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ANALYSIS OF USE, AVAILABILITY OF PERSONAL PROTECTION EQUIPMENT (PPE) AND COVID-19 INFECTIONS CASE ON HEALTH WORKERS: A LITERATURE REVIEW

Kajian Literatur Penggunaan, Ketersediaan Alat Pelindung Diri (APD) Dan Kasus Infeksi Covid-19 Pada Tenaga Kesehatan

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ABSTRACT

COVID-19 is an infectious disease caused by the SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) virus. During the pandemic, health workers had a higher risk of being exposed to the coronavirus. This study aims to analyze the availability and use of PPE in COVID-19 infection cases among health workers. This study used the scoping review method. Selected articles were chosen by topic and according to the inclusion criteria. Twenty-four articles were selected based on the research locations being in the US, China, Italy, Germany, Ethiopia, India, Pakistan, Nigeria, Australia, and Israel. Health workers have used PPE when handling specimens or patients with COVID-19 symptoms. The health workers varied, including doctors, dentists, veterinarians, public health officers, nurses, pharmacists, and medical personnel who both treated COVID-19 patients and did not. The type of PPE most widely used was masks. Health care facilities have provided PPE, but its access, quality, and availability varied. Cases of COVID-19 infection in health workers varied, as did their symptoms. PPE availability indirectly affects the high or low number of cases of COVID-19 infection among health workers, respectively, so the future availability of PPE for health workers must be considered.
Keywords: *COVID-19, infectious, health workers, PPE use, PPE availability.*

ABSTRAK

COVID-19 merupakan penyakit menular yang disebabkan oleh virus SARS-CoV-2 (*Severe Acute Respiratory Syndrome Coronavirus* 2). Selama pandemi, tenaga kesehatan memiliki risiko lebih tinggi terpapar virus corona. Tujuan dari penulisan ini yaitu menganalis ketersediaan dan penggunaan APD terhadap kasus infeksi COVID-19 pada tenaga kesehatan. Penelitian ini menggunakan metode *scoping review*. Artikel yang dipilih sesuai dengan topik dan kriteria inklusi. Didapatkan 24 artikel dengan lokasi penelitian di AS, Cina, Italia, Jerman, Ethiopia, India, Pakistan, Nigeria, Australia, dan Israel. Tenaga kesehatan telah menggunakan APD saat menangani pasien ataupun spesimen pasien dengan gejala COVID-19. Tenaga kesehatan yang diteliti bervariasi, meliputi dokter, dokter gigi, dokter hewan, *public health officer*, perawat, apoteker, tenaga medis yang menangani pasien COVID-19 ataupun tidak. Jenis APD yang paling banyak digunakan oleh tenaga kesehatan yaitu masker. Fasilitas pelayanan kesehatan telah menyediakan APD, namun akses, kualitas, dan ketersediaannya bervariasi. Kasus infeksi COVID-19 pada tenaga kesehatan bervariasi, begitu pula dengan gejala yang timbul. Penggunaan APD dapat meminimalisir risiko penularan COVID-19 pada tenaga kesehatan. Ketersediaan APD berpengaruh tidak langsung terhadap tinggi atau rendahnya kasus infeksi COVID-19 pada tenaga kesehatan, sehingga ketersediaan APD untuk tenaga kesehatan harus diperhatikan.
Kata kunci: COVID-19, menular, tenaga kesehatan, penggunaan APD, ketersediaan APD.

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INTRODUCTION

Coronavirus disease or COVID-19 is an infectious disease that emerged at the end of 2019 in December, in Wuhan, China. COVID-19 is caused by the SARS-CoV-2 virus (Severe Acute Respiratory Syndrome Coronavirus 2) and is often referred to as the coronavirus. The spread of coronavirus in the world was very fast in a short amount of time, and the number of positive cases increased dramatically in all countries. As of June 2021, the number of COVID-19 cases worldwide reached 175,847,347 with a death total of 3,807,276. The WHO estimates that the death rate for COVID-19 in health workers was around 80,000 to 180,000 people. In the period from early 2020 to mid-2021, cases of COVID-19 infection were very high. According to the WHO, COVID-19 spreads from human to human through droplets or the body fluids that come out through coughing and sneezing, as well as the fecal-oral route, and direct contact. Symptoms that often appear in people infected with the coronavirus include a fever, dry cough, and fatigue (WHO, 2020a). The incubation period for COVID-19 ranges between 2-14 days with a range of symptoms. Anyone can be infected with the coronavirus but elderly people over 60 years old and those who have co-morbidities such as high blood pressure, heart disease, diabetes, and obesity can be at risk of severe COVID-19 (CDC, 2021) (WHO, 2020b).

