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## DESCRIPTIVE OF QUANTITATIVE DATA | SUPPLEMENTARY

# Air Quality Analysis in the Service Room Siti Fatimah Mother and Child RSKD, South Sulawesi Province

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**Abstract:** Water as an environmental component that is important in life needs to be maintained and enhanced. Indoor air quality is not only affected by chemical pollution but also by physical environmental factors such as temperature and humidity. Based on the data obtained in the area of the building in the Siti Fatimah Hospital of Mother and Child the building area of 1.808 m<sup>2</sup> consists of IRD is 15 x 19 m<sup>2</sup>, the delivery room is 11 x 27 m<sup>2</sup>, perinatology 10 x 15 m<sup>2</sup>, operating room is 14 x 21 m<sup>2</sup> the treatment room class I 7 x 11 m<sup>2</sup> and classrooms II 10 x 18 m<sup>2</sup>. The delivery room can be occupied by only eight patients and five officers and the IRD patient room max 4 people with five officers. But every room of the patients who were hospitalized brought a companion of more than two people, causing a buildup in the room caused the release of CO<sub>2</sub> over the limit of the maximum access door of the room service provided 3 but there is only one access door located in the delivery room that used the place out which led to the end uncontrolled. Methods: The purpose of this study is to analyze the quality of air in the room service (IRD, delivery room, operating room, and NICU) and treatment room (class 1 and class 2) at Siti Fatimah Hospital of Mother and Child. This type of research is observational research, whereas the research design used Cross Sectional methods by analyzing air quality through the presence of germs in the air by connecting the parameters of the physical environment (temperature, humidity, lighting, and dust in space), and the population density in the room service and the treatment room Hospital of Mother and Child Siti Fatimah South Sulawesi province. The analysis was performed with the chi-square test and correlation matrix Results: The results showed there is a lighting effect on the existence of germs with a p-value of 0.032 (P < 0.05) with value of correlation r = 0.410, which means the power to do a moderate but still there is a relationship. Suggestion: Preferably in-room service and care at the Hospital of Mother and Child Siti Fatimah no kitchen to prevent the increase of CO<sub>2</sub> before the bacteria thrive and are contaminated by the patient's health officials, and the public who were around the area of the hospital.

**Keywords:** Air Quality, Presence of Germs, Temperature, Lighting, Humidity, Residential Density.

## 1. INTRODUCTION

Air is an important component of respiration for the survival of humans and various other living things. The chemical, biological and physical composition of air. The air that surrounds the earth consists of about 78% nitrogen, 21% oxygen, 0.9% argon, 0.03% carbon dioxide, and small amounts of other gases such as neon, helium, and methane. According to the 1997 National Institute of Occupational Safety and Health (NIOSH) quoted by the Indonesian Ministry of Health 2005, the causes of indoor air quality problems are generally caused by several things, namely lack of air ventilation (52%), the presence of sources of contaminants from indoors (16%) (Setiawan, 2021), contaminants from outdoors (10%), microbes (5%), building materials (4%), and others (13%).

According to Kepmenkes Number 1204/MENKES/SK/X/2002 concerning hospital environmental health requirements that in a room that does not meet health requirements, the disease can be transmitted through equipment, materials used, food and drink, health workers, and visitors.



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To prevent disease transmission, the Minister of Health requires that the air in the treatment room must be free of pathogenic germs with a total germ count of no more than 500 colonies/m<sup>3</sup> of air. In Indonesia, the incidence of transmission in the type or type of hospital is very diverse. Research conducted by the Ministry of Health of the Republic of Indonesia in 2004 obtained data on the proportion of transmission of germs in government hospitals with a total of 1,527 patients out of a total of 160,417 at-risk patients (55.1%), while for private hospitals with a total of 991 patients out of a total of 130,047 (35.7%). For the ABRI hospital with a total of 254 patients out of a total of 1,672 patients at risk (9.1) (Hakiki et al., 2020); (Craig & Howard, 2014; Lyell et al., 2020). The building area of the Siti Fatimah Mother and Child Hospital is 1,808 m<sup>2</sup> consisting of an IRD is 15 x 19 m<sup>2</sup>, a delivery room is 11 x 27 m<sup>2</sup>, perinatology is 10 x 15 m<sup>2</sup>, an operating room is 14 x 21 m<sup>2</sup>, a class I treatment room 7 x 11 m<sup>2</sup> and class II room 10 x 18 m<sup>2</sup>. The delivery room can only accommodate 8 patients and 5 staff and the IRD room has a maximum of 4 patients and 5 staff. However, in each room, one patient who is inpatient brings more than two companions so that there is accumulation in the room causing CO<sub>2</sub> release to exceed the maximum limit obtained based on KEPMENKES Number 1204 of 2004 (Health Profile of RSKD Mother and Child Siti Fatimah, 2016).

