

# Risk Factors Associated with SARS-CoV-2 Infection among Healthcare Workers in a Non-COVID Hospital in Malaysia



Teck Long KING<sup>1,2</sup>, Diana Hui-Ping FOO<sup>2</sup>, Huey Chun LEE<sup>3</sup>, Priyadarvena SANTHRAMOGAN<sup>3</sup>, Ming Gui TAN<sup>4</sup>, Sofina Azurin Bt SOFFIAN CHEN<sup>3</sup>, Siang Poon GOH<sup>5</sup>, Alan Yean Yip FONG<sup>2</sup>, Hie Ung NGIAN<sup>6</sup>

<sup>1</sup> Pharmacy Department, Sarawak General Hospital, Kuching, Sarawak  
<sup>2</sup> Clinical Research Centre, Sarawak General Hospital, Kuching, Sarawak  
<sup>3</sup> Occupational Health Unit, Sarawak General Hospital, Kuching, Sarawak

<sup>4</sup> Psychiatric Department, Sarawak General Hospital, Kuching, Sarawak  
<sup>5</sup> Otorhinolaryngology Department, Sarawak General Hospital, Kuching, Sarawak  
<sup>6</sup> Director, Sarawak General Hospital, Kuching, Sarawak

## Introduction

This study aimed to evaluate risk factors associated with SARS-CoV-2 infection among HCWs who had exposure from infected patients and HCWs in a recent outbreak in Sarawak General Hospital (SGH)

## Materials and Methods

We included HCWs who were investigated during contact tracing of SARS-CoV-2 confirmed patients and HCWs in SGH. We analysed the risk factors including personal protective equipment (PPE) use, social distancing, contact duration, hand hygiene practice, and involvement in aerosol producing activities associated with HCW's SARS-CoV-2 infection risk, which was confirmed by using real-time polymerase chain reaction assay.

## Results

We included 2104 HCWs: 62.2% were female with median age of 32 years old. Majority were nurses (45.3%) and doctors (29.8%). Fifty (2.4%) HCWs were later confirmed with SARS-CoV-2 infection. Among them, 12 had exposure from infected patient(s); 34 from infected HCW(s); and four had contacted both infected patient(s) and HCW(s).

In univariable and multivariable analyses, in patient-HCW exposure, aerosol-producing activities was the only risk factor significantly associated with SARS-CoV-2 infection [OR=4.55, 95%CI=1.14-18.12], while in HCW-HCW exposure, hand hygiene was the sole significant risk factor (OR=2.21, 95%CI=1.13-4.31). Not wearing mask in HCW-HCW contact showed marginal significance level in univariable analysis (p=0.06, OR=6.98, 95%CI=0.93-50.03). Other risk factors were not found to significantly associated with SARS-CoV-2 infection risk in HCWs.

Table 1. Basic characteristics of healthcare workers with and without SARS-CoV-2 infection

Variables	Total (n=2104)	SARS-CoV-2 Negative (n = 2055)	SARS-CoV-2 Positive (n = 49)
Age (years)	32 (10)	32 (11)	32
Gender, male	580/2101 (27.6)	568/2052 (27.7)	12/49
Job category			
Nurses	946/2088 (45.3)	925/2040 (45.3)	21/48
Doctors	622/2088 (29.8)	602/2040 (29.5)	20/48
Other clinical HCWs	354/2088 (17.0)	349/2040 (17.1)	5/48
Other non-clinical HCWs	166/2088 (8.0)	164/2040 (8.0)	2/48
Ward / Department			
ER	295/2104 (14.0)	284/2055 (13.8)	11/49
ICU	293/2104 (13.9)	283/2055 (13.8)	10/49
Other wards/clinics	1192/2104 (56.7)	1169/2055 (56.9)	23/49
Other non-clinical departments	324/2104 (15.4)	319/2055 (15.5)	5/49
Exposure history			
Infected patient only	245/2104 (11.6)	233/2055 (11.3)	12/50
Infected HCWs only	1615/2104 (76.8)	1582/2055 (77.0)	33/50
Both	244/2104 (11.6)	240/2055 (11.7)	4/50

Data are presented as median (interquartile range) and frequency/total number (percentage). HCW, healthcare worker; ER, emergency room; ICU, intensive care unit.

Table 2. Risk factors of SARS-CoV-2 infection for healthcare workers who had unintentional exposure from patients with SARS-CoV-2.

