

Test, Trace, and Treatment Strategy to Control COVID-19 Infection Among Hospital Staff in a COVID-19 Referral Hospital in Indonesia

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ABSTRAK

Latar belakang: infeksi COVID-19 disebabkan oleh virus korona baru. Salah satu strategi yang paling banyak digunakan untuk mengendalikan penyebaran COVID-19 adalah 3T (test, trace, and treatment). Penelitian ini bertujuan untuk mengevaluasi strategi 3T pengendalian infeksi COVID-19 di Rumah Sakit Rujukan COVID-19 Depok, Jawa Barat, Indonesia. **Metode:** penelitian potong lintang yang dilakukan di RS Universitas Indonesia. Penelitian dilakukan pada bulan Juni 2020 dengan 742 partisipan (anggota staf) menggunakan data sekunder hasil uji polymerase chain reaction (PCR). Kami menyajikan data dalam bentuk deskriptif dan melakukan analisis bivariat menggunakan uji chi-square/Fischer untuk data kategorikal. **Hasil:** hasil tes PCR positif pada 83 (11,1%) peserta, dengan rasio kasus per penelusuran 1:24 dan 1:2 masing-masing pada fase pelacakan pertama dan ketiga. Grafik kasus COVID-19 untuk peserta menurun seiring dengan penerapan strategi 3T. Tingkat positif pada pelacakan tahap pertama adalah 20% dan menurun menjadi 5% pada pelacakan tahap ketiga. Staf dengan hasil tes yang dikonfirmasi positif disarankan untuk mengisolasi diri mereka sendiri (rumah sakit atau isolasi sendiri). Isolasi rumah sakit ditemukan terkait dengan durasi konversi tes PCR ($p < 0,001$). **Kesimpulan:** strategi 3T efektif untuk mengendalikan penyebaran COVID-19. Penerapan strategi ini harus dilakukan bersamaan dengan kewaspadaan kesehatan lainnya untuk mengurangi risiko penyebaran infeksi.

Keywords: strategi 3T, COVID-19, tes PCR, RS. Universitas Indonesia.

ABSTRACT

Background: COVID-19 infection is caused by a novel coronavirus. One of the most used strategies that can be used to control the spread of COVID-19 is the 3T (test, trace, and treatment) strategy. This study aimed to evaluate the 3T strategy to control COVID-19 infection in a COVID-19 Referral Hospital in Depok, West Java, Indonesia. **Methods:** this is a cross-sectional study conducted at the University of Indonesia Hospital. The study was conducted in June 2020 with 742 participants (staff members) using secondary data from polymerase chain reaction (PCR) test results. We presented data in the descriptive form and performed bivariate analysis using the chi-square/Fischer test for categorical data. **Results:** the PCR test results were positive in 83 (11.1%) participants, with a case-per-tracing ratio of 1:24 and 1:2 in the first and third phases of tracing, respectively. The COVID-19 case graph for the participants decreased along with the implementation of the 3T strategy. The positivity rate in the first phase of tracing was 20% and decreased to 5% in the third phase of tracing. Staff with

confirmed positive test results were advised to isolate themselves (hospital or self-isolation). Hospital isolation was found to be associated with the duration of PCR test conversion ($p < 0.001$). **Conclusion:** the 3T strategy is effective for controlling the spread of COVID-19. The strategy should be implemented simultaneously with other health precautions to reduce the risk of spreading infection.

Keywords: 3T strategy, COVID-19, PCR test, Universitas Indonesia Hospital.

INTRODUCTION

COVID-19 is a respiratory infection caused by the novel coronavirus or SARS-CoV-2. It originated in the animal and seafood market of Hubei Province, China in December 2019.¹ According to the World Health Organization (WHO), COVID-19 affected 219 countries, infected 16,558,289 people, and caused 656,093 deaths.² Indonesia is one of the countries with the highest infection rates. Data from the Indonesian Ministry of Health showed that as of July 29, 2020, there were 104,432 COVID-19 confirmed cases in Indonesia and 4,975 deaths.³

Depok is a suburban city located near Jakarta and at risk of being the center of infection due to high mobility and a higher number of COVID-19 cases in neighboring cities. On July 29, 2020, there were 1,172 confirmed cases and 45 deaths in Depok.⁴ To increase the diagnostic capacity of close contacts of confirmed COVID-19 patients and people or patients under surveillance, the Government of Depok allocated 3,600 additional polymerase chain reaction (PCR) tests for Depok residents. The University of Indonesia Hospital was appointed to perform these additional PCR tests.

