements of Regulation of the Minister of Health of the Republic of Indonesia No. 7 of 2019 with a standard of 40 - 60% and occupancy density was met the requirements of the Technical Guidelines for Hospital Buildings for Inpatient Rooms in 2012 quality standards of 7.2 m^2 / TT for class 3 treatment rooms.

Table 2. Test Results of Air Germ Numbers Quality Parameters of Inpatient Room G Hospital X Surabaya Year 2023

Room Name	Air Germ Count Standard (<180 CFU/m^2)	Description
Room G1 at the first point	103	No risk
Room G1 at the second point	83	No risk
Room G2 at the first point	26	No risk
Room G2 at the second point	56	No risk
Room G3 at the first point	393	Risk
Room G3 at the second point	626	Risk
Room G4 at the first point	210	Risk
Room G4 at the second point	133	No risk

Table 2, it is known that of the eight air sampling points, three are considered at risk and the other five wasn't risk. Based on Regulation of the Minister of Health of the Republic of Indonesia No. 7 of 2019 concerning Hospital Environmental Health in the treatment room, the air germ number > 180 CFU / m^2 is at risk of spreading disease.

4 DISCUSSION

4.1 Temperature

The highest temperature measured in room G3 was 30.8℃, as there was many patients staying there. This was in line with research Praptiwi et al., (2020) that the number of occupants in the room can cause the indoor air temperature to increase.

Overall the room temperature does not meet the requirements of Regulation of the Minister of Health of the Republic of Indonesia No. 7 of 2019 concerning Environmental Health, this can occur because there is no sunlight entering the room. In line with research Saito et al., (2022) light entering the room affects the amount of temperature and if the temperature is low it can cause an increase in indoor humidity. In addition, poor lighting will be an ideal place for bacterial growth (Amri, U.S et al., 2022) (Fatma, F. dan Ramadhani, R, 2020) (Widodo, K., Cahyono, T, 2023). Efforts to maintain temperature can be made by opening windows or curtains so that air and sunlight enter the hospital inpatient room. (Gola, M. et l., 2019) (Baqer, N. S et al., 2022).

4.2 Humidity

Room G3 was the highest humidity level of 59%, which is caused by the lack of ventilation and natural lighting.. Humidity is related to the lack of ventilation and lighting, if ventilation is lacking it results in less than maximum air circulation (Gumiyarna, H, 2021). Humidity above 60% and higher will contain many microbes in the air and become an ideal medium for the transmission of pathogenic microorganisms (Babaoglu, U. T et al., 2020) (Fonseca, A et al., 2018). Therefore, to maintain humidity, it must be monitored and controlled through a natural ventilation system that can open and close completely.

4.3 Residential Density

The highest occupancy density was found in room G3 with a value of 7.2 m^2 / TT. This happens because of the difference in building floor area with the number of beds. Hospitals can have higher levels of bacteria due to high occupancy solids. In line with research Praptiwi et al., (2020), the level of airborne bacteria increases due to high occupancy density or the number of people in the room (Ashuro, Z et al., 2022). Bacteria carried by residents can spread around the room so that the air germ number increases and can cause CO^2 levels to increase (Putri, R.A., 2021) (Tamamilang, C.M et al., 2019). . Besides raising the temperature, high occupancy can lead to less than optimal air exchange, which affects the number of airborne pathogens (Capolongo, S., & Settimo, G.,2017). Therefore, it is necessary to organize patient beds in such a way that the occupancy density is maintained (Fraczek, K., & Gorny, R. L., 2011) (Chamseddin et al., 2019).

4.4 Air Germ Count

The results of the examination of air germs that fall into the risk category was room G3 at the first point with a value of 393 CFU/m^2, room G4 at the first point with a value of

626 CFU/m^2 and room G4 at the second point with a value of 210 CFU/m^2. While the lowest germ number results are in the first point G2 room with a value of 26 CFU/m^2. This can occur because there are differences in the condition of the room, especially the cleanliness of the toilet when sampling the air germ count.

In line with research Firjatullah et al., (2021) The highest germ count results were found in rooms where toilet cleanliness was lacking. The cleanliness of the toilet greatly affects the number of air germs in the room (Lomboan, et al., 2020) (Gola, M et al., 2020) . In addition, there are several things that cause an increase in indoor air germ numbers such as lack of environmental cleanliness, floor mopping techniques and environmental conditions around the room (Purnamasari, T et al., 2017) (. High airborne germ counts can cause health problems and decreased health in hospitalized patients (Tasya, A.S. dan E.E., 2022) (Tang, H et al., 2019)

Therefore, it is necessary to monitor and control the air germ count in the hospital inpatient room by cleaning the room with disinfectants regularly and providing sufficient ventilation facilities in the form of windows that can be opened and closed optimally so that air circulation is smooth, regulating the number of patient beds, and using fans or air conditioners that are cleaned regularly.

5 CONCLUSION AND RECOMMENDATION

Based on the results of the study, it was found that the physical quality of air in inpatient room G of Surabaya X Hospital which has not met the requirements (average temperature 30.5 ℃), and which has met the requirements (average humidity 59.2%, occupancy density 9.4 m^2 / TT). And the quality of air germs numbers there are 3 points that have a risk of danger of spreading disease or air pollution, namely in room G3 the first point, room G4 the first point and room G4 at the second point. Suggestions given to agencies are to carry out supervision and monitoring related to air quality in hospital inpatient rooms regularly and maintain air quality to meet the requirements of regulation the minister of health No.7 of 2019 by adding natural ventilation that can be opened and closed optimally, cleaning the room regularly with disinfectants, regulating the number of patients in the room, using fans that are cleaned regularly.

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