

Analysis of COVID-19 Infection in Medical Workers: A Systematic Review

Rama Garditya¹, Adik Wibowo²

Hospital Administration Study Program, Faculty of Public health, Universitas Indonesia¹
Faculty of Public health, Universitas Indonesia²



Keywords:

Risk factor, medical workers, COVID-19

ABSTRACT

Health workers experience a high risk of contracting COVID-19, and the number of COVID-19 cases among medical personnel is increasing and even causing death. Therefore, it is crucial to identify the factors affecting COVID-19 infection in medical workers in hospitals. We conducted a systematic review by searching the following databases Scopus, SpringerLink, PubMed, and Proquest from January-1st, 2020 to December-23, 2020. We searched the databases using search terms like 'risk factor medical workers COVID-19'. There were restrictions in terms of the country only in Asia. Risk factors that affect COVID-19 infection in medical workers in hospitals in this systematic review are inadequate use or non-usage of PPE (35,7%), work environment (21,4%), habits of medical worker (21,4%), scarcity of PPE (7,1%), aerosol-generating procedures (10,7%), and late diagnosis of COVID-19 (3,5%). The most important risk factors are the use of personal protective equipment, work zoning in hospitals, and the habit of health workers. Concerning the infection-related risk factor of medical workers, we highlight the fact that for measures of medical worker protection, PPEs are the primary key. Therefore, the strategies to deal with the current pandemic situation are the provision of PPEs, adequate training and reinforcement of PPE usage, eye protection, and the adoption of standard precautions to increase the awareness of medical workers to prevent and control COVID-19 infection. However, there are other important factors that need to be considered to reduce COVID-19 infections such as the habit of medical workers in complying to the preventive actions in their daily practice and also the work environment in the hospital.



This work is licensed under a Creative Commons Attribution Non-Commercial 4.0 International License.

1. INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) pandemic hit almost all countries in the world in 2020. The COVID-19 disease was first discovered in December 2019 in the city of Wuhan, China [1]. Based on the latest data up to December 24th, 2020, the COVID-19 pandemic caused by severe acute respiratory syndrome coronavirus (SARS-CoV-2) has resulted in 77,530,799 confirmed positive cases COVID19 and 1,724,904 deaths worldwide. COVID-19 cases in Indonesia as of December 13th, 2020, the number of positive cases was 605,000 and 18,511 deaths [2].

SARS-CoV-2 infects the human respiratory tract, is heat sensitive, and can be effectively inactivated by disinfectants containing chlorine. Common symptoms of COVID-19 include fever, cough, and difficulty breathing. We can divide the clinical syndrome into groups without complications, mild pneumonia and severe pneumonia. Specimens to examine are acquired from throat swabs (nasopharynx and oropharynx) and lower airways (sputum, bronchial rinse, endotracheal aspirate). COVID-19 infected patients will undergo isolation to prevent wider spread [1].

The ineffective prevention and control of COVID-19 cases have resulted in the number of new COVID-19 cases increasing out of control. Health workers have a higher risk of contracting COVID-19, and the number of COVID-19 cases among medical personnel is increasing and even causing deaths. Close contact with confirmed and unconfirmed COVID-19 patients increases the risk. Several reports have stated that many health workers have been infected with COVID-19 in various hospitals worldwide [3- 5]. Guidelines on handling COVID-19 have been made, including recommendations for safety protocols for health workers such as the use of personal protective equipment (PPE) corresponding. The scarcity and use of PPE has been known to be a crucial factor affecting COVID-19 infections globally. However, apart from PPE, other factors concerning the transmission of COVID-19 in hospitals may not be known yet and these factors may turn out to be just as crucial [6].