Hospital staff are susceptible to infection in this pandemic due to their close contact with infected patients. For example, in the early COVID-19 pandemic, it was found that 1.1% of health workers in tertiary hospitals in Wuhan, China were confirmed to be positive for SARS-CoV-2.⁵ Similar findings were also observed in Indonesia. In June 2020, 75 health workers were confirmed cases in East Java, of whom 12 were medical residents.⁶ In late May 2020, Depok General Hospital was forcibly closed because 27 staff members were found to be positive for SARS-CoV-2.⁷ The University of Indonesia Hospital is one of the referral hospitals of COVID-19 in Depok and dealing with similar situations. Therefore, the University of Indonesia Hospital must devise a way that not only focuses

on controlling infection transmission, but also mitigates the risk of becoming an infection epicenter.

One of the most used strategies that can be used to control COVID-19 spread is the test, trace, and treatment (3T) strategy. This strategy is designed to control the infection chain of the disease by identification of COVID-19 cases using laboratory tests, tracing close contacts of confirmed cases, and advising them to isolate to prevent further spread of infection.⁸ This article discusses the implementation of a 3T strategy to control the spread of infection among the staff of University of Indonesia Hospital.

METHODS

A cross-sectional design was used in this study. The study was conducted at the University of Indonesia Hospital in June 2020. The data were collected from the secondary data from the PCR test results of the staff members of the Hospital. A total of 742 participants were included in this study. All participants included the hospital staff of University of Indonesia Hospital (health workers and non-health workers). We present data in the descriptive form and performed bivariate analysis using the chi-square or Fischer test for categorical data. The Ethical Committee of Universitas Indonesia Hospital approved this study (Reference no. 002/SKPE/KKO/2020/00).

The Universitas Indonesia Hospital conducted PCR testing during June 19-23, 2020. PCR tests were carried out on staff members who were registered and screened through electronic forms provided by the Universitas Indonesia Hospital. The registration form included identity, screening for symptoms, contact history, risk of transmission, comorbid diseases, history of the disease, and a history of previous PCR testing. Occupational Safety and Health Department of the University of Indonesia Hospital conducted contact tracing for the patients or hospital staff

with a positive PCR test result. Individuals who had contact with a COVID-19 case were tested by PCR. If the PCR test results are positive, the patient must be isolated. This isolation could be performed at a hospital or self-isolation at home.

Tracing is carried out based on three levels of contact tracing, namely high risk, medium risk and low risk. Included in the high risk criteria are people who have had direct contact with a positive COVID-19 patient with a distance of less than one meter, more than fifteen minutes, without using personal protective equipment, or using inadequate personal protective equipment. The medium risk category is people who have direct contact with patients under surveillance who have not been confirmed positive for COVID-19 with a distance of less than one meter, more than fifteen minutes, without using personal protective equipment, or using inadequate personal protective equipment. Meanwhile, the low risk category is people who have direct contact with patients under surveillance or people under surveillance who have not been confirmed positive for COVID-19 with a distance of less than one meter, more than fifteen minutes, using

personal protective equipment according to standards. For people in the high risk category, a swab test will be carried out the following day. It is attempted to finish the results of the swab on the same day to determine the next tracing.

RESULTS

PCR testing was performed for 742 hospital staff members consisting of 154 staff members in the testing phase and 557 in the tracing phase (**Figure 1**). Of all PCR tests, 83 staff members tested positive for COVID-19 (11.1%). The Occupational Health and Safety, Department of the Universitas Indonesia Hospital traced staff members who tested positive. The criterion for identification of close contact was: close contact with COVID-19 confirmed patient within 2 meters for a minimum of 15 minutes. Those who were found positive were advised to isolate themselves. The staff could choose between self-isolation and hospital isolation, and participants who self-isolated at home were asked to fill out the monitoring form.

