p-ISSN 2086-6380
e-ISSN 2548-7949

Jurnal Ilmu Kesehatan Masyarakat, Nov2021, 12(3):229-240
DOI: https://doi.org/10.26553/jikm.2021.12.3.229-240
Available online at http://ejournal.fkm.unsri.ac.id/index.php/jikm

RISK OF COVID-19 INFECTION AMONG MEDICAL RECORDERS: A DESCRIPTIVE STUDY IN CENTRAL JAVA PROVINCE

Tiara Fani,* Kriswiharsi Kun Saptorini, Retno Astuti Setijaningsih, Nimas Arum Titisari
Faculty of Health Science, Dian Nuswantoro University, Semarang, Central Java, 50131, Indonesia

ABSTRACT

Covid infection risks among non-medical staff in healthcare facilities may not be as high as physicians and nurses. However, healthcare facilities should understand infection risk among non-medical staff who works during the pandemic. This study describes several factors associated with Covid-19 infection among medical recorders. A descriptive study with a cross-sectional approach observed 124 medical record officers in Central Java Province from January to June 2021. This study measured socio-demographic factors, job characteristics, infection prevention and control (IPC) efforts, and Covid-19 infection through an online questionnaire with Kobotoolbox. Data analyze performed in descriptive and bivariate analysis. Most respondents said personal protective equipment (PPE) availability was adequate and had received IPC training. Socio-demographic factors, PPE availability, IPC training, and occupation were significantly unrelated to covid 19 infections. Having infected co-workers was related to covid 19 transmissions. Covid-19 cases proportion mostly in respondents who work in type C and D hospitals, never or rarely available PPE, received IPC training, worked <7 hours/day, and medical record staff. Healthcare facilities should pay more attention to PPE availability and other infection prevention and control for medical recorder staff. Further research should assess the contact history of workers with positive covid 19 both in or outside their workplace and their activities outside their workplace, PPE use compliance, and IPC training time.

Keywords: *COVID-19 risk, factors, medical recorder*

ABSTRAK

Risiko infeksi Covid di antara staf non-medis di fasilitas kesehatan mungkin tidak setinggi dokter dan perawat. Namun, fasilitas kesehatan sebaiknya memahami risiko infeksi di antara staf non-medis yang bekerja selama pandemi. Penelitian ini menjelaskan beberapa faktor yang berhubungan dengan infeksi Covid-19 di kalangan petugas rekam medis. Penelitian deskriptif dengan pendekatan cross sectional mengamati 124 petugas rekam medis di Provinsi Jawa Tengah dari Januari hingga Juni 2021. Penelitian ini mengukur faktor sosial demografi, karakteristik pekerjaan, upaya pencegahan dan pengendalian infeksi (PPI), dan infeksi Covid-19 melalui kuesioner online dengan Kobotoolbox. Analisis data dilakukan secara deskriptif dan analisis bivariat. Sebagian besar responden mengatakan ketersediaan APD memadai dan telah mendapatkan pelatihan PPI. Faktor sosio-demografi, ketersediaan APD, pelatihan PPI, dan jabatan secara signifikan tidak berhubungan dengan infeksi covid 19. Adanya rekan kerja yang positif terinfeksi secara signifikan berhubungan dengan infeksi covid 19. Proporsi kasus Covid-19 sebagian besar pada responden yang bekerja di RS tipe C dan D, APD tidak pernah atau jarang tersedia, menerima pelatihan PPI, bekerja <7 jam/hari, dan staf URM. Fasilitas pelayanan kesehatan sebaiknya lebih memperhatikan ketersediaan APD dan upaya pencegahan dan pengendalian infeksi lainnya bagi petugas rekam medis. Penelitian selanjutnya sebaiknya mengkaji riwayat kontak staf yang positif covid 19 baik di dalam maupun di luar tempat kerja dan aktivitas staf tersebut di luar tempat kerja, kepatuhan penggunaan APD, dan waktu pelatihan PPI.

