ORIGINAL ARTICLE

Journal of Clinical Microbiology and Infectious Diseases (*JCMID*) 2022, Volume 2, Number 1: 16-18
E-ISSN: 2808-9405

Published By : the Indonesian Society for Clinical Microbiology

# The circulation of sars-cov-2 virus inward environment of covid-19 intensive care unit, Dr. Soetomo Hospital Surabaya

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Received: 2022-03-25
Accepted: 2022-05-30
Published: 2022-06-10

## ABSTRACT

**Introduction:** The big problem to overcome COVID-19 transmission is to suppress the viral particle circulation in the air and environment. A severe case of COVID-19 is commonly managed in a negative pressure ICU ward. Covid-ICU room in Dr. Soetomo hospital is a negative pressurized room comprising 5 rooms with an occupancy of 2 beds per room. Meanwhile, the patient's environment is still possibly contaminated by the virus due to airborne transmission of the virus having tiny particles so the virus can easily spread through the patient's environment. Thus, the purpose of this study is to evaluate the presentation of the SARS-CoV-2 virus, that was contaminating the room air, floor, and other surfaces inside the Covid-ICU.
**Method:** The study was a cross-sectional descriptive study. The biological sample that analyzes was air. The air samples were taken from all areas including ante-room, patient room, gallery, clothing room, nurse station, and ICU area outside the room using an air sampler (As82 PURIVA H1) with a capacity of 200 $m^2$/hour. The virus filter was put in the port of air entry, after air suction for 2 hours, it was immersed in VTM and continued for rtRT-PCR (real-time Reverse Transcriptase PCR) examination. Surfaces samples were taken by swabbing on the floor, bed cover, door handle, medical equipment, wall, and other equipment. They were swabbed for 5 specimens per location. After data was collected, it analyzes descriptively by using SPSS ver.25
**Results:** A total of 39 air samples were collected and examined with an RT-PCR machine, 5 (12.8%) positive namely 2 samples from the gallery and 3 from one room, whereas from 30 surfaces, 1 (3.3%) positive, from a sample of the bed cover.
**Conclusion:** The SARS-CoV-2 virus is identified in the air and surface of Covid-ICU wards, indicating the risk for Covid-19 transmission. It is important for Infection Prevention and Control (IPC) policy implementation in a clinical setting.

**Keywords:** Covid-19, ICU, SARS-CoV-2, environmental contamination.
**Cite This Article:** Koendhori, E.B., Alimsardjono, L., Oktaviani, S.R.S., Widya,A.M., Kusumaningrum, D., Narita, Kurniati, N.D., Endraputra, P.N., Kuntaman, K. 2022. The circulation of sars-cov-2 virus inward environment of covid-19 intensive care unit, Dr. Soetomo Hospital Surabaya. *Journal of Clinical Microbiology and Infectious Diseases* 2(1): 16-18.

## INTRODUCTION

The first case of covid-19 was reported in Wuhan, China in December 2019 and spread worldwide at the end of 2020.[1] In Dr. Soetomo Hospital Surabaya, the first case was on March 14, 2020, and successfully recovered. This disease was caused by SARS-CoV-2 and the announced pandemic by WHO in March 2020 resulted in great mortality and morbidity.[1,2] Around 2 million people lost their lives due to COVID-19 in 2020, and the prevalence was still high until 2021.[3]

Virus particles may spread through respiratory secretion and contaminate the surface where preventions are not applied. In situations where ventilation is inappropriate, aerosolized virus particles may persist in the air for hours, land on the surface nearly 10 meters in distance, and survive up to 9 days.[1,4] Around 5-20% of patients were hospitalized with COVID-19 necessary to have ICU, and many of these patients require mechanical ventilation. A study established that ventilator-associated event (VAE) rates per 100 episodes of mechanical ventilation and 1,000 ventilator-days were higher among COVID-19–positive patients than among COVID-19–negative patients.[5] Around 40% of ICU patients were found to contaminate their environment. No particular trend emerged regarding the type of surface contaminated. It was known that the modality of oxygen support was not associated with the risk of environmental contamination.[6] Several established data indicate the enhancement of the risk of transmission within hospitals outbreaks have occurred in many medical institutions.[7] Such circumstances may potentially expose healthcare workers (HCWs) to the risk of covid-19 infection. Therefore, this study aimed to evaluate SARS-CoV-2 contamination in the air and environmental surface within a room where patients with covid-19 were hospitalized.

## METHODS:

### Sample and study design

The study was a cross-sectional descriptive study. The data was collected from 2020 until 2021. This study used consecutive sampling. The inclusion criteria of this study were the patient has been diagnosed with COVID-19 infection that confirms by PCR test. The exclusion criteria in this study were specimens less than 8 hours if there was any cleaning process.

### Specimen preparation

The biological sample that analyzes was air. Air samples were collected from the main room, anteroom, room for clothing, the lobby/gallery outside the room, and open-air area using an air sampler (As82 PURIVA H1) with a capacity of 200 $m^2$/hour. A virus filter was put in the port of air entry. After 2 hours of air collection, the filter was immersed in VTM. The samples of the surface were performed on the floor, wall, door handle, bedsheets, and other equipment surfaces. A premoistened swab was wiped on a 10x10 $cm^2$ area of surface and immersed into VTM. They were swabbed for 5 specimens per location. All specimens were carried out for nucleic acid detection using rt RT-PCR (Roche, Cobas Z-480) and Liferiver Kit for detection of Orf1ab, N, and E genes.