## 2. MATERIALS AND METHODS

This type of research is observational, while the research design used the Cross-Sectional method by analyzing air quality through the presence of germs in the air by correlating physical environmental parameters (temperature, humidity, lighting, and dust in the room), and occupancy density in service and treatment rooms. The research was carried out from October 2020 – February 2021 in the service rooms (IRD, delivery room, operating room, and NICU) and treatment rooms (class 1 and class 2) at Siti Fatimah Women and Children Hospital. The sampling technique used is non-probability sampling. Sampling was carried out with assistance and consultation from the Center for Environmental Health Engineering and Disease Control (BTKLPP) Class I Makassar and the Microbiology Laboratory of the Teaching Hospital FK UNHAS according to the procedures according to the requirements of the Minister of Health of the Republic of Indonesia Number: 1335/MENKES/SK/X/2002 regarding operational standards for taking and measuring air quality samples in hospital rooms. The instruments used in this study were a thermometer to measure indoor temperature, a hygrometer to measure indoor humidity, a lux meter to measure lighting, a dust meter to measure dust, Nutrient Agar (NA) media to take airborne germ samples, data analysis consisted of Univariate and Bivariate.

## 3. RESEARCH RESULTS AND DISCUSSION

Based on table 1 shows that the results of measuring the number of germs in the air in the IRD, Delivery Room, NICU, Operating Room, Class I and Class II RSKD Siti Fatimah Mother and Child showed that the largest number of colonies was in the IRD room of 2049 CFU/m<sup>3</sup> and the smallest of the class II room 70 CFU/m<sup>3</sup>.

**Table 1: Distribution of Germ Numbers in the Air in Every Space At Siti Fatimah Mother and Child Hospital in 2021**

Room	Sample Point			
	Point I		Point II	
	Amount	Ket	Amount	Ket
IRD				
Morning (Before Cleaning)	1766	TMS	2049	TMS
Afternoon (After Cleaning)	424	TMS	212	TMS
Delivery room				
Morning (Before Cleaning)	565	TMS	1095	TMS



Room	Sample Point			
	Point I		Point II	
	Amount	Ket	Amount	Ket
Afternoon (After Cleaning)	247	TMS	530	TMS
Surgery room				
Morning (Before Cleaning)	70	TMS	106	TMS
Afternoon (After Cleaning)	282	TMS	282	TMS
Class I				
Morning (Before Cleaning)	565	TMS	282	Ms
Afternoon (After Cleaning)	424	Ms	600	TMS
Class II				
Morning (Before Cleaning)	530	TMS	282	Ms
Afternoon (After Cleaning)	176	Ms	70	Ms
NICU				
Morning (Before Cleaning)	141	Ms	106	Ms
Afternoon (After Cleaning)	176	Ms	106	Ms
Total	24 period			

Source: Primary Data, 2021

Note: Germicidal Number Unit (CFU/m<sup>3</sup>)

MS (Qualified): 10,200, 500 CFU/m<sup>3</sup>

TMS (Not Qualified): ≥10,200, 500 CFU/m<sup>3</sup>

Based on table 2, shows that the measurement results are based on the requirements of KEPMENKES RI No. 1204 of 2004