Kata kunci: risiko COVID-19, faktor-faktor, perekam medis

Correspondence Address: Tiara Fani, Faculty of Health Science, Dian Nuswantoro University, Indonesia, E-mail tiara.fani@dsn.dinus.ac.id

Received : September 3, 2021 Accepted : October 28, 2021 Published: November, 30, 2021

Introduction

Diseases incidence with a high transmission rate such as COVID-19 is a challenge in ensuring the health and safety of workers, especially workers whose work must be in direct contact with the general public or workers who work in healthcare facilities.[1] The Healthcare workers, both medical (physicians or nurses) and non-medical (patient data administration staff or medical recorders) are at the forefront of handling positive patients with COVID-19. Therefore, healthcare workers, including medical record officers as patient data administration staff, are a group that is vulnerable to covid-19 infection. HCWs infected with covid 19 varies from 0.9% to 19% in various studies.[2–4] Study in London Teaching Hospital reported medical personnel to have a higher incidence of covid-19 than non-medical staff in hospitals, but the total disease incidence was not different. The number of covid 19 incidences among physicians or nurses was highest among healthcare workers, but the duration of illness was shorter than non-medical staff.[5] Other studies showed that 30% of non-clinical staff working in some COVID-19 referral childcare hospitals were positive for SARS-CoV-2 [6], and COVID-19 proportion was higher in cleaning and technicians staff than physicians.[7] These studies showed that apart from physicians and nurses, other healthcare workers in healthcare facilities are also at risk of COVID-19. Several incidents of COVID-19 in both medical and non-medical healthcare workers did not show symptoms.[6,7]

Multiple factors in hospital settings might play essential roles in COVID-19 transmission. Health facilities need to increase effective measures in preventing COVID-19 infection among health workers.[8] A systematic review showed an increased relative risk for COVID-19 among healthcare workers related to personal protective equipment (PPE), workplace setting, profession, exposure, contacts, and testing.[9] Another systematic review proves Infection and prevention control (IPC) training for healthcare workers related to a reduced risk of COVID-19 infection.[10] Type of hospital and department also related to covid 19 infection.[8]

The number of COVID-19 and its risk factors among medical record officers was unknown, especially in the Central Java Province. COVID-19 cases in Central Java Province was in the top 5 highest cases in Indonesia for the past few months based on COVID-19.go.id.[11] Most previous studies have identified the risk of COVID-19 in physicians and nurses. On our knowledge, the description of the risk of COVID-19 in medical recorders is not yet known, even though medical recorders should work during the covid pandemic to manage patient data. Medical recorders also serve the registration process for COVID-19 patients and distribute the medical record files to the inpatient and outpatient care departments. So that medical recorders are also at risk of COVID-19 infection while working. This study will provide an overview of the COVID-19 incident among

medical recorders and the related factors such as PPE availability, occupation in the Medical Record department, type of hospital, IPC training, etc.

Method

This cross-sectional study had conducted from January to June 2021. We targeted medical record officers who work at the COVID-19 referral hospitals in Central Java Province. We calculated our minimum sample (119 respondents) using a cross-sectional study sample formula with a precision of 5% and a significance level of 95%. However, we included five more respondents who were willing to participate in this survey. So, the final number of samples reported in this article becomes 124 respondents.

We collected information on age, gender, type of hospital, region, education, job titles, average working hours (≥7 hours/day; <7 hours/day), PPE availability, IPC training, having infected co-workers, and covid-19 infections. The type of hospital in this survey split into two groups, group 1 types A and B, group 2 types C and D. Type A for Central or Provincial hospital, type B for City or District hospital with various specialistic and sub-specialistic services, type C for a hospital with some sub-specialistic services, and type D for a transit hospital. The region was split into Semarang District/City Area and outside Semarang Districts/Cities Area. The education divides into health education programs and non-health education programs. Job titles in this study divide into frontline staff (staff in patient registration and those who distribute medical record files) and not frontline personnel (coding, assembling, filing, and other officers which not deal directly with patients and hospital visitors).We made an online questionnaire using Kobotoolbox. We shared the questionnaire link to several medical recorders listed in the contact number of the research team. Also, we asked for help from respondents who received the message to share the questionnaire link with other medical record officers who worked at the COVID-19 referral hospital in Central Java.

