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THE VALUE OF AIR GERM NUMBERS AT SOEKARNO HATTA AIRPORT IN 2021

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Abstract

Introduction: *Indoor air quality greatly affects human health, because almost 90% of human life is indoors. This study aims to analyze the number of airborne germs at Soekarno Hatta Airport in 2021.* ***Methods:*** *The research design was cross-sectional study. The number of measurements of airborne germ numbers was carried out in 29 locations with 136 sample points, and mapping was carried out at 20 locations with 78 sample points. Data collection was using secondary data from Port Health Office of Class I Soekarno Hatta. The analysis used is univariate analysis, presented in the form of a frequency distribution table and mapping with ArcGIS and AutoCad.* ***Results and Discussion:*** *The study showed that most of the airborne germ numbers matched the quality standard, but there were 14 sample points (10.3%) that exceeded the quality standard. High-risk locations with red zones are located at Domestic Terminal 3 and Port Health Office of Class I Soekarno Hatta. Low-risk locations with green zones are in International Terminal 3 and Terminal 2.* ***Conclusion:*** *Therefore, all building, bus, and airline managers need to improve implementation disinfection, cleaning of the entire area, periodic maintenance of air conditioner and replacement of Hepafilter. Measurement of air germ numbers is needed as a routine activity of Port Health Office of Class I Soekarno Hatta to evaluate and monitor air quality.*

INTRODUCTION

Indoor air quality greatly affects human health, because almost 90% of human life is indoor. In America, the issue of indoor air pollution was raised when the EPA in 1989 announced that indoor air pollution studies were heavier than outdoor (1). According to the National Institute Of Occupational Safety and Health (NIOSH), the causes of indoor air quality problems are generally caused by several things, namely the lack of air ventilation (52%), the presence of sources of contaminants from outside (10%), microbes (5%), building materials (4%), and others (3%) (2).

The number of microorganism colonies in the air depends on the activity in the room (3). Microorganisms can be in the air in various ways, especially from flying dust (4). Extreme humidity and temperature can be a medium for bacterial and fungal growth (5). Microorganisms that are spread in the room are known as bioaerosols. Diseases related to bioaerosols can be in the form of infectious diseases such as flu, hypersensitivity: asthma, allergies, and also toxicoses (1).

The number of germs in the air is the samples of the number of germs in the air from a certain room or place being examined (6). The incoming air is pounded on the surface of the agar media in a petri dish (7). The bacteria live on the media which is marked by the presence of a colony (8). A bacterial colony is a collection of similar bacteria (9). Efforts are made to reduce the number of germs in indoor air, which can be done physically (ultraviolet light, filters), chemically (disinfectants), and using ions (plasmacluster ions, ozone) (10). The higher the lighting value in the room, the lower the number of airborne bacterial colonies in the room (11).

The airport is the entrance to an area and is a link between one region and another (12). One aspect of health concern is at the entrance to the country (13). Research shows the number of microorganisms in the air in the waiting room of the bus terminal, the results

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obtained are 860 CFU/m^3 (14). The quality standard for germ numbers based on Minister of Health Regulation No. 48 of 2016 is 700 CFU/m^3 (15).

Research noted bacterial species that can grow in the air and on cabin surfaces onboard various aircraft (16). Several species of airborne bacteria most were Gram-positive bacteria. Research reported a significant diversity of airborne *Staphylococcus*. Important of monitoring indoor air quality in the cabin environment as a preventive measure against the spread of clinically significant airborne pathogens (17).

Mapping and analysis of environmental conditions is needed to describe the existing environmental factors and have risks (18). Geographic Information System Application Capabilities are measurement, mapping, monitoring (19). Air pollution sources based on spatial distribution are points, lines and areas (20). The airport is used as a place for aircraft to land and take off, boarding passengers, loading and unloading goods, and a place for intra and intermodal transportation (21).