**Table 2: Distribution of Germ Numbers Based on Each Room At Siti Fatimah Mother and Child Hospital**

Parameter	Room												Total	
	IRD		Birthing room		NICU		OK		Class I		Class II			
	N	%	n	%	N	%	N	%	n	%	n	%	n	%
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of bacteria**	4	10	3	75	0	0	4	10	2	50	1	25	14	58
TMS (≥10 & 200 CFU/m <sup>3</sup> )	0		1	25	4	10	0	0	2	50	3	75	10	41
MS (10 & 200 CFU/m <sup>3</sup> )														
Total	4	10	4	10	4	10	4	10	4	10	4	10	24	10

Source: Primary Data, 2016

Note: TMS (Not Qualified)

MS (Qualified)

\*\* Based on KEPMENKES RI No. 1204 of 2004

Based on table 2, shows that the results of identification of germs are *Bacillus Sp* germs originating from the delivery room, then *Providencia Struatii* germs originating from the IRD, and Class I *Staphylococcus Aureus* germs originating from the IRD, Delivery Room, Class I, NICU, and Class II. *Staphylococcus Epidermidis* germs come from the Delivery Room, Operating Room, and Class II.

**Table 3: Distribution of Identification of Airborne Germs in Each Room At Siti Fatimah Mother and Child Hospital**

Room	Identification of Germs	
	Point I	Point II
1	2	3
IRD		



Room	Identification of Germs	
	Point I	Point II
Morning (Before Cleaning)	Staphylococcus aureus	Staphylococcus aureus
Afternoon (After Cleaning)	Providencia struatii	Providencia struatii
Delivery room		
Morning (Before Cleaning)	Bacillus sp	Staphylococcus epidermidis
Afternoon (After Cleaning)	Staphylococcus aureus	Staphylococcus aureus
Surgery room		
Morning (Before Cleaning)	Staphylococcus epidermidis	Staphylococcus epidermidis
Afternoon (After Cleaning)	Staphylococcus epidermidis	Staphylococcus epidermidis
Class I		
Morning (Before Cleaning)	Providencia struatii	Providencia struatii
Afternoon (After Cleaning)	Staphylococcus Aureus	Staphylococcus aureus
Class II		
Morning (Before Cleaning)	Staphylococcus epidermidis	Staphylococcus epidermidis
Afternoon (After Cleaning)	Staphylococcus aureus	Staphylococcus aureus
NICU		
Morning (Before Cleaning)	Staphylococcus aureus	Staphylococcus aureus
Afternoon (After Cleaning)	Staphylococcus aureus	Staphylococcus aureus

Source: Primary Data, 2021

**Table 4: Distribution of Germ Identification Based on Each Room At Siti Fatimah Mother and Child Hospital**

Room	Identification of Germs								Total	
	Bacillus Sp		Providencia Struatii		Staphylococcus aureus		Staphylococcus Epidermidis			
	N	%	N	%	n	%	n	%	N	%
1	2	3	4	5	6	7	8	9	10	11
IRD	0	0	2	50	2	50	0	0	4	10
Delivery room	1	25	0	0	2	50	1	25	4	10
Surgery room	0	0	0	0	0	0	4	10	4	10
Class I	0	0	2	50	2	50	0	0	4	10
Class II	0	0	0	0	2	50	2	50	4	10
NICU	0	0	0	0	4	10	0	0	4	10
Total	1	4.2 %	4	16.7 %	12	50.0 %	7	29.2 %	24	10

Source: Primary Data, 2021

(Salilih et al., 2020) Based on Table 4, it is known that temperature can affect the development of germs, there are 14 points (58.3%) that do not meet the requirements, namely the IRD has 4 points (100%), the delivery room is 2 points (50%), class I is as much 3 points (75%), and class II only 1 point (25%) which can affect the body's resistance to living germs. While the temperature that meets the requirements is 10 points (41.7%) which consists of several rooms, namely the delivery room, NICU, and operating room every 2 points (50.0%) then class II by 3 points (75%). Based on table 6, humidity can affect the growth of germs if the humidity is less than the specified conditions ( $\leq 45-60\%$ ). Humidity that does not meet the requirements has 16 points (66.7 %) consisting of the delivery room, IRD, and class II every 4 points (100%), in the operating room and class I get 2 points (50%), while who met the requirements a total of 8 points (33.3%) originating from the operating room and class I each had 2 points (50%) and the remaining NICU rooms were 4 points (100%).