From the beginning of the emergence of the COVID-19 outbreak, health workers have acted as the front line in dealing with COVID-19 cases. Thus, health workers have a high risk of being exposed to the coronavirus. Various efforts have been undertaken for health workers to reduce their risk of exposure to the coronavirus, one of which is the use of personal protective equipment (PPE). The use of PPE is expected to minimize the risk of transmission of the novel coronavirus, especially for health workers who have direct contact with positive COVID-19 patients. PPE in the healthcare environment must be present. PPE for health workers to protect them against exposure to the coronavirus includes medical masks, glasses, protective clothing, gloves and boots (WHO, 2020c). It is interesting to study the availability and use of PPE for health workers during the pandemic, when knowledge about the virus was still minimal. This is because the time of the research in this article was carried out in the early days of the pandemic. At the beginning of the pandemic, there was also a shortage of PPE due to the large demand and low production, which was due to the implementation of lockdowns in several countries (WHO, 2020c). Lockdown, according to Cambridge, is a condition when a person is not allowed to leave or enter an area due to an emergency. Lockdown has been proven to reduce the spread of the virus (Yunus and Rezki, 2020). The low use of PPE can be caused by the absence of clear policies and guidelines, causing health workers to be less compliant when using PPE (Gurses et al., 2018). In addition, a weak health system can cause panic and fatigue in the workforce which can increase the risk of coronavirus infection (Mhango et al., 2020). The purpose of this paper is to analyze the availability and use of PPE and cases of COVID-19 infection among health workers.

METHOD

The type of research used in this study was a scoping review. This study presents a descriptive analysis to describe the availability of PPE and the use of PPE in cases of COVID-19 infection in health workers through a literature study. The online journal platforms used to search for articles were Pubmed, Science Direct, and Springer. The criteria for the articles used were articles published between 2019 - 2020, original research, written in English, published in scientific journals and indexed in at least Scopus Q3, available with a free full text, and on the availability of PPE, the use of PPE, and COVID-19 infection. In the early 2020 to mid-2021 period, knowledge about this virus was still limited, so publications related to the topic were relatively limited. The keywords used were “healthcare” OR “healthcare facility” OR “hospital” AND “healthcare workers” OR “health workers” OR “doctors” OR “nurses” OR “dentist” AND “PPE use” OR “Personal Protective Equipment” OR “PPE supply” OR “COVID-19” OR “Sars-CoV 2” OR “coronavirus” OR “COVID-19 in healthcare” OR “COVID-19 in health workers” OR “healthcare associated COVID-19 infection”. Article selection was carried out in January - February 2021. The search yielded 24 articles. In Figure 1, the article search flow is presented.