Soekarno Hatta International Airport is the largest airport in Indonesia serving domestic and international flights, which are still operating international flights during the pandemic. The implementation of the 2005 International Health Regulation was carried out by the Port Health Office of Class I Soekarno Hatta through monitoring activities for transportation means, people, goods, and the environment. The measurement number of airborne germs was carried out for the first time on 20-24 September 2021 by the Port Health Office of Class I Soekarno Hatta with Center for Environmental Health and Disease Control Engineering Jakarta, to determine environmental health risk factors. Analysis of data on mapping environmental risk factors for air germ numbers has yet been carried out. This study aims to analyze the number of airborne germs at Soekarno Hatta Airport in 2021.

METHODS

This research is a analyze study with a research design using a Cross-Sectional Study. The research was from September 2021 to February 2022 at Soekarno Hatta Airport, Tangerang City, Banten. Data collection uses secondary data from the measurement of airborne germ numbers in 2021 from the Port Health Office of Class I Soekarno Hatta by measuring the document review of the measurement results. The measurements of airborne germ numbers in this study was 29 locations with 136 sample points and mapping of airborne germ numbers was carried out at 20 locations with 78 sample points. The analysis used in this study is the univariate analysis presented in the form of a frequency distribution table and mapping. The results of the measurements using the Microbiological Air Sampler MAS-100 NT were analyzed descriptively and presented in the form of a frequency distribution table with categories according to quality standards (≤700 CFU/m^3) and exceeding quality standards (>700 CFU/m^3). The mapping was analyzed using ArcGIS software to display the mapping of location coordinates and AutoCad software to display a more specific location mapping using building layouts. In the mapping, the color classification of the location is carried out to determine the environmental risk factors for the number of airborne germs, the red color for the high-risk location is found to exceed the quality standard, and the green color for the low-risk location is found to be under the quality standard at the sampling location. This research has passed the research ethics review with the number 0922-02.058 /DPKE-KEP/FINAL-EA/UEU/II/2022.

RESULTS

Based on table 1, the description of air germ numbers at Soekarno Hatta Airport, it can be seen that from a total of 136 sample points, most of them matched the quality standards, but there are air germ numbers that exceed the quality standards as many as 14 sample points (10.3%). Locations that have sample points exceeding the standard are Domestic Terminal 3 with 10 sample points (100%), Port Health Office of Class I Soekarno Hatta with 1 sample point (2.7%), Bus with 2 sample points (9.5%), and Aircraft as much as 1 sample point (2.9%).

Table 1. Description of the Air Germ Numbers at Soekarno Hatta Airport in 2021

Location	Categories				Quantity	
	Exceeding The Quality Standard		According to a Quality Standard			
	n	%	n	%	n	%
International Terminal 3	0	0	30	100	30	100
Domestic Terminal 3	10	100	0	0	10	100
Terminal 2	0	0	4	100	4	100
Port Health Office of Class I Soekarno Hatta	1	2.7	36	97.3	37	100
Bus	2	9.5	19	90.5	21	100
Aircraft	1	2.9	33	97.1	34	100
Total	**14**	**10.3**	**122**	**89.7**	**136**	**100**

Based on Figure 1, the mapping of airborne germ numbers at Soekarno Hatta Airport can be seen from 20 measurement locations with 78 sample points found 4 high-risk locations with red zones. The locations are the Port Health Office Class I Soekarno Hatta Clinic Domestic Terminal 3, the female room Domestic