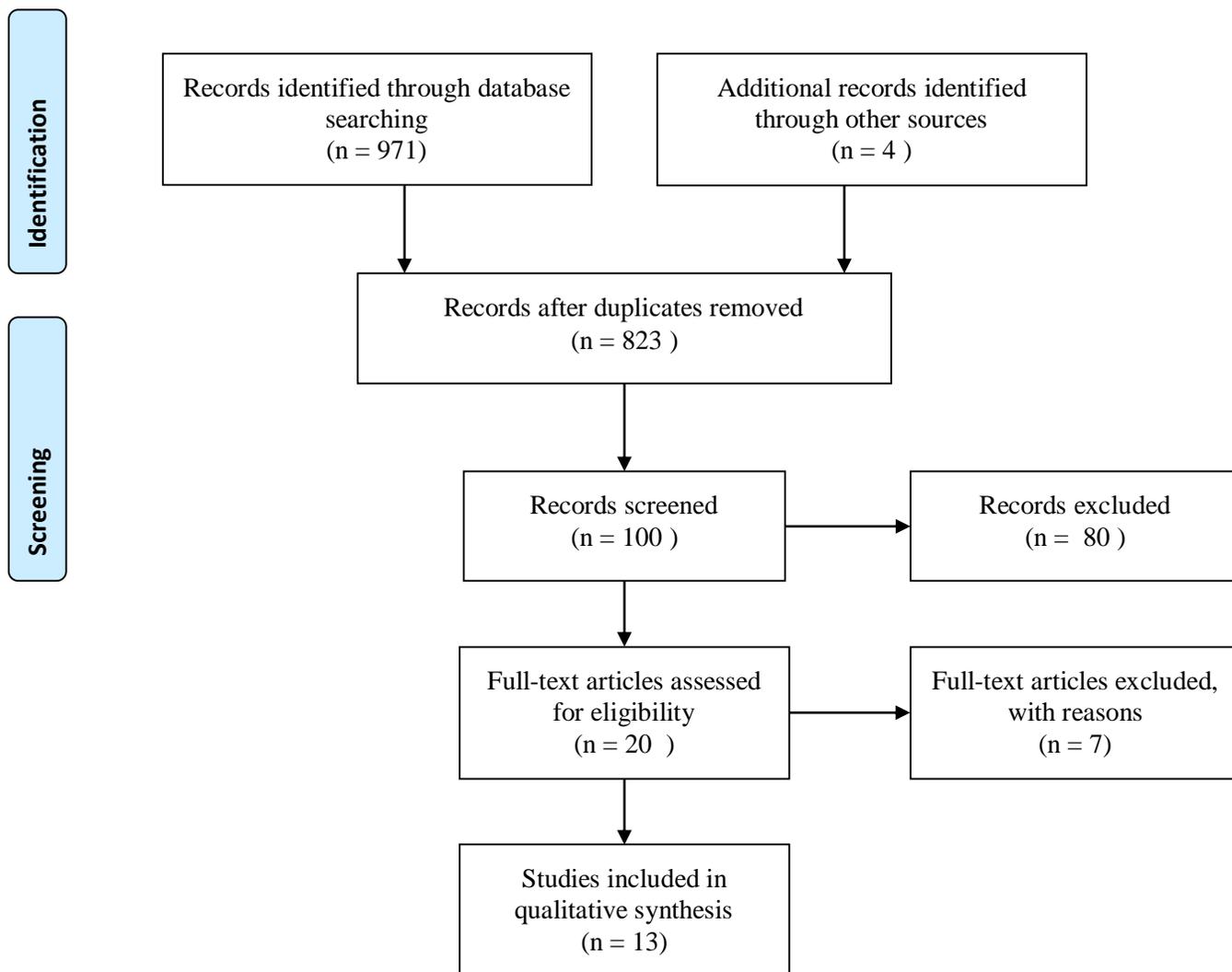
Hospitals have an essential role in preventing and overcoming COVID-19. However, the number of health workers at the forefront of this is limited, so it is essential to pay attention to the safety of health workers to remain protected and provide optimal health services in handling COVID-19 in hospitals. Furthermore, if the transmission of COVID-19 occurs to health workers in hospitals, it will cause obstacles to the COVID-19 response process, including in Indonesia. How can we prevent COVID-19 infections in medical workers in the hospital? Therefore, knowing the factors affecting COVID-19 infections in medical workers in hospitals and analyzing these factors to find solutions is crucial in preventing COVID-19 infection in medical workers in the hospital. This study aims to identify factors associated with COVID-19 infections in medical workers in the hospital to guide the prevention of COVID-19 infections in medical workers in the hospital.

