ORIGINAL ARTICLE

Predictive Factors of Covid-19 Infection in Resident Doctors at Specialized Isolation Center of Covid-19 Hospital

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ABSTRACT

Introduction: The COVID-19 pandemic is a global emergency. Many changes have occurred in social and professional scenario, including medical education system, especially among resident doctors. Aim of this study is to investigate the predictive factors of COVID-19 infection in resident doctors at a specialized isolation center for COVID-19 hospital. **Methods:** This study used a cross-sectional study design with sampling method which was conducted from March 2020 to February 2021. A total of 287 out of the 434 resident doctors were included in the study. Competency level, period of work, working duration, place of assignment, level of PPE kit was compared with rRT-PCR result. Significant variables were entered, and logistic regression analysis was conducted to predict factors that can affect the infection. A p-values <0.05 was considered to be statistically significant. **Results:** Among the total participants, 164 (57.1%) had junior level competency; 156 (54.4%) were assigned for more than 4 weeks; 133 (46.3%) worked in isolation ward; 277 (96.5%) used PPE level 3 and 30 (10.5%) had positive rRT-PCR result. Bivariate analysis showed that individuals working at laboratory (p=0.013), level of PPE (p=0.013), enrollment in certain months {(August (p=0.001), September (p=0.011), and November (p=0.005)} were related to a positive rRT-PCR result. **Conclusion:** There was an association between COVID-19 infection in resident doctors with level of PPE kit, place of assignment and enrollment in certain months (August and November 2020).

Keywords: Teaching hospital, resident doctors, COVID-19

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INTRODUCTION

Corona Virus Disease 2019 (COVID-19) which originated in Wuhan, China, has spread around the world infecting many healthcare workers. The first case in Indonesia was reported on March 1, 2020, while the first death occurred in Bali on March 11, 2020. As of February 2021, 66.5% (826,563) cases of COVID-19 had been confirmed in Java. Jakarta had the highest number of confirmed cases per million population, followed by East Kalimantan, North Kalimantan, West Papua, and Bali (1). Meanwhile, as of February 2021, the number of confirmed cases in Bali was 34,215, with areas of local transmission occurring in almost all districts. However, the cure rate reached 90.83% (2).

Taking into consideration the modalities of social and

professional interaction, protection of the healthcare workers require many changes, including the medical education system and health services, especially those provided by the resident doctors in teaching hospitals (3). Healthcare workers, especially resident doctors, face numerous challenges in handling COVID-19 patients, including direct contact with the infected patient, exposure to high viral loads, working in isolation ward that are beyond their usual responsibilities, and provided with limited Personal protective equipment (PPE) (3,4,5). COVID-19 cases in Indonesia remain high, which impact the physical and mental condition of front lines health workers who are struggling, especially on duty resident doctors in the teaching hospitals because of their moral responsibility in the handling of COVID-19 cases. This condition put the resident doctors in direct contact with affected individuals, which can increase the chances of transmitting the infection. Many residents were exposed to COVID-19 infection during hospitalization. However, a very limited publication on the infection status among resident doctors has been identified till date. The aims of this study are to identify and predict the factors

influencing the positive rapid Reverse-Transcriptase Polymerase Chain Reaction (rRT-PCR) COVID-19 in resident doctors at Universitas Udayana Hospital, which is a specialized COVID-19 isolation hospital in Bali Indonesia.

MATERIALS AND METHODS

Research Setting and Design
This is a cross-sectional study design using secondary data obtained from the Department of Human Resources and Education, Universitas Udayana Hospital, Bali, Indonesia which was conducted in February 2021. Universitas Udayana Hospital is a teaching hospital under the auspices of Udayana University, located in the southern part of Bali, Indonesia and has been assigned as a special hospital for COVID-19 isolation since March 2020 until now.