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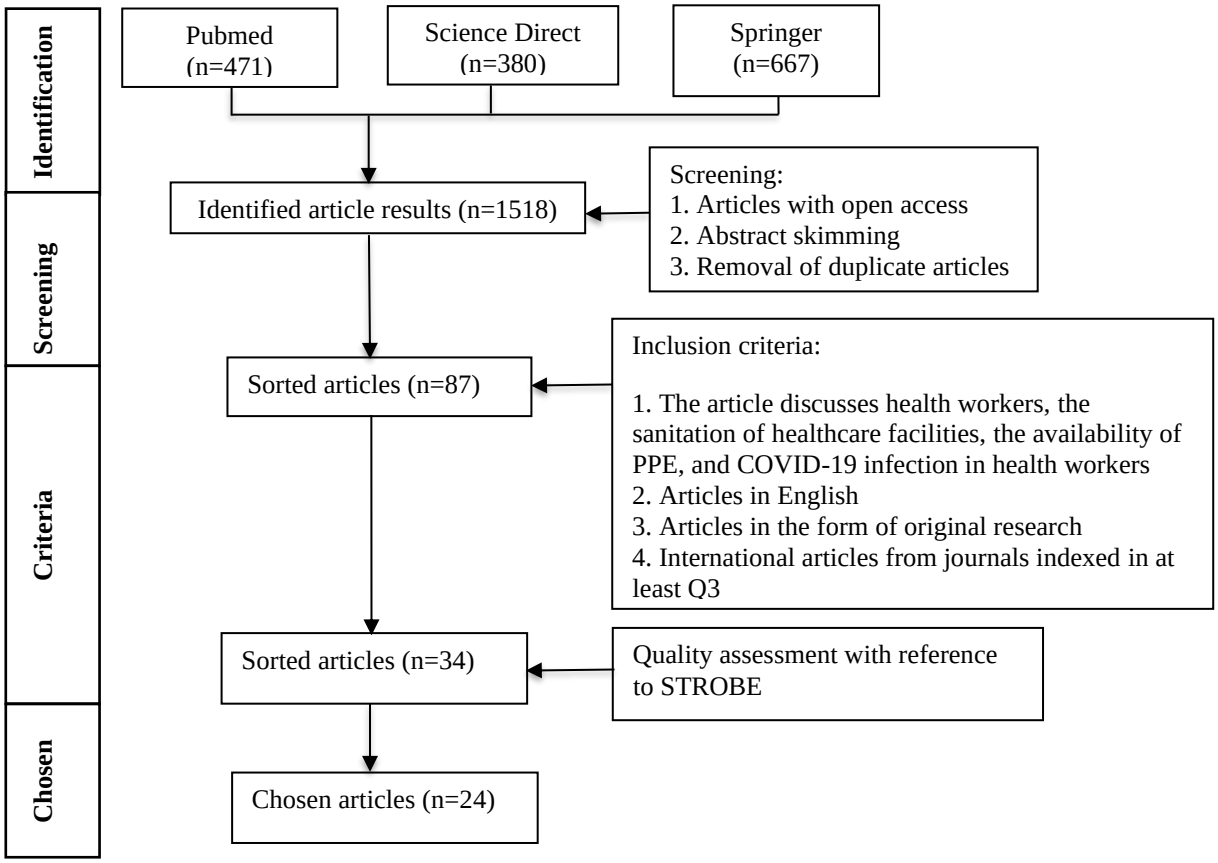

Figure 1.1 Article selection flowchart

RESULTS

Based on the article search that has been done, there are 1,518 articles published with the specified keywords, with 471 articles obtained from PubMed, 380 articles from Science Direct, and 667 articles from Springer. The next stage was filtering the articles according to the inclusion criteria (87 articles). After sorting the articles so then duplication did not occur and after making sure the full text was available for free, a total of 24 articles were obtained according to the research topic.

There were 11 articles on the use of Personal Protective Equipment by health workers (Table 1).

Use of Personal Protective Equipment (PPE) by Health Workers

Table 1. Use of Personal Protective Equipment (PPE) by Health Workers

Writer	Country	Result	Ppe Type				
			Mask	Protective Dress	Protective Glasses	Gloves	Others
(Estrich *et al.*, 2020)	USA	99.6% of dentists used basic clinical PPE.	Surgical mask, N95 mask	Protective dress	Goggles, face shield	Gloves	APD klinis dasar
(Wang *et al.*, 2020)	China	As many as 92% of health workers used medical masks or surgical masks correctly	97.83% used medical masks or surgical masks	n/a	n/a	n/a	n/a

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Continuation of Table 1. Use of Personal Protective Equipment (PPE) by Health Workers