2. Methods

This systematic review was conducted using the PRISMA guidelines. Databases including PubMed, Scopus, SpringerLink, and Proquest were searched to identify relevant articles from January-1st, 2020, until December-23, 2020. The search terms included “covid-19”, “medical worker”, and “risk factor”. Boolean terms, AND and OR, were used to separate the keywords. There were restrictions in terms of the country only in Asia. Reference lists of all relevant articles and related citation search tools were checked for any additional publications. Full-text of relevant articles were retrieved manually.

Studies identified by searchers conducted in the selected databases entered in a table using Microsoft Excel® 2016 and identified the duplicated articles. Two reviewers screened the titles and abstracts according to the selection criteria. For each article, we extracted the country and city where the study was conducted or affiliated institution of the first author, study design, infection-related data, and risk factors associated with virus transmissibility. Data of articles were extracted and entered in a table using Microsoft Excel® 2016.

PRISMA Flow Diagram



3. Results and discussion

We identified 971 studies from PubMed, SpringerLink, Scopus, and Proquest and four studies through other sources using the search criteria. A total of 100 records were screened after the removal of duplicates. In addition, a total of 20 full-text articles were assessed for eligibility, and seven articles were excluded because the results did not relate to this systematic review. Finally, thirteen studies were included in this systematic review.

All selected studies were published in 2020. Countries where studies were conducted were: China (n=7), Bangladesh (n=1), Lebanon (n=1), Turkey (n=1), India (n=2), and Qatar (n=1). Studies type were case series (n=1), case report (n=1), cohort study (n=1), cross-sectional study (n=9), and case control (n=2).

The most-reported infection-related risk factors for SARS-Cov-2 were: inadequate use or non-usage of PPE (n=10), work environment (n=6), the behavior of medical worker (n=5), the risk for aerosol-generating procedures (n=3), the scarcity of personal protective equipment (PPE) (n=2), and late diagnosis of COVID-19 (n=1). (Table 1)

Risk Factor	N
Scarcity of PPE	2 (7,1%)
Work environment	6 (21,4%)
Inadequate use or non-usage of PPE	10 (35,7%)
Aerosol-generating procedures – AGP	3 (10,7%)
Late diagnosis of COVID-19	1 (3,5%)
Habits of medical worker (poor hand hygiene, low awareness, touching nose, eye, mouth)	6 (21,4%)
Total	28 (100%)

Three factors that affect the increase in the number of cases of health workers infected with COVID-19 in this systematic review are inadequate use or non-usage PPE (35,7%), work environment (21,4%), and habits of medical worker (21,4%). Ten studies reported inadequate use or non-usage PPE, i.e. [7- 16]. In addition, six studies reported work environment, i.e., [7], [8], [10], [17], [15], [16]. Finally, five studies reported habits of medical workers (poor hand hygiene, low awareness, touching nose, eye, mouth), i.e., [9], [11], [12], [17], [15].

[7] reported high-risk department group had a 2.13 times higher risk in developing COVID-19 compared with the general department group. After contact with patients in the high-risk department, bad hand hygiene had 3.07 times higher risk of getting COVID-19 infection. [8] evaluated 103 professional staff with COVID-19 possibly infected in working environment in hospital (84,5%), and forty-three (41.8%) thought their infection was related to protective equipment, utilization of standard equipment (masks and gloves). [9] reported that physicians unaware of direct participation in COVID-19 patient care, unaware of the COVID-19 status while performing the aerosol-generated procedure (AGP), and reused the medical gown had higher odds of being COVID-19 positive. Physicians who use face shields/goggles and regular decontamination of the patient's surroundings while performing patient care and use N95 masks while performing AGP had protective roles against COVID-19.

4. Risk factors of COVID-19 infection in medical workers

The objective of this systematic review was to identify infection-related risk factors of medical workers involved in the treatment of COVID-19 patients. Risk factors originated from experts' opinions observed in cross-sectional, cohort, case series, and case-control studies. Because COVID-19 is caused by an infectious agent identified only recently, there were no expectations of studies with an adequate follow-up. In this study, several risk factors found to be associated to COVID-19 infection among medical workers were scarcity of PPE, work environment, inadequate use or non-usage of PPE, aerosol-generating procedures (AGP), late diagnosis of COVID-19, and habits of medical worker (poor hand hygiene, low of awareness, touching nose, eye, mouth). Among those risk factors, the most crucial risk factors were the use of personal protective equipment, work zoning in hospitals, and the habit of health workers.