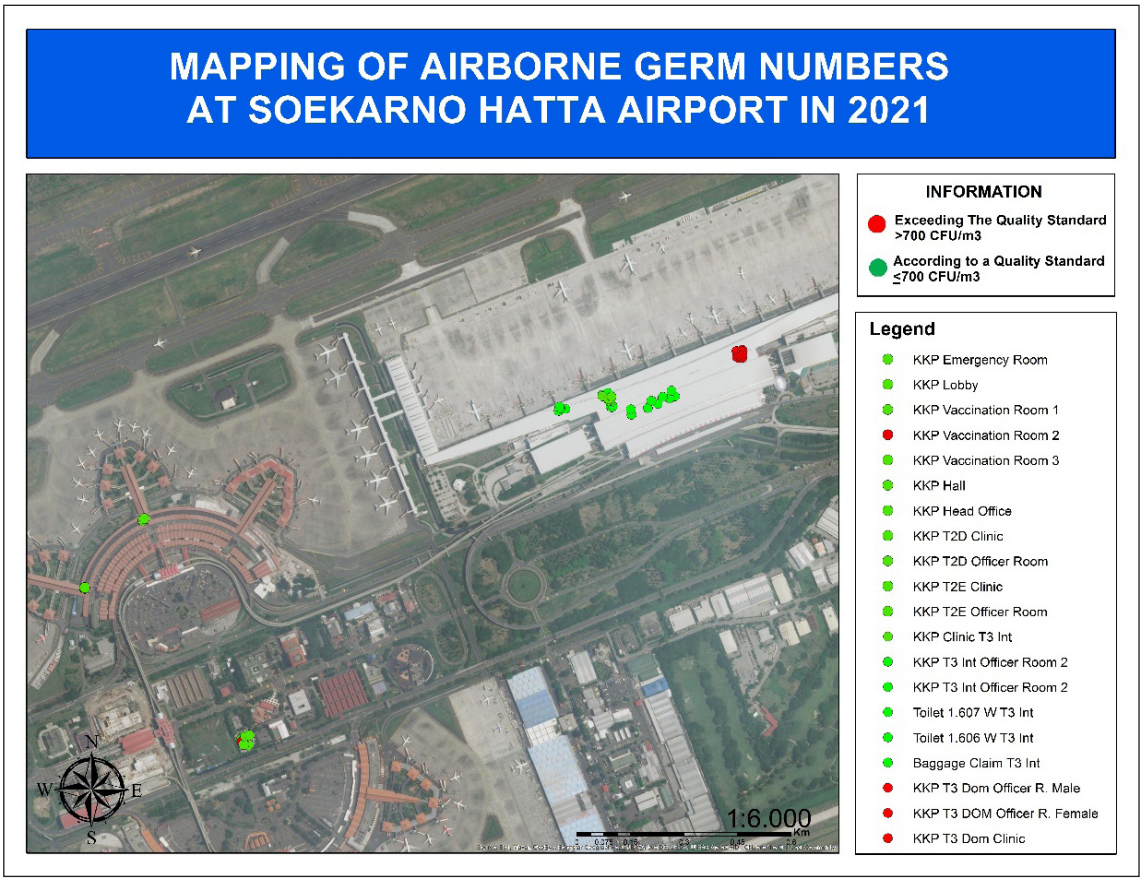

Figure 1. Mapping of the Air Germ Numbers at Soekarno Hatta Airport Based on the Location of the Measurement Points

Terminal 3, the male room Domestic Terminal 3 room, and the vaccination room 2 Port Health Office of Class I Soekarno Hatta.

Based on Figure 2 overview of Mapping the Air Germ Numbers of Terminal 3 International and Domestic Soekarno Hatta Airport can be seen that at Terminal 3 International, all locations are low risk with green zones. At Domestic Terminal 3 the overall high-risk location with a red zone.

Based on Figure 3, it can be seen that in Terminal 2, the overall low-risk location with a green zone is shown in Figure 3.