Figure 1 shows the decline of positive cases found using PCR tests performed at the

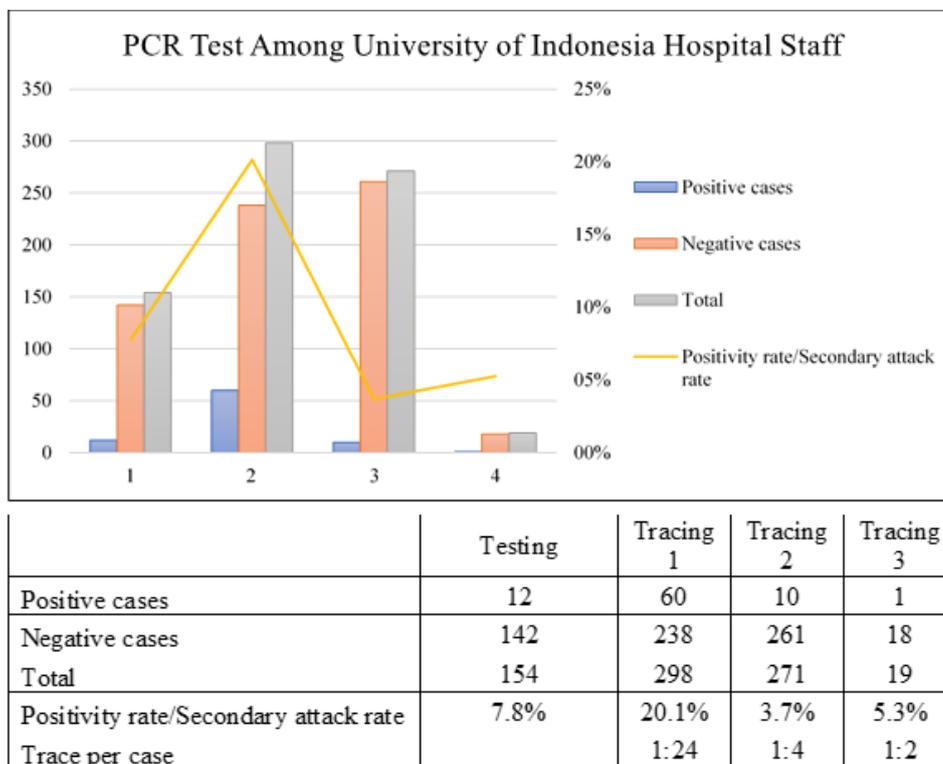


Figure 1. PCR test results among Universitas Indonesia Hospital staff.

Table 1. Demographic data of PCR test in the Universitas Indonesia Hospital

Variables		Positive (%)	Negative (%)	Total	Attack Rate (%) (CI 95%)	P value
Age	- <30 years	5 (41.7)	93 (62.8)	98	5 (0.01-0.09)	0.122*
	- ≥30 years	7 (58.3)	49 (34.5)	56	13 (0.04-0.22)	
Sex	- Male	4 (33.3)	47 (33.1)	51	8 (0.01-0.15)	1.000*
	- Female	8 (66.7)	95 (66.9)	103	8 (0.03-0.13)	
Occupation	Health worker	4 (33.3)	19 (13.4)	23	17 (0.02-0.32)	0.083*
	- Doctor	2 (16.7)	10 (7.0)	12		
	- Nurse	1 (8.3)	9 (6.3)	10		
	- Midwife	1 (8.3)	0 (0)	1		
	Non health worker	8 (66.7)	123 (86.6)	131	6 (0.02-0.10)	

University of Indonesia Hospital. The positivity rate of the PCR test in the testing phase was 7,8% (confidence interval [CI] 95%; 0,04–0,12). The secondary attack rate was the number of cases that occurred among close contacts who were traced. Secondary attack rate among hospital staff from tracing one declined with time, 20.1% (CI 95%; 0.15–0.25) to 3.7% (CI 95%; 0.02–0.06) and 5.3% (CI 95%; -0,05–0,15). The secondary attack rate of all 588 close contacts was 12.1% (CI 95%; 0,09–0,15) (71 cases per 588 close contacts). It was higher than the attack rate found in the testing phase (12,1% vs. 7,8%).