Writer	Country	Result	Ppe Type				
			Mask	Protective Dress	Protective Glasses	Gloves	Others
(Bontà *et al.*, 2020)	Italy	Overall health workers use PPE	82.80% use surgical masks	90.10% use disposable clothes	90.55% wear protective glasses or visors	n/a	n/a
(Neuwirth *et al.*, 2020)	Germany	85% of health workers in COVID-19 wards and 76% of health workers in non-COVID-19 wards use PPE	surgical mask	n/a	n/a	n/a	n/a
(Asemahagn, 2020)	Ethiopia	62% of health workers engage in good COVID-19 prevention practices	80% wear surgical masks	n/a	n/a	74% use gloves	n/a
(Zhang *et al.*, 2020)	Cina	82.64% of health workers know how to use masks and other PPE correctly	61.90% surgical masks, 27.60% used disposable medical masks, 10.23% used medical protective masks, and 1.09% used particulate protective masks	n/a	n/a	n/a	n/a
(Jin *et al.*, 2020)	Cina	53.4% of health workers always follow the procedures for using and removing PPE	use of masks 66.0%	use of gowns 28.2%	use of face shields/screens 25.2%	use of gloves 51.5%	use of protective shoes 23.3%
(Chatterjee *et al.*, 2020)	India	84.92% of health workers use PPE, and the rest (15.08%) never use PPE	82.01% wear masks	40.21% use a protective gown	43.12% use a face shield	70.63% use gloves	43.92% use head protection; 35.19% use shoe protectors
(Hussain *et al.*, 2021)	Pakistan	88.4% of health workers often use PPE and 11.6% of health workers sometimes use PPE	mask	protective dress	n/a	Gloves	n/a
(Ejeh *et al.*, 2020)	Nigeria	79.1% of doctors, 96.7% of veterinarians, 98% of public health officers, 77.3% of nurses, and 87.5% of pharmacists use PPE when handling specimens from patients with signs of COVID-19	n/a	n/a	n/a	n/a	n/a

Notes:
n/a : *not available*

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Based on the data presented in Table 1, the research conducted on medical personnel in terms of the use and types of PPE varies greatly. Based on the research conducted in the US, 99.6% of dental medical personnel complied with wearing PPE, with the types of PPE used being surgical masks, protective gowns, eye protection and gloves, which are the basic clinical PPE. They used N95 masks or equivalent for protection against aerosols (Estrich et al., 2020). Most of the research results showed that medical personnel used PPE when handling patients or patient specimens with COVID-19 symptoms, while the use of PPE among medical personnel varied from 99.6% to 62%. The medical personnel studied also varied, including doctors, dentists, veterinarians, public health officers, nurses, pharmacists, and other medical personnel who both treat COVID-19 patients and not (Estrich et al., 2020; Neuwirth, et al 2020; Ejeh et al., 2020). The type of PPE that was most widely used by health workers was masks, which varied in specification. Other types of PPE that were widely used were protective gowns (covering), eye protection (goggles, face shields) and gloves (Asemahagn, 2020; Bontà et al., 2020; Chatterjee et al., 2020; Estrich et al., 2020; Jin et al., 2020; Hussain et al., 2021).

Availability of Personal Protective Equipment (PPE) to Health Workers

Table 2. Availability of Personal Protective Equipment (PPE) to Health Workers

AUTHORS	COUNTRY	**RESULTS**
(Felice *et al.*, 2020)	Italy	77% of health workers stated that PPE was available in the workplace, but only 22% considered the PPE to be adequate in terms of quality and quantity.
(Firew et al., 2020)	USA	PPE was available to 47,60% of health workers.
(Halcomb *et al.*, 2020)	Australia	Gowns (26,7% always available, 33,2% sometimes, 40,1% never), P2/N95 masks (23,3% always available, 31,3% sometimes, 45,4% never), surgical masks (39,7% always available, 38,2% sometimes, 22,1% never), and protective eyewear (45,5% always available, 25,9% sometimes, 28,6% never)
(Savoia *et al.*, 2020)	Italy	13% of respondents always had access to PPE, 50% sometimes have access, and 37% never/rarely have access.
(Asemahagn, 2020)	Ethiopia	A total of 52% found PPE to be available.
(Huang *et al.*, 2020)	China	As many as 12,6% of health workers are very satisfied, 35,4% are satisfied, 28,4% are neutral, 15,1% are not satisfied, and 6,4% are very dissatisfied with the availability of PPE.
(Gesser-Edelsburg *et al.*, 2020)	Israel	The availability of PPE is fulfilled by 31%.
(Dhahri *et al.*, 2020)	Pakistan	59% reported the unavailability of PPE and only 24.9% were satisfied with the availability of PPE they had. 78% of health workers had access to disposable masks.

Based on the articles analyzed, 8 articles discussed the availability of PPE. All of these articles examined the satisfaction and experiences of health workers regarding access to and the availability of PPE in health facilities, their workplaces. A study conducted in Italy found that 77% of health workers stated that PPE was available in the workplace, while only 22% considered that the available PPE was complete in terms of quantity and quality. Satisfaction with the availability and access of PPE is relatively low, mostly below 50% (Felice et al., 2020; Firew, Ellen D. Sano, et al., 2020; Halcomb et al., 2020). The availability of PPE was the lowest, with 13% of health workers having access to PPE (Savoia et al., 2020). As for the satisfaction of health workers with the availability of PPE, the lowest was found in China, with a percentage of 12.6% (Huang et al., 2020).