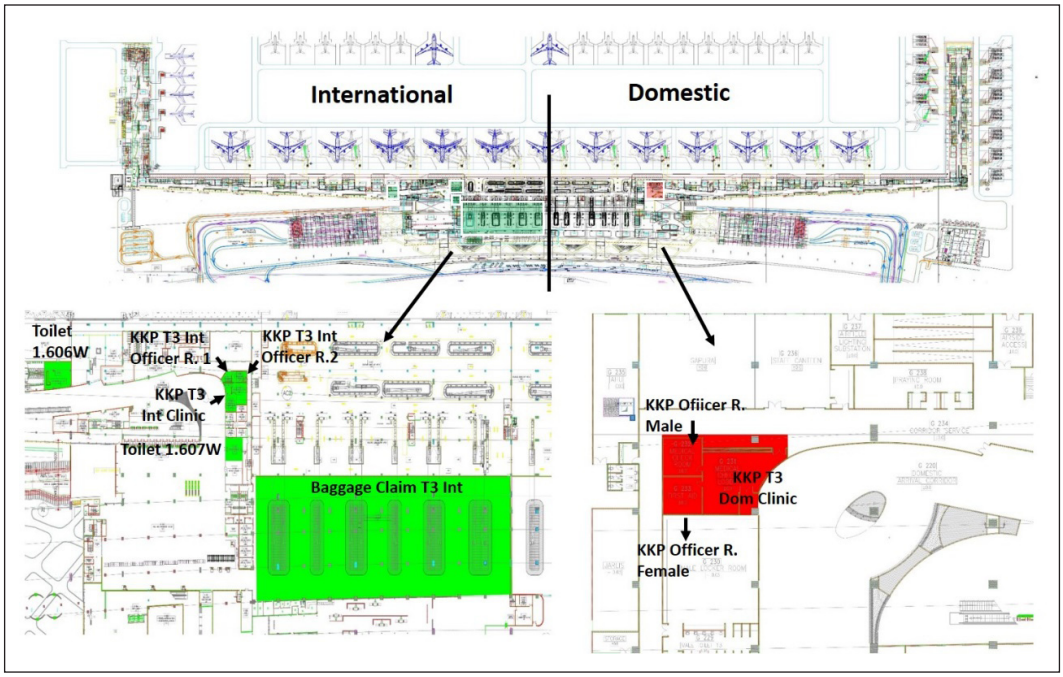

Figure 2. Mapping of the Air Germ Numbers at Terminal 3 International and Domestic Soekarno Hatta Airport