Data Collection and Management
The registration data of resident doctors who enrolled in the hospital was retrieved and acquired as provided by the Department of Human Resources and Education. The inclusion criteria were all resident doctors who enrolled to the hospital from March 2020 to February 2021. The exclusion criteria were resident doctors with positive rRT-PCR COVID-19 results before assignment and also doctors with incomplete data. Then data were processed and analyzed using the data processing program.

Study Variables
The dependent variable was the positive results of rRT-PCR COVID-19 of the resident doctors who were at the end of their assignment at the Universitas Udayana Hospital, while the independent variables were demographic variables (gender and age), level of PPE kit, and the COVID-19 rRT-PCR results before the assignment. Other variables were also collected such as period of academic years which determined level of competency, which was divided into Junior (basic and intermediate level) and Senior (senior and chief) residency levels, work duration and work location including Emergency Room, Isolation Ward, Intensive Care Unit, Laboratory/PCR lab. The level of the PPE was divided into PPE levels 2 and 3, and the results of rRT-PCR for COVID-19 were acquired at the end of duty and were divided into positive and negative. The materials samples for the COVID 19 rRT–PCR examination were obtained from nasopharyngeal and oropharyngeal swabs, and all the data were presented as categorical data.

Ethical Consideration
The study was approved by the Ethical Committee in Udayana Medical Faculty and conducted under their guidance with number: 1010/UN14.2.2.VII.14/LT/2020. Confidentiality was guaranteed and all forms of harm were avoided. The materials used for this study were properly referenced.

RESULTS

Based on the data from the Department of Human Resources and Education, a total of 434 resident doctors registered from March 2020 to February 2021. About 127 were excluded due to reconditioning on residency regulation and resource allocation. The resident doctors that registered before June 2020 were not assigned for rRT-PCR evaluation pre and post assignment, nevertheless, they were assigned for SARS CoV-2 Rapid Antibody Test. Furthermore, 9 resident doctors had positive rRT-PCR result before the assignments, and 11 resident doctors were still on duty until the end of February 2021. Only 287 resident doctors with the report of rRT-PCR result at the end of duty, participated in this study.

The demographic variables and assignment aspects of 287 resident doctors were documented and the majority were males (61%) with a mean age of 31 (27-46) years. Most of the resident doctors were in the third year of their study, and they were at the junior level competency (57.1%), from the non-surgical department (53%) with a mean enrollment period of 4 (1-16) weeks. Furthermore, 30 (10.5%) resident doctors had a positive rRT-PCR result at the end of duty. Other demographic data are explained in Table I.

From bivariate analysis, the differences between positive and negative rRT-PCR results associated with previous variables were evaluated and compared. A significant association ($p<0.05$) was found between rRT-PCR result, level of PPE kit, work at the laboratory, and enrollment in a certain month (August, September, November) as shown in table II. The resident doctors who had enrolled in August, September, and November 2020 had a positive rRT-PCR results of 24%; 21.7%; 0%, respectively. Furthermore, 40% of resident doctors who enrolled in the laboratory had positive rRT-PCR results at the end of the duty. This percentage is similar to the number of positive rRT-PCR results in resident doctors that used PPE level 2 while on duty.

After performing logistic regression, it was found that only 3 variables could be used to predict positive rRT-PCR results at the end of the duty. These were levels of PPE, work at the laboratory and enrollment for certain months (August and November 2020). Further analysis revealed that resident doctors who enrolled on August 2020 has a 3.785 higher probability of having positive rRT-PCR results at the end of the duty (95% CI: 1.696 to 8.446, p-value=0.001). Table III shows the findings from the multivariate analysis.