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Table 3. Cases of COVID-19 Infection in Health Workers

AUTHORS	DIAGNOSIS METHOD	COUNTRY	RESULTS
(Firew, et al. 2020)	Swab and antigen test	USA	29,3% of respondents tested positive for COVID-19. Health workers in the emergency department (31,64%) were more likely to contract COVID-19 than those in the ICU (23,17%) and inpatient departments (25,53%).
(Algado-Sellés *et al.*, 2020)	PCR swab test	Spain	Of the 3,900 health workers in a department, (45,9%) showed symptoms or were part of contact tracing. The prevalence of health workers with symptoms was 20,1% (784/3,900; 95% CI = 18,8, 21,4), while those confirmed to have COVID-19 was 4.0% (156/3,900; 95% CI = 3.4, 4 ,6), and those with severe COVID-19 disease made up 0,5% (18/3.900; 95% CI = 0.2, 0.7).
(Barrett *et al.*, 2020)	PCR swab test	USA	41 (5%) health workers were positively infected with SARS-CoV-2, (34,2%) who reported symptoms. The majority of those infected were nurses (62,5%). Positive tests increased for two weeks in line with the increase in confirmed cases in the hospital and the surrounding city.
(Bontà *et al.*, 2020)	Questionnaire	Italy	Only 0.25% of health workers (dentists) tested positive for COVID-19. The most common symptoms were fatigue (8,19%), headache (7,81%) and a sore throat (7,32%).
(Colaneri *et al.*, 2021)	PCR swab test	Italy	The cumulative incidence of SARS-CoV-2 infection among health workers was 3,54%.
(Chatterjee *et al.*, 2020)	PCR swab test	India	In this study, 5% of health workers were confirmed positive for COVID-19. In the multivariate analysis, health workers who performed endotracheal intubation had a higher chance of becoming infected with SARS-CoV-2 [(AOR): 4.33, 95% CI: 1.16-16.07].
(Chatterjee *et al.*, 2020)	PCR swab test	India	Here, 5% of health workers tested positive for COVID-19. In the multivariate analysis, health workers who performed endotracheal intubation had a higher chance of becoming infected with SARS-CoV-2 [(AOR): 4.33, 95% CI: 1.16-16.07].
(Estrich *et al.*, 2020)	Swab test and blood test	USA	An estimated 0.9% had confirmed or probable COVID-19 infection.
(Eyre *et al.*, 2020)	PCR swab test and immunoassay	UK	COVID-19 was found in 11,2% of health workers. COVID-19 was found more among the staff working in areas exposed to COVID-19.
(Felice *et al.*, 2020)	Questionnaire	Italy	Among the population tested, 18% tested positive for COVID-19, while 33% were asymptomatic.
(Jin *et al.*, 2020)	Hospital medical records	China	There were 105 infected health workers. 84,5% got infected from the hospital work environment, 1,0% felt that the infection was caused by a laboratory environment, and 4.9% felt that they had got infected in the community environment. 41,8% felt that their infection was related to personal protective equipment. The three main symptoms felt before diagnosis were a fever by 41,8%, lethargy 33,0% and muscle pain 30,1%.
*(*Nguyen *et al,. 2020)*	Questionnaire	UK and USA	UNITED STATES OF AMERICA The prevalence of COVID-19 among health workers was 2,474 per 100,000 health workers. Compared to the general public, health workers were more at risk of being infected with COVID-19 (11,6195% CI 10.93–12.33).
(Lai *et al.*, 2020)	Nucleic acid test and clinical diagnosis	China	Of the 325 health workers, 151 (46,6%) health workers infected with COVID-19

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Continuation of Table 3. Cases of COVID-19 Infection in Health Workers

AUTHORS	DIAGNOSIS METHOD	COUNTRY	RESULTS
(Zhang *et al.*, 2020)	Blood tests, antibodies, swabs, and CT scans.	China	No infected health workers (0).
(Wang *et al.*, 2020)	Questionnaire	China	33,7% of health workers were infected with COVID-19
(Ran *et al.*, 2020)	PCR swab test	China	For the health workers infected with COVID-19, 85,71% showed symptoms of fever, 60,71% a cough, and 7,14% a headache.