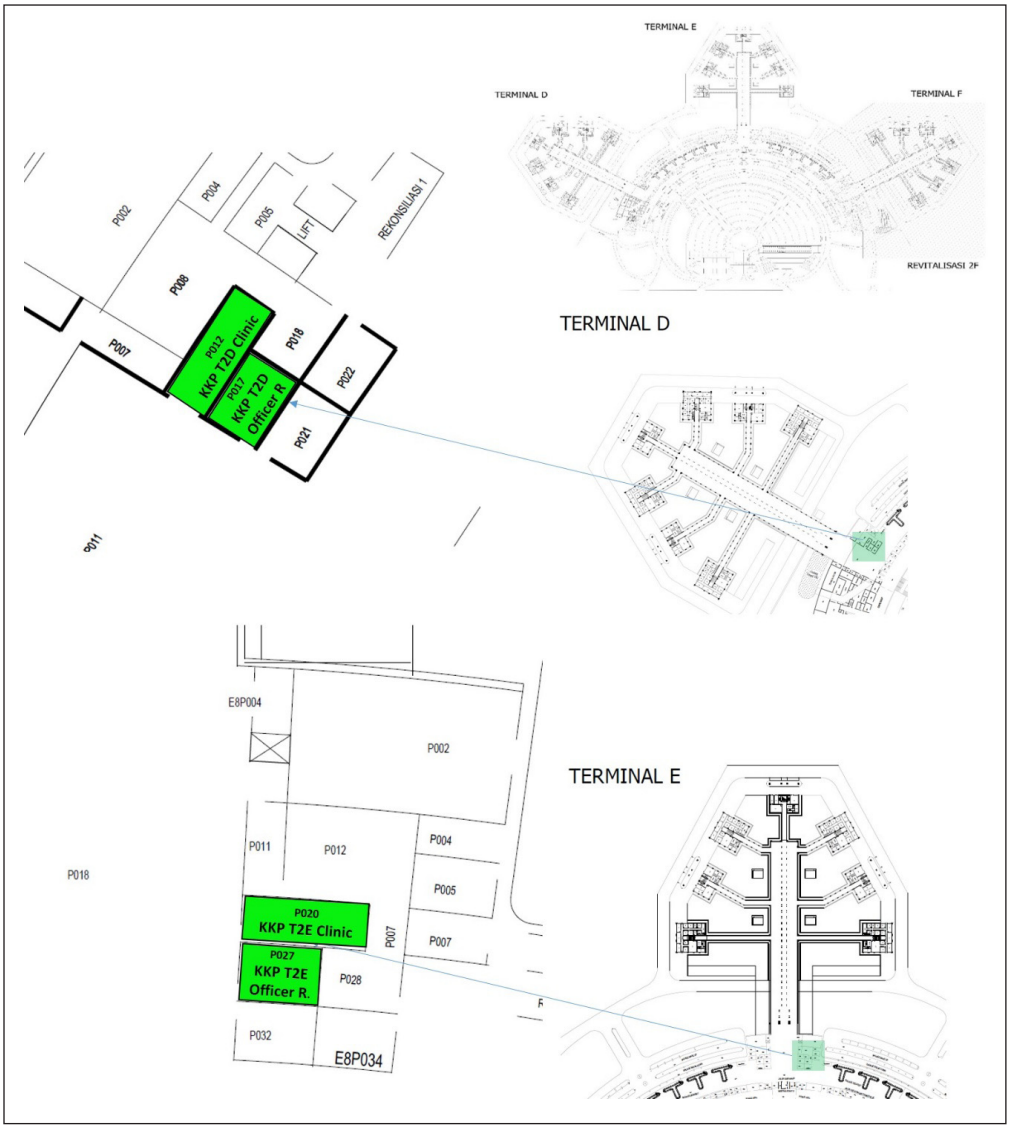

Figure 3. Mapping of the Air Germ Numbers at Terminal 2D and 2E Soekarno Hatta Airport

Based on Figure 4 Overview of Mapping the Air Germ Numbers of Port Health Office of Class I Soekarno Hatta from 7 measurement locations at Port Health Office of Class I Soekarno Hatta, there is 1 high-risk location with a red zone. The location is vaccination room 2 on the 1st floor.

DISCUSSION

The results of this study indicate that the number of airborne germs at Soekarno Hatta Airport from a total of 136 sample points, mostly according to quality standards, but there are numbers of airborne germs that exceed the quality standard as many as 14 sample points (10.3%). This is in line with research conducted at the X Jakarta office which stated that 30% of the germ numbers from 10 measurement points did not meet the standard maximum limit of 700 CFU/m^3 (22). The results of research in elementary schools the average number of airborne germs in classrooms is 1685.33 CFU/m^3 (23).

The number of germs in the air is the number of samples of the number of germs in the air from a certain room or place being examined so that the count of germ numbers aims to determine the number of bacteria in the sample based on that each living bacterial cell in suspension will grow into a colony after being incubated in culture media, and suitable environment. The principle of this examination is to count the number of colonies that grow on Plate Count Agar (6).

According to the Regulation of the Minister of Health of the Republic of Indonesia Number 48 of 2016, which states that to obtain a level of health and comfort in the room, the maximum number of germs is 700 CFU/m^3 of air and free of pathogenic microorganisms in the entire room (15). According to Regulation No. 5 of 2018 of the Ministry of Manpower of the Republic of Indonesia, the criterion for biological factors is a maximum limit of 700 CFU/m^3 and no pathogenic microorganisms (24). Air quality that does not meet biological requirements due to risk factors can have a health impact and efforts need to be made to improve health (25).

Figure 4. Mapping of the Air Germ Numbers of Port Health Office of Class I Soekarno Hatta

The impact of air germ numbers above the quality standard is that it becomes a disease related to bioaerosols in the form of infectious diseases such as flu, hypersensitivity (asthma, allergies), and also toxicosis, namely toxins in the air in contaminated rooms as the cause of Sick Building Syndrome (SBS) symptoms. Several forms of disease associated with SBS are irritation of the eyes and nose, dry skin and mucus layer, mental fatigue, headaches, Acute Respiratory Infections (ARI), coughing, sneezing, and hypersensitivity reactions. Physical symptoms commonly encountered due to biological contaminants are cough, chest tightness, fever, chills, muscle aches, and allergic reactions such as irritation of mucous membranes and upper respiratory tract congestion. One of the indoor air contaminants, *Legionella sp*., causes Legionnaire's disease (25).