### Statistical analysis

After data was collected, it was pooled and coded in SPSS. It analyzes descriptively by using SPSS ver.25. The data was performed in the table.

## RESULT

Covid-ICU has 4 rooms with a capacity of 2 patients, 1 room for only one patient, and a transition room for 3 patients, all rooms equipped with ventilator machines. In total location tests from 39 samples, only 12,8% were contaminated by the COVID-19 virus. According to our analysis, the most common location contaminated by the virus was the transitional room (60%), after that followed by the gallery in the caring area (22,2%). We neither find positive COVID-19 contamination in the anteroom, caring area, room for clothing, and nurse station nor in the open-air area (Table 1). Meanwhile, the surface site sample only performed a positive result in bedsheets (20%) (Table 2)

**Table 1. Sampling site and number of positive air sample**

| Location* | Total Sample | Swab Results | | | |
|---|---|---|---|---|---|
| | | Positive | | Negative | |
| | n(39) | n | % | n | % |
| Anteroom | 5 | 0 | 0 | 5 | 100 |
| Caring area | 5 | 0 | 0 | 5 | 100 |
| Gallery in caring area | 9 | 2 | 22,2 | 7 | 77,8 |
| Room for clothing | 5 | 0 | 0 | 5 | 100 |
| Nurse station | 5 | 0 | 0 | 5 | 100 |
| Open-air area | 5 | 0 | 0 | 5 | 100 |
| Transitional room | 5 | 3 | 60 | 2 | 40 |

*Transition room, temporary observation room before transferred to ICU, but now a regular ward with ventilator machine; Gallery space is wider, 2-3x room space, without special exhaust system; Open area, the area outside the Covid-ICU.

**Table 2. The surface site and number of positive samples**

| Location | Total Sample | Swab Results | | | |
|---|---|---|---|---|---|
| | | Positive | | Negative | |
| | N(30) | n | % | n | % |
| Floor | 5 | 0 | 0 | 5 | 100 |
| Bedsheet | 5 | 1 | 20 | 4 | 80 |
| Doorhandle | 5 | 0 | 0 | 5 | 100 |
| Medical equipment | 5 | 0 | 0 | 5 | 100 |
| Wall | 5 | 0 | 0 | 5 | 100 |
| Room utensils | 5 | 0 | 0 | 5 | 100 |

## DISCUSSION

Corona virus-19 was an airborne disease. Its transmission was mediated by tiny particles. This particle can persist in the air for up to 3 hours. After that, the particle will fall and stick to other objects in the environment.[8] Therefore, routine cleaning is needed to minimalize the transmission from contaminated environment to the patient, and many others. We demonstrated minimal contamination within the air and environmental surface around covid-ICU as shown in Table 1 and Table 2. In China, one sample was found to be positive from the air in ICU.[9] While in Moscow, 5/6 samples were positive for SARS-CoV-2 in ICU.[7] The air exhaust port near the patient bed was suggested to blow out the contaminated air, unfortunately, this study proved a potential risk for health care workers (HCWs) or any staff due to inadequate ventilation to take out the virus from the wardroom. Other study established the similar topic and stated that 21082 patient that need critical care, 15367 received care in a HDU and 5715 in an ICU. The number of patients admitted to critical care with COVID-19 rose sharply over the 4 weeks. The unadjusted 30-day mortality of people with COVID-19 requiring critical care peaked in March 2020 with an HDU mortality of 28.4% and ICU mortality of 42.0%. Survival subsequently improved with unadjusted 30-day mortality dropping to 7.3% in HDU and 19.6% in ICU patients by the end of the analysis cycle. The improvement in survival was found to be unaffected by age, sex, ethnicity or comorbidity.[10] In addition, the Meta-Analysis revealed that the pooled prevalence of mortality in patients with coronavirus disease in ICU was 39% (95% CI: 34 to 43, 37 studies and 24, 983 participants).[11] On the other hand, a study by Wu et al. and Cheng et al. did not find evidence of SARS-CoV-2 in the air area where covid-19 patients were taken care of.[12,13] The patients' environment was

contaminated as in another study.[6,7] The higher rate of SARS-CoV-2 detection in the gallery might be due to the absence of special exhaust in this room space.[7] It was also in transition room showed a higher detection rate of SARS-CoV-2, it would be due to the higher capacity of patient care, 3 patients.

The limitation of this study was we only collected the specimen once, it would be better if the sample is collected several times thus we can also analyze the virus pattern according to their amount. We do not evaluate the cleanliness in this study, and also do not evaluate other factors that may contribute to environmental contamination, particularly in ICU.

## CONCLUSION

It was identified the presence of SARS-CoV-2 particles in the air and patient's surrounding within covid-ICU. These findings indicate the ford of higher countermeasures such as vigorous decontamination and better ventilation airflow to reduce the risk of covid-19 transmission, particularly among HCWs including those in laundry management.

## FUNDING

None.

## ETHICAL CLEARANCE

Our institution has been agree with our research

## AUTHOR CONTRIBUTION

All the author has been contributed in this article

## DISCLOSSURE

## ACKNOWLEDGMENT:

This work was supported by funds provided by the CSR of Petrokimia Company. We would like to express our gratitude to all staff at Dr. Soetomo hospital for facilitating this study and also HCWs in covid-ICU for their assistance.

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