DISCUSSION

Nosocomial infections of the respiratory tract are

Table I: Demographic variables, assignment variables, and level of PPE kit (N = 287)

Variable	N	%
Sex		
Male	175	61
Female	112	39
Age	31 (27-46) years	
≤ 31 years	175	61
> 31 years	112	39
Residency program		
Anesthesiology and Intensive Therapy	68	23.7
Internal Medicine	68	23.7
Pediatric	34	11.8
Surgery	25	8.7
Radiology	18	6.3
Psychiatry	17	5.9
Otorhinolaryngology	13	4.5
Opthalmology	12	4.2
Clinical pathology	10	3.5
Obstetrics and Gynecology	9	3.1
Orthopedics and Traumatology	8	2.8
Neurology	5	1.7
Study duration	6 (2-15) semester	
≤ 6 semester	175	61
> 6 semester	112	39
Competency level		
Basic	20	7
Intermediate	144	50.2
Senior	85	29.6
Chief	38	13.2
Hospital assignment duration	4 (1-16) weeks	
< 4 weeks	131	45.6
≥ 4 weeks	156	54.4
Location of assignment		
Emergency department	82	28.6
Isolation room	133	46.3
ICU	62	21.6
Laboratory		
Level of PPE kit	10	3.5
Level 2	10	3.5
Level 3	277	96.5
Assignment period	61	21.3
June 2020		
July 2020	66	23.0
August 2020	75	26.1
September 2020	46	16.0
October 2020	53	18.5
November 2020	44	15.3
December 2020	35	12.2
Januari 2021	37	12.9

*ICU: Intensive Care Unit , PPE: Personal Protective Equipment

Table II: Bivariate Analysis, Comparison rRT-PCR results and demographic variables, assignment variables, and level of PPE kit (N = 287)

Variable	Positive rRT-PCR Result n (%)	Negative rRT-PCR Result n (%)	p-value
Sex			
Male	18 (10.3)	157 (89.7)	0.908
Female	12 (10.7)	100 (89.3)	
Age Group			
≤ 31 years	19 (10.9)	156 (89.1)	0.780
> 31 years	11 (9.8)	101 (90.2)	
Study duration			
≤ 6 semester	19 (10.9)	156 (89.1)	0.780
> 6 semester	11 (9.8)	101 (90.2)	
Competency level			
Junior	19 (11.6)	145 (88.4)	0.469
Senior	11 (8.9)	112 (91.1)	
Hospital assignment duration			
< 4 weeks	15 (11.5)	116 (88.5)	0.613
≥ 4 weeks	15 (9.6)	141 (90.4)	
Working on June 2020			
Yes	10 (16.4)	51 (83.6)	0.087
No	20 (8.8)	206 (91.2)	
Working on July 2020			
Yes	10 (15.2)	56 (84.8)	0.155
No	20 (9.0)	201 (91.0)	
Working on Augustus 2020			
Yes	18 (24.0)	57 (76.0)	0.001*
No	12 (5.7)	200 (94.3)	
Working on September 2020			
Yes	10 (21.7)	36 (78.3)	0.011*
No	20 (8.3)	221 (91.7)	
Working on October 2020			
Yes	8 (15.1)	45 (84.9)	0.221
No	22 (9.4)	212 (90.6)	
Working on November 2020			
Yes	0 (0.0)	44 (100.0)	0.005*
No	30 (12.3)	213 (87.7)	
Working on Desember 2020			
Yes	1 (2.9)	34 (97.1)	0.092
No	29 (11.5)	223 (88.5)	
Working on January 2021			
Yes	1 (2.7)	36 (97.3)	0.075
No	29 (11.6)	221 (88.4)	
Medical staff group			
Surgical department	11 (8.1)	124 (91.9)	0.229
Non-surgical department	19 (12.5)	133 (87.5)	
Assignment in emergency department			
Yes	6 (7.3)	76 (92.7)	0.272
No	24 (11.7)	181 (88.3)	
Assignment in isolation room			
Yes	20 (10.3)	175 (89.7)	0.874
No	10 (10.9)	82 (89.1)	
Assignment in ICU			
Yes	5 (8.1)	57 (91.9)	0.488
No	25 (11.1)	200 (88.9)	
Assignment in laboratory			
Yes	4 (40.0)	6 (60.0)	0.013*
No	26 (9.4)	251 (90.6)	
Level of PPE			
Level 2	4 (40.0)	6 (60.0)	0.013*
Level 3	26 (9.4)	251 (90.6)	

*ICU: intensive care unit, PPE: personal protective equipment

frequently observed in health-workers at the hospital (6). Similar to these findings, previous studies showed that there was an initial improvement in the vulnerability of exposure to COVID-19 infection for health workers, especially resident doctors in the hospital (8,9,3,11). This study showed that the incidence of exposure to COVID-19 infection in resident doctors at the hospital reaches 10.5%. Therefore, exposure in the hospital can be assumed as the possible mode of transmission while on duty. But there is no full evidence that exposure occurred while on duty in the hospital or off duty outside the hospital.