Data analysis concluded with descriptive and bivariate statistics. Numerical data is defined by calculating the average or median, minimum, and maximum values. Categorical data is defined in frequency and proportion per category in each variable. A normality test with Kolmogorov Smirnov was carried out on numerical data to determine the distribution of age and average working hours per day. The Chi-Square or Fisher's Exact test (as an alternative test) uses to determine the relationship between categorical variables and covid-19 incidence in medical recorders.

Ethical clearance to conduct this research was granted by the Health Research Ethics Committee (KEPK) of Universitas Negeri Semarang (UNNES) number: 040/KEPK/EC/2021. The Informed Consent was obtained from all respondents when the respondent choose “AGREE” button after reading the research explanation at the beginning of the questionnaire.

Results

Subject Characteristics

The survey had conducted from early January 2021 until June 2021. More than 119 respondents (our minimum target) participated in this study. As many as 124 medical recorders from several cities or districts in the Central Java Province were willing to participate (response rate 104%). Based on Table 1, the age of medical record staff who participated in this study ranged from 20 to 57 years old. Most respondents were women (65.3%), graduated from associate or bachelor programs on health education (75%), and worked in Type C or D Hospitals (65.3%). The distribution of respondents from Semarang District or City a little bit higher than respondents from outside Semarang District or City like Banjarnegara, Banyumas, Batang, Brebes, Jepara, Kebumen, Kendal, Klaten, Kudus, Magelang, Pekalongan, Purwodadi, Purwokerto, Purworejo, Sragen, Sukoharjo, and Temanggung.

Table 1. Subject Characteristics

Variable	n	%
Covid 19 Infections		
Yes	19	15.3
No	105	84.7
Gender		
Male	43	34.7
Female	81	65.3
Age (Me: 31 years, Min: 20 years, Max: 57 years)		
Age ≤ 31 tahun	64	51.6
Age > 31 tahun	60	48.4
Education		
Not graduated from health education program	31	25.0
Graduated from health education program	93	75.0
Type of Hospital		
Type C or D	81	65.3
Type A or B	43	34.7
Region		
Outside Semarang District or City	55	44.4
Semarang District or City	69	55.6
Job titles		
Frontline staff	46	37.1
Non-frontline staff	78	62.9
Working hours		
> 7 hours per day	52	41.9
≤ 7 hours per day	72	58.1
PPE Availability		
Never of rarely available	16	12.9
Always available	108	87.1
IPC Training		
Not provided	23	18.5
Provided	81	81.5
Infected Coworkers		
Ya	97	78.2
Tidak	27	21.8

Based on table 1, the are 19 (15.3%) of respondents have been infected by COVID-19. Most respondents work as not frontline staff (62.9%) including, coding, assembling, insurance, filing, and other officers who did not deal directly with patients and hospital visitors. The average

working hours were 7 hours/day (58.1%), with the minimum working hours 5 hours/day and a maximum of 10 hours/day. 87.1% of respondents said PPE was always available for staff. 81.5% of respondents said the hospital provided IPC training for staff. Most respondents also had infected co-workers (78.2% of respondents).

Risk of Covid-19 Infection

Based on table 2, All factors observed in this study were not risk factors for COVID-19 in medical recorders.