Soekarno Hatta Airport has implemented an environmental disinfection program to suppress Covid19 with a disinfectant capable of killing pathogenic germs on environmental surfaces and in the air. Disinfection was carried out by the Port Health Office of Class I Soekarno Hatta when environmental risk factors were found at Soekarno Hatta Airport, both in terminal buildings and on planes and buses, by using a "pasticlean disinfectant" for the environment and a "noviruclean disinfectant" for aircraft disinfection. The implementation of disinfection was increased during the Covid19 pandemic. The implementation is carried

out every day by each management party at Soekarno Airport, both from Angkasa Pura II, the Port Health Office of Class I Soekarno Hatta, Bus Management, and Airline Parties. The airline will disinfect the aircraft every time it departs for the destination airport. The disinfectant used is adapted to the aircraft cabin material. Aircraft disinfection is reported to the Port Health Office of Class I Soekarno Hatta.

All locations use air conditioner as ventilation so that air exchange occurs in a closed room. The airline has also equipped the aircraft with a hepafilter that works as an air filter to produce clean air in the aircraft cabin. In all locations of Soekarno Hatta Airport, both in terminal buildings and in planes and buses, cleaning has been carried out in the vicinity of the Port Health Office of Class I Soekarno Hatta to produce a safe and healthy environment as an effort to prevent the entry and exit of disease at the entrance to the country.

Domestic Terminal 3, with 3 measurement locations and 10 sample points, has a proportion of 100% exceeding the quality standard for air germ numbers. From the results of the study, it can be seen that the three locations are closed rooms that use air conditioning as ventilation. Based on interviews conducted with officers at locations where air conditioner maintenance schedules are not routinely carried out, air conditioner maintenance is carried out on request. If the condition of the air conditioner is not good and does not feel cold, the officer at the location reports to the air conditioner maintenance section to check. air conditioner as ventilation is needed so that the air in the room remains healthy and comfortable. Based on observations during the measurement of airborne germ numbers in these three locations, the condition of the air conditioner as a ventilation function did not run optimally when the air conditioner was not cold. The air conditioner emits dirt, so modifications are made to the air conditioner by closing it using paper that has been given small holes. If the ventilation in the room does not meet the standards, the air quality will be unhealthy and the temperature in the room will rise. This has an impact on the number of microbes because the optimum temperature for microbial growth is 25°C–37°C. The higher the air temperature in the room, the higher the number of airborne germs in the room. The air conditioner filter must be cleaned periodically according to the manufacturer's provisions because the air conditioner filter is a place for dust to accumulate from the filtered air and is a breeding ground for bacteria. This can happen because the dirty air conditioner filter comes from the room and will be recirculated into the room.

Port Health Office Class I Soekarno Hatta Clinic Domestic Terminal 3 as a health service facility always has activities. Indoor activities affect the number of airborne germs because visitors who always come to change with activities can bring dust particles that contain pathogenic germs and increase the concentration of substances in the air. Many pathogenic germs are spread in the air through dust particles, but this location does not have a hepafilter as an air filter. This location found the ceiling (ceiling) that was perforated and dirty. Ceilings that do not meet building sanitation requirements can increase the number of airborne germs. The condition of the perforated ceiling is a source of indoor air quality pollution as a result of air and dust from outside the ceiling entering the room. Dirty ceilings as a place for pathogenic germs. At this location, the room has never been sterilized by general cleaning and installing tools that can kill pathogens.

At this location, environmental sanitation measures must be carried out by sterilizing room air using tools that can kill pathogens, cleaning the entire room, maintenance and cleaning air conditioners so that the air filtration/filtering process is effective. Health measures must be taken immediately because this location is a health service where there can be spread of infection from sick people to sick people and sick people to healthy people through airborne transmission.

Vaccination room 2 Port Health Office of Class I Soekarno with 2 measurement sample points has a proportion of 50% exceeding the quality standard for air germ numbers. Vaccination room 2 is closed and always has a denser activity than other rooms. In this room, injections of the Covid19 vaccine, yellow fever vaccine, meningitis vaccine, and verification of health documents are carried out. Visitors who always come to change with dense human activities can carry dust particles that contain pathogenic germs and increase the concentration of substances in the air. Vaccination room 2 uses air conditioner as ventilation.