Based on the articles analyzed, 15 articles were found discussing COVID-19 infection in health workers. The diagnostic methods used in each article varied, such as SWAB tests, antigens, PCR, immunoassays, diagnoses, medical records, nucleic acid tests, CT scans, and questionnaires. The lowest case rate for COVID-19 infection among health workers was found in the study conducted by Zhang et al. (2020), which stated that there were no cases of COVID-19 infection. This can happen because the health care facilities implement health protocols properly, and the health workers comply with these health protocols. Health workers should also get information about the early symptoms of infection, transmission, standard practice procedures, how to use PPE properly, and attend work protection training (Zhang et al., 2020). Meanwhile, the percentage of other infections was below 20% (Algado-Sellés et al., 2020; Barrett et al., 2020; Bontà et al., 2020; Colaneri et al., 2020; Chatterjee et al., 2020; Estrich et al., 2020; Eyre et al., 2020; Felice et al., 2020; Jin et al., 2020; Nguyen et al., 2020). The highest number of cases of COVID-19 infection in health workers had a percentage of 46,6% (Lai et al., 2020)

Table 4. Analysis of the Use of PPE for COVID-19 Infection Cases

AUTHORS	COUNTRY	RESULTS
(Eyre *et al.*, 2020)	UK	Health workers who are in contact with COVID-19 patients and who do not use PPE are at risk of being infected with COVID-19 (1,44, (1,24–1,67, p<0,001).
(Algado-Sellés *et al.*, 2020)	Spain	COVID-19 infection occurs in health workers who come into contact with COVID-19 patients without using adequate PPE (AOR = 2,2, 95% CI = 1,2,-3,9), especially when handling patients directly.
(Barrett *et al.*, 2020)	USA	Consistent use of PPE correlates with low infection rates, even when the health workers directly treat patients suspected of or who are infected with COVID-19.
(Zhang *et al.*, 2020)	China	Inappropriate use of PPE is the cause of COVID-19 infection in health workers (21,14%).
(Jin *et al.*, 2020)	China	The lack of use of PPE (only masks) caused 32,6% of health workers to be infected with COVID-19.
(Lai *et al.*, 2020)	China	Protective factors for health workers against COVID-19 infection include the use of PPE, including masks (p < 0,001), gloves (p < 0,001), goggles (p < 0,001), protective clothing (p < 0,001), protective gowns (p < 0,001) <0001), shoe covers (p < 0,001), and headgear (p < 0,001).
(Wang *et al.*, 2020)	China	The main factor that can reduce the risk of COVID-19 infection is the correct use of medical or surgical masks. The main factor contributing to COVID-19 infection among medical personnel is touching the cheeks, nose and mouth while working.
(Ran *et al.*, 2020)	China	COVID-19 infection in health workers who use PPE inappropriately has a relative risk of 2.82 (95% CI = 1,11–7,18, P <0,05).
(Chatterjee *et al.*, 2020)	India	The risk of COVID-19 transmission increases by 5.33 if health workers do not use PPE.

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Based on the articles that have been analyzed, 9 articles were found linking the use of PPE with cases of COVID-19 infection in health workers. All articles stated that there is a relationship between the use of PPE and cases of COVID-19 infection. Three studies stated that a lack of PPE use can increase the risk of being infected with COVID-19 (Algado-Sellés et al., 2020; Eyre et al., 2020; Jin et al., 2020, Chatterjee et al., 2020). Health workers who used PPE inappropriately can cause COVID-19 infection by 21.14% and have a 2.82 times greater risk (Ran et al., 2020; Zhang et al., 2020). Despite the more consistent use of PPE among health workers who provided care for patients with suspected or confirmed COVID-19, this may explain why ICU workers exhibited low infection rates compared to other units. However, this needs to be confirmed in light of reports of variations in access to PPE, the reuse of PPE, and the types of PPE provided across units and hospital roles. This has the potential to result in measurement errors that may obscure the relationship between PPE use and SARS-CoV-2 infection (Barrett et al., 2020).