Table 2. Covid 19 Infection Risks

Variable	n	Covid 19 infection		P-value	POR (CI 95%)
		Yes (%)	No (%)		
Gender					
Male	43	7 (16.3)	36 (83.7)	0.829	1.118(0.405 to 3.087)
Female	81	12 (14.8)	69 (85.2)		
Age					
Age ≤ 31 years	64	10 (15.6)	54 (84.4)	0.923	1.049(0.394 to 2.792)
Age > 31 years	60	9 (15.0)	51 (85.0)		
Education					
Not graduated from health education program	31	3 (9.7)	28 (90.3)	0.398	0.516(0.140 to 1.905)
Graduated from health education program	93	16 (17.2)	77 (82.8)		
Type of Hospital					
Type C or D	81	14 (17.3)	67 (82.7)	0.405	1.588(0.531 to 4.752)
Type A or B	43	5 (11.6)	38 (88.4)		
Region					
Outside Semarang District or City	55	12 (17.4)	57 (82.6)	0.474	1.444(0.527 to 3.956)
Semarang District or City	69	7 (12.7)	49 (87.3)		
Job Titles					
Frontline staff	46	4 (8.7)	42 (91.3)	0.116	0.400(0.124 to 1.289)
Non-frontline staff	78	15 (19.2)	63 (80.8)		
Working hours					
> 7 hours per day	52	5 (9.6)	47 (90.4)	0.134	0.441(0.148 to 1.312)
≤ 7 hours per day	72	14 (19.4)	58 (80.6)		
PPE Availability					
Never of rarely available	16	3 (18.8)	13 (81.3)	0.711	1.327(0.340 to 5.186)
Always available	108	16 (14.8)	92 (85.2)		
IPC Training					
Not provided	23	2 (8.7)	21 (91.3)	0.523	0.471(0.101 to 2.198)
Provided	81	17 (16.8)	84 (83.2)		
Infected Co-workers					
Yes	97	19 (19.6)	78 (80.4)	0.012	-
No	27	-	27 (100.0)		

Based on table 2, show that the Chi-Square or Fisher's Exact test, socio-demographic characteristic variables of the respondents also had no association with COVID-19 infection in respondents. like age (P-value 0.923 > 0.05), gender (P-value 0.829 > 0.05), education background (P-value 0.398 > 0.05), type of hospital (P-value 0.405 > 0.05), and Cities/ Districts (P-value 0.474 > 0.05). Mostly, COVID-19 infections were experience by respondents who graduated from the health education program (17.2% of the 93 respondents who graduated from the health sector program). Meanwhile, COVID-19 infections in respondents who had not graduated from the health education program were 9.1% of the 31 respondents. COVID-19 prevalence was higher among

respondents who work in type C and D hospitals (17.3% of respondents who work in Type C or D hospitals).

Several variables in this survey were not related to COVID-19 infection includes job titles (P-value 0.116 > 0.05), average working hours (P-value 0.134 > 0.05), PPE availability (P-value 0.474 > 0.05), and IPC training (P-value 0.523 > 0.05). Based on the COVID-19 prevalence in each category of independent variables, and COVID-19 infections occurred when PPE was never or rarely available (18.8% of 16 respondents). However, COVID-19 infections were higher in some non-suspected risk groups. Like on not frontline staff (19.2% of 78 respondents), working hours less than 7 hours per day (19.4% of 77 respondents), and the hospital provided IPC training (16.8% of 101 respondents). All respondents infected by COVID-19 also had co-workers who were infected by COVID-19. Having infected co-workers related to COVID-19 infection among respondents (P-value 0.012 < 0.05).

Discussion

Various studies have described the risk of COVID-19 in health workers.[8] However, to our knowledge, there was no publication about COVID-19 risk among non-medical staff, especially medical record officers in Indonesia. This study described several factors related to COVID-19 infection among medical record staff working at the Covid Referral Hospital in the Central Java Province. The prevalence of COVID-19 among medical record officers in this study was 15.3%. In the Chou et al. literature study, COVID-19 prevalence in healthcare workers ranged from 3.8% to 5.1% [10] and 2.24% according to Wei et al. epidemiology study.[8] Studies in UK and United States general population showed that the number of COVID-19 was higher among healthcare workers than non-healthcare workers.[12] In our study, COVID-19 prevalence in medical record staff was similar to physicians and nurses but higher than COVID-19 infections in other population groups (non-healthcare workers) from previous studies.