The inappropriate use of PPE while caring for COVID-19, staying in the same personnel break room as an HCW without a medical mask for more than 15 minutes, consuming food within 1 m of an HCW, and failure to keep a safe social distance from an HCW were statistically significant risk factors for infection [12]. The use of PPE that is not according to standards and the habit of health workers who do not understand the prevention and control of COVID-19 need to be the primary concern in every health service. The scarce limitations of PPE can cause substandard PPE usage. The lack of experience and poor level of knowledge regarding modes of transmission of the disease affect health workers' habits. These could partly explain the poor preventive practices of physicians [18]. The use of PPE is critical, especially in high-risk departments and when performing aerosol actions. The aerosol action can cause the SARS-CoV 2 virus to spread in the

air surrounding the room. In research [19] SARS-CoV-2 was widely distributed in the air and on object surfaces in both the ICU and general ward (GW), implying a potentially high infection risk for medical staff and other close contacts. The environmental contamination was more significant in the ICU than in the GW; thus, medical staff working in the ICU should take better protective measures. The SARS-CoV-2 aerosol distribution characteristics in the ICU indicate that the transmission distance of SARS-CoV-2 might be four meters.

The work environment also affects the risk of COVID-19 infection in medical workers. In this case, close contact with confirmed and unconfirmed COVID-19 patients increases the risk. In addition, the late diagnosis of infected medical workers without symptoms and the behavior of medical workers who do not maintain distance between medical workers can increase the spread of the COVID-19 virus to medical workers [10]. The longer incubation time of COVID-19 makes it challenging to recognize patients with the disease at an early stage. In addition, the unavailability of sufficient protective measures in clinical departments other than fever clinics and wards put non-first-line medical workers at a higher risk [10].

Concerning the infection-related risk factor of medical workers, we highlight the fact that for measures of medical worker protection, PPEs are the primary key. The strategies that has been implemented to deal with the current situation of the pandemic are ensuring the provision of PPEs, adequate training for medical workers in using the PPE, and the adoption of standard precaution. Medical workers have to get adequate training on handling PPE, such as using and removing the mask, medical gown, gloves, and hand hygiene so as to prevent COVID-19 infections while performing care using the PPE. However, potential COVID-19 infection situations in the field of work and the habits of daily activity that may constitute a potential risk for contamination among medical workers are also highly relevant as infections can also occur during daily contacts with other medical workers in the hospital. In this sense, we must establish a strategy to change habits, raising awareness of medical workers that transmission can also happen during meals and group meetings. In addition, implementing restrictions on medical workers' working hours, periodic medical examinations for health workers, especially for sick medical workers, carrying out testing, tracing, and proper treatment of infected medical workers, implementing a work program according to standards, and intensive training of medical workers working in isolation rooms should reduce the risk of COVID-19 infection in medical workers.

5. Conclusion

During the COVID-19 pandemic situation, medical workers face occupational risks of morbidity and mortality caused by COVID-19 infections. The scarcity of PPE remains a crucial factor associated to COVID-19 infections in medical workers in the hospital. However, there are other important factors that need to be considered to reduce COVID-19 infections such as the habit of medical workers in complying to the preventive actions in their daily practice and also the work environment in the hospital.

There are several limitations to our study. First, the studies included in our analysis were only from six countries, while more than 200 countries have been affected by COVID-19. Second, because COVID-19 is caused by an infectious agent identified only recently, there were no expectations of studies with an adequate follow-up.

6. References

[1] WHO. Coronavirus [Internet]. [cited 23 Desember 2020]. Available from: https://www.who.int/health-topics/coronavirus#tab=tab_1