Table 5. Analysis of the Availability of PPE in Relation to COVID-19 Infection Cases

AUTHORS	COUNTRY	RESULT
(Firew *et al.*, 2020)	United States	Health workers reported that the availability of PPE being less than half the time reduced infections by 33% (PR = 0.67, 95% CI 0.56 - 0.79), while the rest reported that the availability of PPE most of the time reduced infections by 45% (PR = 0.55, 95% CI 0.46 - 0.66).
(Nguyen *et al.*, 2020)	England and United States	PPE being used by health workers repeatedly (adjusted HR 1.46, 95% CI 1.21–1.76) and where there is inadequate PPE (1.31, 1.10–1.56) can increase the risk of infection.
(Lai *et al.*, 2020)	China	COVID-19 infection was found to be related to the satisfaction of health workers and the hospital's response when providing PPE. Uninfected health workers were more satisfied than infected health workers in terms of the provision of PPE by the hospital (p = 0.031).
(Huang *et al.*, 2020)	China	At the beginning of the pandemic, many health workers became infected with COVID-19. At that time, there was also a shortage of PPE. However, when the provision of PPE was managed centrally, the number of COVID-19 infections in health workers decreased.
(Zhang *et al.*, 2020)	China	The lack of availability and damage to PPE (16.42%) was the cause of COVID-19 infection.
(Jin *et al.*, 2020)	China	According to 44.2% of health workers, the cause of COVID-19 infection was generally due to the lack of PPE availability.

Based on the articles that have been analyzed, 6 articles were found that link the availability of PPE with cases of COVID-19 infection in health workers. There were 2 articles that discussed the lack of PPE availability as causing COVID-19 infection in health workers (Huang et al., 2020; Jin et al., 2020; Zhang et al., 2020). Some of the results of these studies are also supported by the research of Nguyen et al (2020). Due to the inadequate availability of PPE, health workers using PPE repeatedly have a risk that is 1.46 and 1.31 times greater of being infected with COVID-19. Health workers who received full and partial PPE can reduce the risk of COVID-19 infection by 45% and 33% (Firew et al., 2020).

DISCUSSION

Use of Personal Protective Equipment (PPE) for Health Workers

Guidelines for the types of PPE for health workers to treat patients with suspected or confirmed COVID-19 have been issued by the WHO, which were published in November 2020 (WHO, 2020e). PPE is used by health workers before making contact with patients or before

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entering the room. Based on the WHO's recommendations, the use of PPE for health workers who are in close contact with COVID-19 patients includes N95 or FFP2 (Filtering Face Piece 2) or FFP3 (Filtering Face Piece 3) respirators, protective gowns, gloves, eye protection (glasses or facepieces and shields) and aprons. Meanwhile, health workers who do not have close contact should wear medical masks, eye protection and various other PPE according to the type of treatment. The WHO does not recommend the repeated reuse of PPE (WHO, 2020c). The procedure for using PPE begins with using a scrub suit and boots, followed by doing hand hygiene, using a protective gown, a mask, a face shield or protective glasses, a head and neck cover, an apron, and gloves (WHO, 2020d). It is possible that there was a shortage of PPE availability caused by the surge in demand for PPE influenced by the high number of COVID-19 cases. The WHO recommends several ways to use PPE optimally, including minimizing the use of PPE by using telemedicine to detect cases and limiting the number of health workers entering the COVID-19 patient's room, as well as using PPE appropriately according to procedures, and coordinating the need for PPE as well as possible (WHO, 2020c). The highly contagious nature of the SARS-CoV-2 virus requires strict Infection Prevention and Control (PPI) to reduce the transmission of COVID-19 in healthcare facilities. However, health facilities that have low resource management and a lack of access to water due to a non-functioning water infrastructure and fluctuating water quality are in very detrimental conditions.

Availability of Personal Protective Equipment (PPE) for Health Workers

The availability of PPE during the COVID-19 pandemic experienced a drastic increase in demand stress. The full availability of PPE was mostly financed by hospitals, supported by the government, and sourced from social donations. Almost all research locations had a limited availability of PPE. A lack of PPE, high workload, co-morbidities, knowledge, and access to PPI training and guidelines are factors that limit the practice of preventing the spread of COVID-19 in health workers. Thus, a consistent supply of PPE is essential to prevent COVID-19 among health workers (Asehagn, 2020). To protect health workers, the supply, awareness and use of PPE for health workers in all hospital departments should be promoted. The hospital as the manager must provide support that is relevant to the needs of all health workers, including the provision of PPE (Lai et al., 2020).