In the current study, age, gender, education, City/District, and type of hospital were not risks factors of COVID-19 among medical record staff. In an epidemiology study, most COVID-19 cases aged between 30 to 79 years.[13] The distribution of COVID-19 based on medical record staff in our study varies from 23 to 54 years old. This finding was similar to COVID-19 incidence in the general population in Indonesia (mostly aged 19-59 years).[11] Most medical record staff were women (65.3%). These results were similar to other studies. Women's participation was higher than men among medical and non-medical healthcare workers in various countries.[14–16] Following previous studies, the COVID-19 prevalence in this study was higher in men than women.[16,17] The distribution of respondents from Semarang District or City was similar to the total number of respondents outside Semarang City or District. However, the distribution of respondents between Districts or Cities outside Semarang was unequal. COVID-19 cases were higher among

respondents who work in type C and D hospitals. According to Wei J Te et al.'s finding, Healthcare workers working in the district or central hospitals were more susceptible to COVID-19. Therefore, Lower-grade general hospitals like type C and D hospitals in the high-risk region should pay more attention to policies and measures in the prevention of diseases transmission.[8]

The medical record department manages medical record services from the patient registration unit to the filing unit. Therefore, we measured the difference in COVID-19 risk between frontline medical record staff and non-front line medical record staff. However, job titles (frontline staff and not frontline) among medical record staff were not associated with COVID-19 infection in this study. Even though the frontline staff was more likely to interact with the patient's family or patient, COVID-19 cases were higher among non-frontline medical record officers. These results were similar to Al-Kuwari et.al. study, where customer service or administrative staff had less covid 19 than technicians, shopkeepers, and housekeeping staff.[18] Necessary steps to prevent disease infection among healthcare workers include administrative control, technical control, and Personal Protective Equipment (PPE). The administrative control efforts should be applied by healthcare facilities is providing Infection and Prevention Control (IPC) training for their healthcare workers.[19] Most respondents in this study answered that their workplace provided IPC training for healthcare workers. Firew et al said that IPC training for healthcare workers might reduce the risk of COVID-19 infection.[15] However, COVID-19 infections were higher among the group of respondents that attended IPC training in this study. Moreover, it was statistically not proven as an associated factor for covid transmission. Previous studies indicate that PPE use was a risk factor for COVID-19.[10,20] At the beginning of the outbreak, the shortage of protective equipment highly increased the COVID-19 risk among healthcare workers, visitors, and patients.[21] In our study, most respondents (87.1%) said PPE was always available. It was higher than Firew et al's research which only 47.6% of respondents said PPE was always available. Sufficient use and availability of PPE proven as an essential role in reducing the risk of COVID-19 among healthcare workers.[10,15,18,22–24] Providing an adequate and a good quality PPE for Healthcare workers will improve a sense of security for health workers while doing their duties.[23] However, in our study, the frequency of PPE availability was not associated with COVID-19 infection. Online data collection and using one question to get an idea of the PPE availability may affect our study results.

Infections of Covid 19 among healthcare workers is a serious problem of the COVID-19 pandemic.[25] All respondents with COVID-19 history in our study had infected co-workers. Having infected co-workers was significantly associated with COVID-19 infection among respondents (P-value $0.012 < 0.05$). These results were following Abri et al. most healthcare workers had a history of contact with positive cases.[26] However, the contact history of Abri et al. study includes contact history with covid patients. M. Parkulo et al. also showed that COVID-19 infection risks from co-workers in a low-prevalence environment with standard precautions were very low.[25] Meanwhile,

another study showed that contact history with positive co-workers was not associated with COVID-19 infection.[22] In previous studies, no consistent results indicate the association between having an infected co-worker and COVID-19 incidences. It was similar to our findings. Although in the bivariate test, the infected co-worker was related to COVID-19 infections. However, having infected co-workers was not a risk factor for COVID-19 in medical record staff. Some studies said healthcare workers might be contracted to covid outside healthcare facilities or not during work time.[7,27] Pandrowala et al. found that 70% of healthcare workers who were positive for COVID-19 traveled by public transportation and had a history of contact with positive cases in the community.[6] The relationship between having infected co-workers and COVID-19 incidence needs further investigation, considering that the number of Covid infections in the general populations (not healthcare workers) is also high.