- [2] Kementerian Kesehatan Republik Indonesia. COVID-19 [Internet]. [cited 23 Desember 2020]. Available from: <https://infeksiemerging.kemkes.go.id/>
- [3] Xiang YT, Jin Y, Wang Y, Zhang Q, Zhang L, Cheung T. Tribute to health workers in China: a group of respectable population during the outbreak of the COVID-19. *Int J Biol Sci.* 2020;16:1739–1740.
- [4] Chou R, Dana T, Buckley DI, Selph S, Fu R, Totten AM. Epidemiology of and risk factors for coronavirus infection in health care workers. *Ann Intern Med.* 2020;173: 120–136
- [5] Heinzerling A, Stuckey MJ, Scheuer T, et al. Transmission of COVID-19 to health care personnel during exposures to a hospitalized patient - Solano County, California, February 2020. *MMWR Morb Mortal Wkly Rep.* 2020;69:472–476
- [6] Moghaddam, Hossein Hassanian, N. Zamani, A.A Kolahi. COVID-19 pandemic, healthcare providers' contamination and death: an international view. *Critical Care.* 2020; 24:208
- [7] Ran L, Chen X, Wang Y, Wu W, Zhang L, Tan X. Risk Factors of Healthcare Workers With Coronavirus Disease 2019: A Retrospective Cohort Study in a Designated Hospital of Wuhan in China. *Clin Infect Dis.* 2020;71(16):2218–21.
- [8] Jin YH, Huang Q, Wang YY, Zeng XT, Luo LS, Pan ZY, et al. Perceived infection transmission routes, infection control practices, psychosocial changes, and management of COVID-19 infected healthcare workers in a tertiary acute care hospital in Wuhan: A cross-sectional survey. *Mil Med Res.* 2020;7(1):1–13.
- [9] Khalil MM, Alam MM, Arefin MK, Chowdhury MR, Huq MR, Chowdhury JA, et al. Role of Personal Protective Measures in Prevention of COVID-19 Spread Among Physicians in Bangladesh: a Multicenter Cross-Sectional Comparative Study. *SN Compr Clin Med.* 2020;2(10):1733–9.
- [10] Lai X, Wang M, Qin C, Tan L, Ran L, Chen D, et al. Coronavirus Disease 2019 (COVID-2019) Infection Among Health Care Workers and Implications for Prevention Measures in a Tertiary Hospital in Wuhan, China. *JAMA Netw Open.* 2020;3(5):e209666.
- [11] Wang Y, Wu W, Cheng Z, Tan X, Yang Z, Zeng X, et al. Super-factors associated with transmission of occupational COVID-19 infection among healthcare staff in Wuhan, China. *J Hosp Infect.* 2020;106(1):25–34.
- [12] Celebi G, Piskin N, Arzum Celik Beklevic, Altunay Y, Keles AS, T€uz MA, et al. Specific risk factors for SARS-CoV-2 transmission among health care workers in a university hospital. *Am J Infect Control* 48. 2020;48(January):1225–30.
- [13] Chatterjee, P., Anand T., Singh, Kh. J., Rasaily R., Singh R., Das S., Singh H., Praharaj I., Gangakhedkar R.R.. Healthcare workers & SARS-CoV-2 infection in India: A case-control investigation in the time of COVID-19. *Indian J Med Res.* 2020;151:459–67.
- [14] Lai X, Zhou Q, Zhang X, Tan L. What influences the infection of COVID-19 in healthcare workers? *J Infect Dev Ctries.* 2020;14(11):1231–7.

- [15] 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.
- [16] Bajaj JS, Solanki SL. Study of risk factors and psychological impact in physicians diagnosed with COVID-19: An online, postexposure, cross-sectional survey. *J Anaesthesiol Clin Pharmacol*. 2020;36:345–9.
- [17] Alajmi J, Jeremijenko AM, Abraham JC, Alishaq M. COVID-19 infection among healthcare workers in a national healthcare system: The Qatar experience. *Int J Infect Dis*. 2020;100(January):386–9.
- [18] Abou-Abbas L, Nasser Z, Fares Y, Chahrour M, El Haidari R, Atoui R. Knowledge and practice of physicians during COVID-19 pandemic: A cross-sectional study in Lebanon. *BMC Public Health*. 2020;20(1):1–9.
- [19] Guo Z-D, Zhong-Yi Wang, Shou-Feng Zhang, Xiao Li, Lin Li CL, Yan Cui, Rui-Bin Fu, Yun-Zhu Dong, Xiang-Yang Chi, Meng-Yao Zhang, Kun Liu, Cheng Cao, Bin Liu, Ke Zhang, Yu-Wei Gao, Bing Lu WC. Aerosol and Surface Distribution of Severe Acute Respiratory Syndrome Coronavirus 2 in Hospital Wards, Wuhan, China, 2020. *Indoor Built Environ*. 2020;26(7):1586–91.