Variables	SARS-CoV-2 Negative (n = 473)	SARS-CoV-2 Positive (n = 16)	OR (95% CI)	P value
While infected positive patient				
Not wearing mask	15/470 (3.2)	2/15 (13.3)	4.67 (0.97-22.54)	0.055
Not wearing gloves	145/380 (38.2)	1/8 (12.5)	0.23 (0.03-1.90)	0.173
Not wearing goggle/face shield	154/376 (41.0)	3/8 (37.5)	0.87 (0.20-3.67)	0.844
Not wearing isolation gown	164/373 (44.0)	3/8 (37.5)	0.77 (0.18-3.25)	0.716
Not wearing shoe cover	233/342 (68.1)	5/8 (62.5)	0.78 (0.18-3.32)	0.736
Not wearing head cover	208/343 (60.6)	4/8 (50.0)	0.65 (0.16-2.64)	0.546
Aerosol producing procedures	21/473 (4.4)	3/16 (18.8)	4.97 (1.31-18.77)	0.018
After contacting infected patient				
No handwashing/alcohol rubbing	32/396 (8.1)	0/13 (0)	0	1.00
No. of infected patient contacted				
1	426/473 (90.1)	14/16 (87.5)	1.00 (Ref)	-
2	39/473 (8.2)	2/16 (12.5)	1.56 (0.34-7.11)	0.565
≥ 3	8/473 (1.7)	0/16 (0)	0	1.00

Data were presented as frequency/total number (percentage). HCW, healthcare worker; OR, odd ratio; CI, confidence interval; Ref, reference.

Table 3. Multivariable logistic regression model of risk factors associated with SARS-CoV-2 infection for healthcare workers who had unintentional exposure from patients with SARS-CoV-2

Variables	Adj. OR (95% CI)	P value
While contacting infected patients		
Not wearing mask	3.55 (0.69-18.44)	0.131
Aerosol producing procedures	4.55 (1.14-18.12)	0.032

Adj. OR, adjusted odd ratio

Table 4. Risk factors of SARS-CoV-2 infection among healthcare workers who had exposure from other healthcare workers with SARS-CoV-2.

Variables	SARS-CoV-2 Negative (n = 1822)	SARS-CoV-2 Positive (n = 37)	OR (95%CI)	P value
While contacting infected HCW				
Distance < 2 metres	1389/1801 (77.2)	27/37 (73.0)	0.80 (0.38-1.66)	0.548
Contact time > 15 minutes	942/1822 (51.7)	19/37 (51.4)	0.99 (0.51-1.89)	0.966
Either one not wearing mask	737/1822 (40.5)	17/37 (45.9)	1.25 (0.65-2.41)	0.501
Both not wearing mask	452/1822 (24.8)	13/37 (35.1)	1.64 (0.83-3.25)	0.155
Not wearing gloves	1497/1689 (88.6)	33/35 (94.3)	2.12 (0.50-8.89)	0.306
Not wearing goggle/face shield	1507/1793 (84.0)	36/37 (97.3)	6.83 (0.93-50.03)	0.059
Not wearing isolation gown	1532/1664 (92.0)	32/35 (91.4)	0.93 (0.28-3.06)	0.900
Not wearing shoe cover	1624/1673 (97.1)	34/35 (97.2)	1.03 (0.14-7.65)	0.980
Not wearing head cover	1520/1672 (90.9)	33/35 (94.3)	1.65 (0.39-6.94)	0.495
After contacted infected HCW				
No handwashing/alcohol rubbing	506/1740 (29.1)	19/37 (51.4)	2.57 (1.34-4.95)	0.005
No. of infected HCW(s) contacted				
1	1183/1822 (64.9)	19/37 (51.4)	1.00 (Ref)	-
2	385/1822 (21.1)	12/37 (32.4)	1.94 (0.93-4.03)	0.076
≥ 3	254/1822 (13.9)	6/37 (16.2)	1.47 (0.58-3.72)	0.415

Data were presented as frequency/total number (percentage). HCW, healthcare worker; OR, odd ratio; CI, confidence interval; Ref, reference.

Table 5. Multivariable logistic regression model of risk factors associated with SARS-CoV-2 infection among healthcare workers who had exposure from other healthcare workers with SARS-CoV-2.

Variables	Adj. OR (95%CI)	P value
While contacting infected HCW		
Not wearing goggle or face shield	5.72 (0.77-42.52)	0.089
After contacting infected HCW		
No handwashing or alcohol rubbing	2.21 (1.13-4.31)	0.020
No. of infected HCWs contacted		
1	1.00 (Ref)	-
2	1.38 (0.65-2.89)	0.400
≥ 3	0.84 (0.35-2.35)	0.844

Adj. OR, adjusted odd ratio; HCW, healthcare worker.

## Discussion & Conclusion

Aerosol-producing activities and hand hygiene were the significant risk factors associated with SARS-CoV-2 infection risk in HCWs. The findings indicate indirect contact of contaminated surfaces or fomite transmission as the possible transmission mode of SARS-CoV-2. Actions are needed to reinforce hand hygiene habits and practice while use of mask and PPEs should not be undermined in the effort of preventing nosocomial transmission of SARS-CoV-2.