We realize, our findings have many limitations and need further research. The number of samples is relatively small to represent all medical recorders in Central Java. The convenient sampling method affected the uneven distribution of respondents in this study by region, job titles, and type of hospital. Online data collection and misclassification bias might be affected the validity of our findings. Other than that, we did not assess other possible risk factors in the current study, such as type and duration of IPC training, staff compliance in PPE use, transportation, and activities outside their workplace.

Conclusion

The prevalence of COVID-19 on medical recorders in Central Java province reached 15.3% of the 124 medical record staff. COVID-19 distribution among medical record officers was higher among those staff who worked in type C and D hospitals, PPE was never or rarely available at the workplace, had attended IPC training, worked <7 hours/day, and not frontline officers. The only factor that was proven to be related to covid infection among medical record staff was having infected co-workers. However, our survey showed that age, gender, education, job title, working hours, region, type of hospital, PPE availability, IPC training, and having infected co-workers were not risk factors for COVID-19 among medical record staff. Further research should examine the contact history of officers diagnosed as positive for COVID-19 both inside and outside the workplace and their activities outside the workplace, transportation to work, compliance with the use of PPE, and IPC training time.

Acknowledgment

We thank all parties involved in the research and preparation of this article. We also thank the Faculty of Health Science and Department for Research and Community Service (LPPM) Dian Nuswantoro University for their support during the research and publication process.

Funding

The research funded by the Department for Research and Community Service (LPPM), Dian Nuswantoro University, Semarang, Indonesia.

Conflict of Interest

All authors declared no potential conflicts of interest regarding this research, its publication or its funding.

References

1. Burdorf A, Porru F, Rugulies R. The COVID-19 (Coronavirus) pandemic: consequences for occupational health. Scand J Work Environ Health. Nordic Association of Occupational Safety and Health (NOROSH); 2020;46(3):229–30.
2. Dev N, Meena RC, Gupta DK, Gupta N, Sankar J. Risk factors and frequency of COVID-19 among healthcare workers at a tertiary care centre in India: a case-control study [Internet]. Trans R Soc Trop Med Hyg [Internet]. Trans R Soc Trop Med Hyg; 2021 May 1;115(5):551–6. Available from: https://pubmed.ncbi.nlm.nih.gov/33763687/
3. Burrer SL, Perio MA de, Hughes MM, Kuhar DT, Luckhaupt SE, McDaniel CJ, Porter RM, Silk B, Stuckey MJ, Walters M. Characteristics of Health Care Personnel with COVID-19 — United States, February 12–April 9, 2020 [Internet]. Morb Mortal Wkly Rep [Internet]. Centers for Disease Control and Prevention; 2020 Apr 17 [cited 2021 Sep 16];69(15):477. Available from: /pmc/articles/PMC7755055/
4. Lai X, Wang M, Qin C, Tan L, Ran L, Chen D, Zhang H, Shang K, Xia C, Wang S, Xu S, Wang W. Coronavirus Disease 2019 (COVID-2019) Infection Among Health Care Workers and Implications for Prevention Measures in a Tertiary Hospital in Wuhan, China [Internet]. JAMA Netw Open [Internet]. American Medical Association; 2020 May 1;3(5):e209666–e209666. Available from: https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2766227
5. Zheng C, Hafezi-Bakhtiari N, Cooper V, Davidson H, Habibi M, Riley P, Breathnach A. Characteristics and transmission dynamics of COVID-19 in healthcare workers at a London teaching hospital. J Hosp Infect. W.B. Saunders; 2020 Oct 1;106(2):325–9.