Cases of COVID-19 Infection in Health Workers

The majority of health workers infected with COVID-19 were women, at a percentage of 64% (Rastmanesh et al., 2022). Frontline healthcare workers have up to a 12 times higher risk of being infected with COVID-19 (Nguyen, Drew, Joshi, et al., 2020). During the first 18 months of the COVID-19 pandemic, around 115,500 health workers died from COVID-19 (WHO, 2022). The symptoms that appear vary, including a fever, cough, headache, fatigue, anosmia, and myalgia. However, there were also health workers who did not show symptoms. The main diagnostic method used to detect the SARS-CoV-2 virus is a PCR swab test. Other methods used include blood tests, antibody tests, medical records, and questionnaires.

Cases of COVID-19 infection in health workers occurred due to contact when providing clinical care to patients who were not initially suspected of having COVID-19 (Algado-Sellés et al., 2020). Dentists have a greater risk of being infected with COVID-19 because while providing care to patients, they are repeatedly in contact with saliva and blood (Bontà et al., 2020). In addition, nurses have a high risk of infection because nurses spend more time in the rooms of COVID-19 patients (Barrett et al., 2020). The existence of the COVID-19 pandemic has forced a re-examination of the norms prevailing in the national health system around the importance of Water, Sanitation and Hygiene (WASH) related to the quality of the health services, WASH's priorities in health facility investment, and the need for focused cross-sectoral leadership and collaboration between WASH and health professionals. Basic WASH services are a fundamental prerequisite for complying with the IPC principles needed to protect patients and health workers in every health care facility (McGriff and Denny, 2020).

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Analysis of the Use of PPE Against Cases of COVID-19 Infection in Health Workers

The use of PPE has an important role for health workers, especially during the COVID-19 pandemic. The use of PPE is related to cases of COVID-19 infection in health workers. PPE can protect health workers from the risk of COVID-19 infection. PPE can protect health workers from exposure to the coronavirus when handling patients, and includes masks, gloves, goggles, protective clothing, protective gowns, shoe covers, and head coverings (Lai et al., 2020). The use of PPE must be followed by infection prevention and control (PPI) measures such as training, the provision of secure procedures, and supervision so then the health of health workers and patients can be optimally protected (McGriff and Denny, 2020).

Analysis of the Availability of PPE Against Cases of COVID-19 Infection in Health Workers

The availability of PPE can result in the high and low rates of COVID-19 infection in health workers. The availability of adequate PPE both in terms of quantity and quality can reduce the risk of COVID-19 infection. Health workers who have access to PPE and use PPE properly can lessen the risk of COVID-19 infection. The limited availability of PPE can cause non-compliance in the use of PPE among health workers. The repeated or inadequate use of PPE as a result of the unavailability of PPE can increase the risk of COVID-19 infection in health workers (Nguyen, et al., 2020). Although the availability of PPE is adequate, the quality of PPE must also be considered. Although the relationship between the availability of PPE and COVID-19 infection is indirect, the availability of PPE is a factor that must be considered (Kim et al., 2021).

This study addresses the pandemic phenomenon among health workers that can provide insights during subsequent pandemics of similar diseases. The study conclusion, however, is limited to the findings from articles published in English that were accessible for free.

CONCLUSION

Article selection was carried out from January to February, at which time it was the third wave of COVID-19. Based on the articles that have been analyzed, it can be concluded that when handling patients suspected of or infected with COVID-19, health workers have used PPE, at least medical masks. However, the availability and quality of, and access to, PPE have not been met properly. There are still cases of COVID-19 infection in health workers with different symptoms for each individual. Symptoms include fever, cough, headache, fatigue, anosmia, myalgia, and some are asymptomatic. The availability of PPE is one of the efforts that should be undertaken to protect health workers from COVID-19 infection.

SUGGESTION

These suggestions are addressed to the health service agencies. Health service agencies should pay more attention to the availability and quality of PPE for health workers to reduce the risk of them becoming infected by COVID-19. Thus, all health workers have access to PPE in accordance with the recommendations.

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