Testing

Detection of COVID-19 infection among the staff of the University of Indonesia Hospital was achieved using a PCR test for 154 members (health workers and non-health workers), who were routinely tested. Health workers consisted of doctors and nurses. Data regarding demographic characteristics of the PCR test are presented in **Table 1**. Statistical analysis showed no significant associations among variables ($p > 0.05$).

Tracing

Tracing was carried out for confirmed COVID-19 positive cases by monitoring their interactions with families or colleagues. The confirmed positive staff filled in the contact history form and reported their condition to their manager and Occupational Health and Safety team. Furthermore, the close contacts of the confirmed positive cases were tested by PCR. If the contacts were found positive, tracing would continue until there were no positive cases left at the University of Indonesia Hospital.

Tracing were done 3 times, namely tracing 1, 2 and 3. Starting with 12 positive cases in the testing phase, 298 PCR tests were performed for their close contacts (clusters); thus, the trace per case ratio was 1:24 (tracing 1). From 298 cases, 60 new positive cases were detected (positivity rate 20,1%) and were retraced to find 271 new close contacts (case per trace ratio 1:4) in tracing 2. From 271 cases, 10 new positive cases were found and retraced (positivity rate 3.7%). The last, 19 close contacts were identified from previous cases (1:2) and we successfully detected only 1 new positive case in tracing 3 (positivity rate 5.3%).

The infection rate of health workers from the testing phase to tracing increased compared to that of non-health workers (7 vs. 5 times), although the secondary attack rate in health workers was lower than that in non-health workers (10.5% vs. 13.5%). We found a statistically significant association between age and PCR results, but found no similar results in other variables (**Table 2**).

Treatment

Positive cases of COVID-19 among the staff of the University of Indonesia Hospital were isolated or quarantined to stop the spread of the infection. Comfort and psychological reassurance were provided for the patients and the people surrounding them. The University of Indonesia Hospital provided two options for isolation: hospital isolation or self-isolation at home. Self-isolation was for two weeks, whereas in hospital isolation, patients could be discharged after they consecutively tested negative twice

Table 2. Demographic data of tracing phase

Variables	Tracing 1 (n)		Tracing 2 (n)		Tracing 3 (n)		Total (n)		P value	Secondary attack rate (%)	95% CI
	+	-	+	-	+	-	+	-			
Age											
- <30 year	36	141	6	218	0	17	42	376	0.018*	10.0	0.07-0.13
- > 30 year	24	97	4	43	1	1	29	141		17.1	0.11-0.23
Sex											
- Male	23	94	4	78	0	9	27	181	0.618*	13.0	0.08-0.18
- Female	37	144	6	183	1	9	44	336		11.6	0.08-0.15
Occupation											
- Health Worker	22	82	8	161	0	12	30	255	0.264*	10.5	0.07-0.14
- Non-	38	156	2	100	1	6	41	262		13.5	0.10-0.17
Total (n)	60	238	10	261	1	18	71	517		12.1	0.09-0.15

*Statistical analysis using Chi-square test

Table 3. Age, length of stay and duration of conversion.

	Mean (SD)	Min	Max
Age (n=83), year	29.4 (7.4)	19	57
Length of stay (n=44), day	8.7 (3.59)	3	25
Duration of conversion (n=82), day	12.0 (4.00)	3	28
- Self-isolation (n=39), day	13.8 (4.23)	7	28
- Hospital isolation (n=43), day	10.41 (2.99)	6	19

by PCR, and were declared as fit to work by an occupational doctor. During isolation, staff could do their work from home by complying with health protocols.

Of the 83 positive staff members, 44 stayed at the hospital for isolation, and 39 were isolated at home. The average length of stay for hospital isolation was 8 days, with 25 as the longest. Ages of the staff members ranged from 19 to 57 years, with an average age of 29 years (**Table 3**). The average duration for the PCR test to become negative in two consecutive tests was 12 days. One staff member hospitalized at the Universitas Indonesia Hospital have not reached negative conversion leading to exclusion from the study. **Table 4** shows the association between conversion duration and type of isolation and age. The type of isolation was correlated with the duration of conversion.