6. Pandrowala A, Shaikh S, Balsekar M, Kirolkar S, Udani S. Characteristics and Transmission Dynamics of COVID-19 in Healthcare Workers in a Pediatric COVID-Care Hospital in Mumbai [Internet]. Indian Pediatr [Internet]. Indian Pediatr; 2021 Jun 1;58(6):568–71. Available from: https://pubmed.ncbi.nlm.nih.gov/33612486/
7. Leeds JS, Raviprakash V, Scanlon TJN, Cundall J, Leedsf CM. Risk factors for detection of SARS-CoV-2 in healthcare workers during April 2020 in a UK hospital testing programme [Internet]. EClinicalMedicine [Internet]. EClinicalMedicine; 2020 Sep 1;26. Available from: https://pubmed.ncbi.nlm.nih.gov/32838245/
8. Wei J Te, Liu ZD, Fan ZW, Zhao L, Cao WC. Epidemiology of and risk factors for COVID-19 infection among health care workers: A multi-centre comparative study. Int J Environ Res Public Health. 2020;17(19):1–11.
9. Gholami M, Fawad I, Shadan S, Rowaiee R, Ghanem H, Khamis AH, Ho SB. COVID-19 and healthcare workers: A systematic review and meta-analysis [Internet]. Int J Infect Dis [Internet]. Elsevier; 2021 Mar 1;104:335. Available from: /pmc/articles/PMC7798435/
10. Chou R, Dana T, Buckley DI, Selph S, Fu R, Totten AM. Epidemiology of and Risk Factors for Coronavirus Infection in Health Care Workers: A Living Rapid Review [Internet]. Ann Intern Med [Internet]. Ann Intern Med; 2020 Jul 21;173(2):120–36. Available from: https://pubmed.ncbi.nlm.nih.gov/32369541/
11. Pusdatin Kementerian Kesehatan. Peta Sebaran COVID-19 | Covid19.go.id [Internet]. [cited 2021 Sep 3]. Available from: https://covid19.go.id/peta-sebaran-covid19
12. Nguyen LH, Drew DA, Joshi AD, Guo C-G, Ma W, Mehta RS, Sikavi DR, Lo C-H, Kwon S, Song M, Mucci LA, Stampfer MJ, Willett WC, Eliassen AH, Hart JE, Chavarro JE, Rich-Edwards JW, Davies R, Capdevila J, et al. Risk of COVID-19 among frontline healthcare workers and the general community: a prospective cohort study [Internet]. medRxiv [Internet]. Cold Spring Harbor Laboratory Preprints; 2020; Available from: /pmc/articles/PMC7273299/
13. The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020 [Internet]. China CDC Weekly, 2020, Vol 2, Issue 8, Pages 113-122 [Internet]. China CDC Weekly; 2020 Feb 1;2(8):113–22. Available from: http://weekly.chinacdc.cn/en/article/doi/10.46234/ccdcw2020.032
14. Cotrin P, Moura W, Gambardela-Tkacz CM, Pelloso FC, Santos L dos, Carvalho MD de B, Pelloso SM, Freitas KMS. Healthcare Workers in Brazil during the COVID-19 Pandemic: A Cross-Sectional Online Survey [Internet]. Inq A J Med Care Organ Provis Financ [Internet]. SAGE Publications; 2020;57. Available from: /pmc/articles/PMC7550936/
15. Firew T, Sano ED, Lee JW, Flores S, Lang K, Salman K, Greene MC, Chang BP. Original

research: Protecting the front line: a cross-sectional survey analysis of the occupational factors contributing to healthcare workers' infection and psychological distress during the COVID-19 pandemic in the USA [Internet]. BMJ Open [Internet]. BMJ Publishing Group; 2020 Oct 21;10(10). Available from: /pmc/articles/PMC7580061/