Port Health Office of Class I Soekarno has a routine disinfection program every day for all rooms with a frequency of once a day. Disinfection is carried out by employees of the Environmental Risk Control Substance. Environmental Risk Control Substance employees consist of sanitarians and entomologists, all of whom have disinfection expertise. Disinfection is carried out on all parts of the room such as walls, ceilings, tables, doorknobs, etc. In vaccination room 2, it is recommended to arrange the distribution of activities in each vaccination room so that there are not too many visitors in the vaccination room 2.

Bus Terminal 3, from 3 sample points has a proportion of 66.7% exceeding the quality standard. This bus is a bus with busy activities carrying passengers who are always changing and can carry dust particles that contain pathogenic germs. This bus needs air conditioner maintenance and uses air conditioner equipped with a hepafilter to support bus activities. Air conditioning equipped with a hepafilter can help filter the air healthier by filtering dust and killing pathogens. The aircraft with a proportion of 1 sample point (17%) exceeded the quality standard. The plane has been equipped with a hepafilter and has carried out disinfection of the aircraft, but it was not enough to produce healthy air. Therefore, it is necessary to take environmental sanitation measures by cleaning the entire area, maintaining air conditioning, replacing hepafilters, and increasing the implementation of aircraft disinfection to balance activities in the aircraft cabin.

The results of this study indicate that the mapping of airborne germ numbers at Soekarno Hatta Airport, which exceeds the quality standard of 20 locations, found 4 high-risk red zone locations with sample points. The locations are the Port Health Office Class I Soekarno Hatta Clinic Domestic Terminal 3, the female room Domestic Terminal 3, the male room Domestic Terminal 3, and the vaccination room 2 Port Health Office Class I Soekarno Hatta.

Location and environmental conditions affect the number of germs. The three locations for measuring the number of airborne germs that exceed the quality standard in domestic terminal 3 are located near the source of air pollution because the location is closer to the outside of the terminal building and is near the loading dock, canteen, and apron. Air from outside can enter through the cracks and doors of the Port Health Office Class I Soekarno Hatta Clinic Domestic Terminal 3 when it is opened. At this location, a hole in the ceiling was also found as a source of air pollutants from outside the ceiling entering the room. This is included in the building sanitation assessment. Unhealthy sanitation affects the number of airborne germs in a room. Poor room sanitation, poor circulation, and unqualified building construction are factors that increase the number of germs in the air.

Vaccination room 2 Port Health Office of Class I Soekarno Hatta is located on the 1st floor, which is often passed by many people. Activity in this room is also very crowded. The door in this room is always open so that air pollution from outside can occur, causing the air conditioner to not run optimally. This can cause the number of airborne germs in this room to exceed the quality standard and enter a high-risk location with a red zone.

All locations do not yet have a hepafilter. A hepafilter is needed as an air filter that can support crowded room activities to maintain healthy air quality. In high-risk locations with red zones, it is necessary to install a portable hepafilter to support crowded activities, room conditions, and the location of locations close to pollutant sources. With the hepafilter, it can filter the air and kill pathogens to produce clean air. Portable hepafilters can be moved so they are easy to use alternately in other rooms and are more flexible, so they don't interfere with the arrangement of the existing space.

CONCLUSION

It can be seen that out of a total of 136 sample points, most of them are under the quality standard, but there are 14 sample points (10.3%) that exceed the quality standard, namely in Terminal 3 Domestic and the Port Health Office of Class I Soekarno Hatta. An overview of the mapping shows the number of airborne germs in high-risk locations. The red zones are found in Domestic Terminal 3 and the Port Health Office of Class I Soekarno Hatta. To all building managers, buses, and airlines: improve the implementation of disinfection, clean all areas, maintain air conditioners regularly, and replace hepafilters. To the management who gets the results of measuring the number of germs that exceeds the quality standard, they should take environmental health measures with room sterilization activities. In high-risk locations with red zones, it is necessary to install a portable hepafilter as an air filter and kill pathogens to produce clean air. Measurement of air germ numbers is an ongoing routine activity of the Port Health Office of Class I Soekarno Hatta to evaluate indoor air quality and monitor air quality.

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