Besides isolation, there were several

Table 4. Association of age, isolation types, and duration of conversion

Variables	Duration of conversion (n=82)		P value
	<14 days	≥14 days	
Isolation			
- Self-isolation	18 (32.1)	21 (53.8)	0.000*
- Hospital isolation	38 (67.9)	5 (19.2)	
Age			
- <30 years	35 (62.5)	11 (42.3)	0.086*
- ≥ 30 years	21 (37.5)	15 (57.7)	

*Statistical analysis using Chi-square test

measures to control infection in the hospital cluster. This was done by implementing a special protocol related to COVID-19; using appropriate self-protection equipment for those who had direct contact with COVID-19 patients, obligatory mask for all staff in the hospital, body temperature checking, promoting hand hygiene by providing hand sanitizer and soap supply, management of the working area by limiting the number of staff members in one room, physical distancing, and ensuring healthy air circulation.

DISCUSSION

Prevention of the spread of infection is a major goal in controlling COVID-19. The WHO has recommended the identification of cases, contact tracing, and isolation for individuals

with COVID-19. One strategy that can be used to prevent the spread is the 3T (test, trace, and treatment) strategy, which has proven to be able to control COVID-19 outbreaks in several countries, such as South Korea, Singapore, and Scotland.⁹ The implementation of the 3T strategy in Scotland started with PCR testing on patients, health workers, and social workers. If a positive test result was found on examination, tracing would be carried out by the National Contact Tracing Service to identify those who had close contact with the confirmed case, including everyone who had a contact history of being within 2 meters for 15 minutes or more. People who had close contact with confirmed cases were contacted by the National Contact Tracing Service to identify the symptoms and advised to self-isolate for 14 days if they were asymptomatic. However, if the person showed symptoms of COVID-19, then tracing would continue to identify a history of close contact with that person.¹⁰ Moreover, tracing conducted in South Korea and Singapore was also through the GPS on cell phones, transaction history, and CCTV recordings in public areas.⁹

COVID-19 testing should be done in all the hospital staff, and not only limited to the public. A report by Imperial College London states that routine weekly PCR tests can identify asymptomatic or mild symptom cases and become the basis for tracing people who have close contact with the confirmed cases.¹¹ Routine PCR testing of health workers and risk groups helped to reduce the rate of virus transmission by 25%-33%, higher than isolation alone.¹² Contact tracing should be done by considering the individual-level variation in transmission. The higher the transmission variation, the more people will have to undergo an examination. The WHO has recommended that 10-30 examinations should be performed for each confirmed case. Indonesia has also implemented this recommendation by conducting 20-30 examinations in the confirmed cases. This tracking has been implemented in several cities in Indonesia, such as DKI Jakarta and Surabaya.

The Depok government has set 3600 PCR tests dedicated to examining health workers in Depok, including the University of Indonesia

Hospital.¹¹ Therefore, as referral hospitals of COVID-19 in Depok, the University of Indonesia Hospital conducted a mass PCR test for the staff, followed by tracing and isolation to ensure safety from COVID-19 infection. PCR test from mass swab test found 12 positive cases from 154 people (7.8%). Because of that, contact tracing was carried out and resulted in the hospital having to do more swab tests with a ratio of 1:24 (out of 12 positive cases, the next swab test was 298). From 298 people, 60 (20.1%) were confirmed cases which later resulted in more contact tracing. Then for second tracing from 60 positive cases resulted in 271 contact tracing with a trace per case ratio 1: 4 and found 10 positive cases (3.7%). From 10 positive cases, the third contact trace to 19 people and only found 1 positive case. All test conducted by the University of Indonesia Hospital was able to detect 83 (11.2%) confirmed cases from four examination periods and a total of 742 staff examined, namely the testing phase, tracing 1, tracing 2, and tracing 3. Tracing of close contact from the first 12 cases in the testing phase was able to detect 60 new cases with a trace per case ratio of 1:24. In the next tracing, new case findings decreased to 1 new case per 4 close contacts and 3rd trace was 1:2. The ratio reduction indicates that the need for tracing will be higher in the first tracing cluster and lower if the cluster has been treated. When compared to mass swab tests, the result of first tracing shows the important role of tracing over mass swabs, 20.1% compared to 7.8% (positivity rate of mass swab test) or 12.3% (positivity rate of Indonesia in July 25, 2020). This shows a positive rate of contact tracing almost three times than a mass swab (20.1% compared to 7.8%). This percentage is higher than that observed in China where the infection rate of the hospital staff was 1.1%.⁵ Focusing on contact tracing is crucial in Indonesia, where financial condition and PCR test price are not favorable. In the future, mass swabs are not specifically required, and if they are done, they should be done based on cluster sampling followed by tracing. Because mass PCR tests conducted on 5% of the population per week were estimated to reduce transmission by 2%.¹³ Meanwhile from tracing we can conduct until 12% of the population. The higher number