16. Iversen K, Bundgaard H, Hasselbalch RB, Kristensen JH, Nielsen PB, Pries-Heje M, Knudsen AD, Christensen CE, Fogh K, Norsk JB, Andersen O, Fischer TK, Jensen CAJ, Larsen M, Torp-Pedersen C, Rungby J, Ditlev SB, Hageman I, Møgelvang R, et al. Risk of COVID-19 in health-care workers in Denmark: an observational cohort study [Internet]. Lancet Infect Dis [Internet]. Elsevier; 2020 Dec 1;20(12):1401. Available from: /pmc/articles/PMC7398038/
17. Chadeau-Hyam M, Bodinier B, Elliott J, Tzoulaki MDWI, Vermeulen O, Kelly-Irving M, Delpierre C, Elliott P. Risk factors for positive and negative COVID-19 tests: a cautious and in-depth analysis of UK biobank data [Internet]. Int J Epidemiol [Internet]. Int J Epidemiol; 2020 Oct 1;49(5):1454–67. Available from: https://pubmed.ncbi.nlm.nih.gov/32814959/
18. Al-Kuwari MG, AbdulMalik MA, Al-Nuaimi AA, Abdulmajeed J, Al-Romaihi HE, Semaan S, Kandy M. Epidemiology Characteristics of COVID-19 Infection Amongst Primary Health Care Workers in Qatar: March-October 2020 [Internet]. Front Public Heal [Internet]. Frontiers Media SA; 2021 May 20;9:679254. Available from: /pmc/articles/PMC8173064/
19. Park SH. Personal Protective Equipment for Healthcare Workers during the COVID-19 Pandemic [Internet]. Infect Chemother [Internet]. Korean Society of Infectious Diseases; 2020 Jun 1;52(2):165. Available from: /pmc/articles/PMC7335655/
20. Liu M, Cheng S-Z, Xu K-W, Yang Y, Zhu Q-T, Zhang H, Yang D-Y, Cheng S-Y, Xiao H, Wang J-W, Yao H-R, Cong Y-T, Zhou Y-Q, Peng S, Kuang M, Hou F-F, Cheng K, Xiao H-P. Use of personal protective equipment against coronavirus disease 2019 by healthcare professionals in Wuhan, China: cross sectional study [Internet]. BMJ [Internet]. BMJ Publishing Group; 2020 Jun 10;369. Available from: /pmc/articles/PMC7284314/
21. Zhang Z, Liu S, Xiang M, Li S, Zhao D, Huang C, Chen S. Protecting healthcare personnel from 2019-nCoV infection risks: lessons and suggestions [Internet]. Front Med [Internet]. Nature Publishing Group; 2020 Apr 1;14(2):1. Available from: /pmc/articles/PMC7095352/
22. Rodriguez-Lopez M, Parra B, Vergara E, Rey L, Salcedo M, Arturo G, Alarcon L, Holguin J, Osorio L. A case–control study of factors associated with SARS-CoV-2 infection among healthcare workers in Colombia [Internet]. BMC Infect Dis [Internet]. BioMed Central; 2021 Dec 27;21(1):878. Available from: /pmc/articles/PMC8391859/
23. Nienhaus A, Hod R. COVID-19 among Health Workers in Germany and Malaysia [Internet]. Int J Environ Res Public Health [Internet]. Multidisciplinary Digital Publishing Institute (MDPI); 2020 Jul 1;17(13):1–10. Available from: /pmc/articles/PMC7369938/

24. Deressa W, Worku A, Abebe W, Gizaw M, Amogne W. Availability and use of personal protective equipment and satisfaction of healthcare professionals during COVID-19 pandemic in Addis Ababa, Ethiopia [Internet]. Arch Public Heal [Internet]. BioMed Central; 2021 Dec 1;79(1). Available from: /pmc/articles/PMC8369137/
25. Parkulo MA, Brinker TM, Bosch W, Palaj A, DeRuyter ML. Risk of SARS-CoV-2 Transmission Among Coworkers in a Surgical Environment [Internet]. Mayo Clin Proc [Internet]. Elsevier; 2021 Jan 1;96(1):152–5. Available from: http://www.mayoclinicproceedings.org/article/S0025619620312027/fulltext
26. Abri ZGH Al, Zeedi MASA Al, Lawati AA Al. Risk Factors Associated with COVID-19 Infected Healthcare Workers in Muscat Governorate, Oman [Internet]. J Prim Care Community Health [Internet]. SAGE Publications; 2021;12. Available from: /pmc/articles/PMC7883138/
27. Hunter E, Price DA, Murphy E, Loeff IS van der, Baker KF, Lendrem D, Lendrem C, Schmid ML, Pareja-Cebrian L, Welch A, Payne BAI, Duncan CJA. First experience of COVID-19 screening of health-care workers in England [Internet]. Lancet (London, England) [Internet]. Elsevier; 2020 May 2;395(10234):e77. Available from: /pmc/articles/PMC7176380/