Lighting in the room can affect the survival of germs (Park et al., 2023). Based on the specified maximum requirements, namely  $\leq 100$ -500 Lux from all rooms that do not meet the requirements, a total of 16 points (66.7%) consist of the IRD room, delivery room, operating room, and class II every 4 points (100 %), while those who fulfilled the total requirements obtained were 8 points (33.3%) which each came from the NICU and class I by 4 points (100%).

Dust if it exceeds the threshold of 0.15 mg/m<sup>3</sup> will affect the entry of germs from outside the room. There are 16 points (66.7%) that do not meet the requirements of the IRD room, delivery room, and operating room, 4 points (100%) are more from NICU and class II every 2 points (50%). Then those who fulfilled the requirements were 8 points (33.3 %) from the NICU and class II by 2 points (50%), and class I by 4 points (100%). Occupancy density is a factor for the free spread of germs from patients and staff who are in a room with a maximum limit ( $\geq 10$  m<sup>2</sup>/person) that does not meet the requirements for delivery rooms, IRD, NICU, and operating rooms with a total of 20 points (87.3%) each of which is 4 points (100%) while fulfilling the requirements are the operating room, Class I and class II every 4 points (100%).

**Table 5: Distribution of Physical Environment and Occupancy Density Based on Every Room in Siti Fatimah Mother and Child Hospital**

Parameter	Room												Total	
	IRD		Birthing room		NICU		OK		Class I		Class II			
	N	%	n	%	N	%	N	%	n	%	N	%	n	%
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Temperature** TMS (≥19-26 o C) MS (19-26 o C)	4	10	2	50	2	50	2	50	3	75	1	25	14	58
	0	0	2	50	2	50	2	50	1	25	3	75	10	41
Humidity** TMS (≤ 45-60 %) MS (45-60 %)	4	10	4	10	0	0	2	50	2	50	4	10	16	66
	0	0	0	0	4	10	2	50	2	50	0	0	8	33
Lighting** TMS (≤100-500 Lux) MS (100-500 Lux)	4	10	4	10	0	0	4	10	0	0	4	10	16	66
	0	0	0	0	4	10	0	0	4	10	0	0	8	33
Dust** TMS (≥ 0.15 µg/m 3) MS (≤ 0.15 µg/m 3)	4	10	4	10	2	50	4	10	0	0	2	50	16	66
	0	0	0	0	2	50	0	0	4	10	2	50	8	33
Occupancy Density** TMS (≤ 10 m 2) MS (≥ 10 m 2)	4	10	4	10	4	10	4	10	0	0	0	0	20	87
	0	0	0	0	0	0	0	0	4	10	4	10	4	18

Note: TMS (Not Qualified) Source: Primary Data, 2021

MS (Qualified)

\*\* Based on KEPMENKES RI No. 1204 of 2004

The results of data analysis using the chi-square test are in Table 5 (Liu et al., 2022) The results of the cross table between the presence of germs and the physical environment and occupancy density show that lighting and dust contribute significantly to the number of germs with (p-value = 0.032) which can be said to have a strong relationship strength

**Table 7: Distribution of Factors Associated Between the Presence of Germs and the Physical Environment & Occupational Density at Siti Fatimah Mother and Child Hospital in 2021**

Parameter	Number of bacteria**				Total		P-value
	TMS** (≥10 & 200 CFU/m 3 )		MS** (10 & 200 CFU/m 3 )				
	N	%	N	%	n	%	
Temperature** TMS (≥19-26 o C) MS (19-26 o C)	10	71.4 %	4	28.6 %	14	100 %	0.211
	4	40.0 %	6	60.0 %	10	100 %	
Humidity** TMS (≤ 45-60 %) MS (45-60 %)	11	68.8 %	5	31.2 %	16	100 %	0.204
	3	37.5 %	5	62.5 %	8	100 %	
Lighting** TMS (≤100-500 Lux) MS (100-500 Lux)	12	75.0 %	4	25.0 %	16	100 %	0.032
	2	25.0 %	6	75.0 %	8	100 %	
Dust** TMS (≥ 0.15 µg/m 3 ) MS (≤ 0.15 µg/m 3 )	12	75.0 %	4	25.0 %	16	100 %	0.032
	2	25.0 %	6	75.0 %	8	100 %	
Occupancy Density** TMS (≤ 10 m 2 ) MS (≥ 10 m 2 )	12	60.0 %	8	40.0 %	20	100 %	1,000
	2	50.0 %	2	50.0 %	4	100 %	