of cases in the University of Indonesia Hospital could be caused by close contact between staff and confirmed cases.

The staff members of the University of Indonesia Hospital with positive results on the PCR test were asked to isolate. The implementation of the tracing and isolation strategies can reduce transmission of COVID-19 (47%-64%) better than isolation strategies alone (29-37%).¹³ According to the WHO guidelines, confirmed and suspected cases must be isolated in health facilities to prevent the spread of coronavirus. If the number of health facilities is inadequate, isolation is prioritized for individuals with poor prognosis, such as aged >60 years and having a comorbid disease. Patients with mild or asymptomatic symptoms can self-isolate at home or other non-health facilities, such as hotels or stadiums, by implementing standard health precautions.¹⁴ The Indonesian Ministry of Health has also established guidelines for patients undergoing independent isolation: the patient is placed in a separate room that is well ventilated; both patients and families caring for patients will use masks; patient will restrict movement and sharing the same room with family members; patient will use separate cutlery; patient will sleep separately from family members or use a different bed; one healthy caretaker will take care of the patient; family members must wash their hands after every contact with the patient or the patient's environment. Patients undergoing self-isolation need daily monitoring, including identification of symptoms, such as fever, colds, sore throat, shortness of breath, and other complaints, such as mental health and psychosocial support.¹⁵

The University of Indonesia Hospital chose hospital isolation because it can reduce risk community transmission even though it involves a higher cost than self-isolation. About 42% of staff infected with COVID-19 chose to self-isolate at home, whereas others chose hospital isolation. 21 patients (53.8%) who did self-isolation at home converted swab test result in more than 14 days, the remaining 18 patients (32.1%) converted in less than 14 days. Meanwhile, 38 patients (67.9%) isolated in hospital converted in less than 14 days. Five patients (19.2%) who were

isolated in hospital converted in more than 14 days. A significant difference in the conversion time (less than 14 days and more than 14 days) from the staff was in self-isolation and hospital isolation. Hospital isolation can also reduce the stigma of COVID-19 infection. Social stigma and discrimination can be experienced by infected patients, their families, health workers, and other frontline officers who have treated COVID-19 patients. Thus, it is important to consider socio-psychological impacts, such as stigma and discrimination in each phase of the COVID-19 emergency response. Reasonable attention must be given to assist in the integration of people affected by COVID-19.¹⁶

This study found that the infection rate in health workers was lower than that in non-health workers. Lai, et al.⁵ also found a similar result in a study, where infection rates among front-liner hospital staff were lower than in the non-front liners. Many factors may lead to lower infection rates, such as self-protection, equipment availability, usage, and compliance with health precaution protocols.

CONCLUSION

Test, trace, and treatment (3T) strategy is a strategy to eliminate the spread of COVID-19 in the hospital environment. This strategy could be used to control COVID-19 infection because the infection rate of the hospital staff was quite high (11%). Case identification of COVID-19 should be followed by contact tracing. In one confirmed case, 24 additional tests were needed. The staff members who were confirmed positive were isolated. The random test is still applied but the sample does not need to include all staff due to the high cost. We recommend samples to be taken on a random basis per-unit or per-profession. From this randomized test, if some positive people are found, contact tracing is necessary. PCR test results must be obtained within 24 hours, so that people who are being tracked are not isolated for too long while waiting for the results and services at the hospital do not have to be closed. Tracing was carried out until positive COVID-19 results were no longer found. 3T strategy implementation should be performed simultaneously with other health protocols to

reduce the risk of infection spreading, such as hand hygiene, physical distancing, and working space management.

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