Resident doctors may have experienced a high frequency of COVID-19 infection, with milder symptoms and lower mortality than non-healthcare workers, possibly because they are younger and have fewer comorbidities (8). This is related, in which 10.9% of medical residents in the age group ≤31 years of age were exposed to COVID-19 infection.

In this study, it was found that the COVID-19 infection is related to the place of assignment (working at the laboratory), level of PPE, and assignment for certain months (August, September, and November 2020). Furthermore, August and September 2020 are associated with a tendency to increase the national curve of confirmed cases of COVID-19 infections, particularly in Bali. Unexpectedly in the second week of September 2020, there was a significant increase in the number of

Table III: Logistic Regression for positive rRT-PCR result

Variables	(b)[a]	Adjusted OR[b] (95% CI)[c]	Wald statistic	p-value[d]	Adjusted OR (95% CI)
Working on Aug 2020	1.331	3.785 (1.696 – 8.446)	10.561	0.001	3.785 (1.696 – 8.446)
Working on Nov 2020	-18.581	0.000 (0.000 - .)	0.000	0.998	0.000 (0.000 - .)
Level of PPE kit	1.366	3.920 (0.972 – 15.812)	3.685	0.055	3.920 (0.972 – 15.812)

Constant= - 2.622
[a] b regression coefficient
[b] b adjusted odds ratio
[c] 95% confident interval
[d] p-value MLR < 0.05 significant

cases of COVID-19 infection (1,2), as large number of patients visited Universitas Udayana hospital in August 2020 (1,859 patients). Due to the number of confirmed cases, this indicator should be interpreted in the context of the increasing number of the tested people.

The use of an N95 mask has been shown to be associated with a lower risk of infection than wearing a surgical mask (4,11,12,13,14). In this study, it was found that the use of PPE level 2 kit by resident doctors (head cap, eyes protection, surgical masks, and gowns) had a significant association with positive rRT-PCR results. Furthermore, 40% of the resident doctors who enrolled in the laboratory had positive rRT-PCR results at the end of the duty, and all of them used PPE level 2 kit.

The pandemic has presented great challenges. Health workers were physically and mentally exhausted, especially for nursing staff who have been on the front lines. This situation required extensive moral courage in this distressed condition. This situation can result in decreased immunity and an increased risk of infection among health workers. Therefore, recognizing moral distress is important, but it is also necessary to be courageous to strive to do the right thing, especially during and after the pandemic crisis (12).

Currently, several residency programs have been developed and some strategies have been implemented to protect the resident doctors while providing specialized services. For example, concept of telemedicine neurology services and developing virtual neurological examination procedures was proposed (13).

This study has some limitations, such as small sample size, aspect of solitary-site, and less characteristic subjects. Therefore, the results cannot be generalized easily. Nevertheless, the results propose current recommendations for more consistent and optimal use of PPE, which is associated with a reduced risk of infection.

CONCLUSION

Resident doctors who worked in the hospital, experienced significant burdens due to COVID-19. There is a correlation between resident doctors positive rRT-PCR results with the level of PPE kit used, place of assignment and enrollment in a certain month (August and November 2020), resulting in increased COVID-19 cases in Indonesia. Furthermore, resident doctors must be careful while working to prevent further increase in COVID-19 cases. Usage of recommended PPE must be followed especially for resident doctors at the front line in order to lower the risk of exposure. Further investigations of risk factors for COVID- 19 infection in resident doctors are still needed.

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