Note: TMS (Not Qualified) Source: Primary Data, 2021  
 MS (Qualified)

\*\* Based on KEPMENKES RI No. 1204 of 2004

Meanwhile, data analysis using the correlation matrix statistical test in Table 7 shows according to (Chiatti et al., 2023) that only lighting which contributes directly to the germ rate has a moderate linear correlation with 0.410, and is signed with the germ rate (p-value = 0.046). Then, occupancy density is almost significantly related to the number of germs (p-value = 0.109) with a low linear correlation value of 0.336.

#### 1. Analysis of the relationship between the number of airborne germs and space in Siti Fatimah Women and Children Hospital

Based on the results of examining the total number of germs at Siti Fatimah Mother and Child Hospital using Nutrient Agar (NA) media, Based on table 5.3 shows the room with the largest number of colonies in the IRD room of 2049 CFU/m<sup>3</sup> and the smallest in the class treatment room II 70 CFU/m<sup>3</sup>.

#### 2. Analysis of identification of airborne germs with service and treatment rooms at Siti Fatimah Women's and Children's Hospital

From the identification results in table 5.5 and table 5.6, there are colonies of germs using Nutrient Agar (NA) media, namely Bacillus Sp bacteria as much as 1 point (4.2%) in the Delivery Room, then Providencia Struatii bacteria as many as 4 points (16.7%) in IRD 2 points (50.0%) and Class I 2 points (50.0%). Staphylococcus Aureus germs 12 points ( 50.0 %) in IRD 2 points (50.0%), Delivery Room 2 points (50.0%), Class I 2 points (50.0%), NICU 4 points (100% ), and Class II 2 points (50.0%). Staphylococcus Epidermidis germs were 7 points (29.2%) in the Delivery Room 1 point (25.0%), Operating Room 4 points (100%), and Class II 2 points (50.0%).



### 3. Analysis of the relationship between the physical environment and the presence of germs

The relationship between the presence of germs and temperature using the chi-square test statistic (table 5.9)  $p\text{-value} = 0.211 > \alpha = 0.05$ , then  $H_a$  is rejected and  $H_o$  is accepted, meaning that there is no relationship between temperature and the presence of germs in the service and care rooms at the RSKD Mother and Siti Fatimah's child with (table 5.10) a correlation value of  $r = 0.002$ , which means that the strength of the relationship is very weak.

### 4. Analysis of the relationship between occupancy density and the presence of germs

Based on the results of observations on the relationship between the presence of germs and occupancy density using the chi-square test statistical test (table 5.9) the value of  $p = 1.000 > \alpha = 0.05$ , then  $H_a$  is rejected and  $H_o$  is accepted, meaning that there is no relationship between occupancy density and the presence of germs in the room Siti Fatimah Mother and Child Hospital services and care with (table 5.10) a correlation of  $r = 0.336$ , which means that the strength of the relationship is low or there is no relationship.

## 4. CONCLUSION

Based on the results of the research and discussion in the previous chapter, the following conclusions can be drawn: (1) There is an effect of lighting in the presence of germs, value  $p = 0.032 > \alpha = 0.05$  with a correlation value of  $r = 0.410$ , which means that the strength of the relationship is moderate but there is still a relationship. (2) There is a relationship between dust and the presence of germs,  $p = 0.032 > \alpha = 0.05$ , so  $H_a$  is accepted and  $H_o$  is rejected, but the correlation value is  $r = 0.247$ , which means that the strength of the relationship is low.

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