

## Review Article



# Factors Influencing Compliance to the Utilization of Personal Protective Equipment among Healthcare Workers: A Systematic Review

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## ABSTRACT

**Background:** Hospitals, as providers of health services for the community, must be able to maintain the quality of services provided, one of which is by providing safety and comfort guarantees to officers from infectious diseases and other hazardous substances with policies regarding the use of personal protective equipment (PPE) and conducting evaluations from the behavior of officers when using PPE. Many factors affect the compliance of officers in the use of PPE. This research analyzed the factors influencing officers' compliance with PPE.

**Method:** This study used a literature review method. Articles were collected from the online database of Pubmed, Sage, and SpingerOpen from 2012 to 2023. Using the keywords "compliance," "health workers," and "personal protection equipment." Two hundred thirty-eight articles were obtained and filtered based on inclusion and exclusion criteria. Finally, 16 articles were included in the analysis.

**Results:** Internal factors that affect the compliance of officers in the use of PPE include age, years of service, knowledge, attitudes, and motivation, while external factors that influence compliance are facilities, training, and supervision carried out by management

**Conclusion:** To increase officer compliance, it is necessary to have supervision and support from management, such as facilities, ease of access, and conducting training.

**Keywords:** Compliance; Health worker; Personal Protective Equipment

## INTRODUCTION

Hospitals, as suppliers of health care services, must be able to improve the quality of their services because they differ from other services and are influenced by scientific, technological, and socioeconomic improvements. To increase service quality, hospitals must protect health professionals against all dangers of nosocomial infections.<sup>1</sup> Nurses are health workers who have an essential role in comprehensive patient care, such as providing nursing care, direct

assistance, or nursing services to patients and families, both inpatient and outpatient.<sup>2</sup> Therefore, hospitals must protect nurses from contagious diseases and other hazardous substances. Hospitals may mandate personal protective equipment (PPE) while providing services.<sup>3</sup>

Personal Protection Equipment (PPE) is a tool that is correctly used by every worker who strives to protect from all dangers generated by employment, especially nurses who use it to protect themselves and patients from hazardous materials such as chemical, physical, biological, and viral threats.<sup>4</sup> The usage of PPE does not remove hazards or risks at work. Nonetheless, it remains a barrier to reducing direct contact with hazardous chemicals or dangers, particularly during direct contact with patient fluids, giving health workers to patients with infectious diseases.<sup>5</sup> Health workers frequently utilize PPE such as masks, gloves, protective gowns or gowns, protective shoes, aprons, eye or facial protection, and head protection.<sup>1</sup>

PPE compliance is essential to avoid direct contact with dangerous materials or risks while working. Adherence to PPE will alter disease transmission; if PPE is ignored, the likelihood of transmission of infectious illnesses increases.<sup>6</sup> The use of PPE must be based on the amount of danger and usage practices to ensure that PPE provides maximum protection.<sup>7</sup> Factors influencing nurse compliance with PPE require cooperation from various sources, particularly management.<sup>8</sup> PPE compliance is influenced by knowledge, employment, education, training, attitudes, motivation, communication, availability of PPE, supervision, punishment and reward, workload, infection prevention and control guidelines, and hospital rules.<sup>9</sup> This article provides an overview of health professionals' compliance with PPE and the factors influencing compliance. This article can also help health workers and health facilities increase compliance with using personal protective equipment (PPE) and understand the elements that can influence health workers' compliance with PPE.

## METHOD

This research was a systematic review following Prisma Guideline, a guide or step for analyzing a systematic review,<sup>10</sup> aimed to collect evidence related to using PPE among health workers to prevent nosocomial infections. We used keywords to search articles in the following databases: Pubmed, SpringerOpen, and Sage. The keyword for the searched article was *"Compliance, health workers, personal protective equipment."* The inclusion criteria in this study were articles from 2012 - 2023, published in English, full articles available for free access, using cross-sectional research design, and assessing health worker compliance using PPE. The exclusion criteria were a qualitative research article and a review article.

## RESULT

### Screening Process with Prisma Guideline

Figure 1 shows that the articles that have been obtained are checked to avoid duplication, as well as to check the completeness of the article's content and then reselecting based on inclusion and exclusion criteria. From the first screening results, 47 articles were obtained based on the suitability of the title and abstract. In the next step, we performed another screening based on the abstract, research method, sample, inclusion criteria (year of publication, language in English, full text free available), and exclusion criteria. Accordingly,

we got 21 articles. Finally, we included 15 articles in our study, while 6 other articles were eliminated since the full-text reading did not use a cross-sectional design.

### Data extraction

From data extraction summarized in Table 1, 10 articles stated that the prepositioning factors (age, length of working, attitude, knowledge, motivation), enabling factors (facilities and infrastructure), and reinforcing factors (training and supervision) had a significant relationship with PPE compliance, five articles stated that PPE compliance among health workers was influenced by knowledge, workload, motivation, and PPE facilities, two articles stated the PPE compliance among training and supervision.

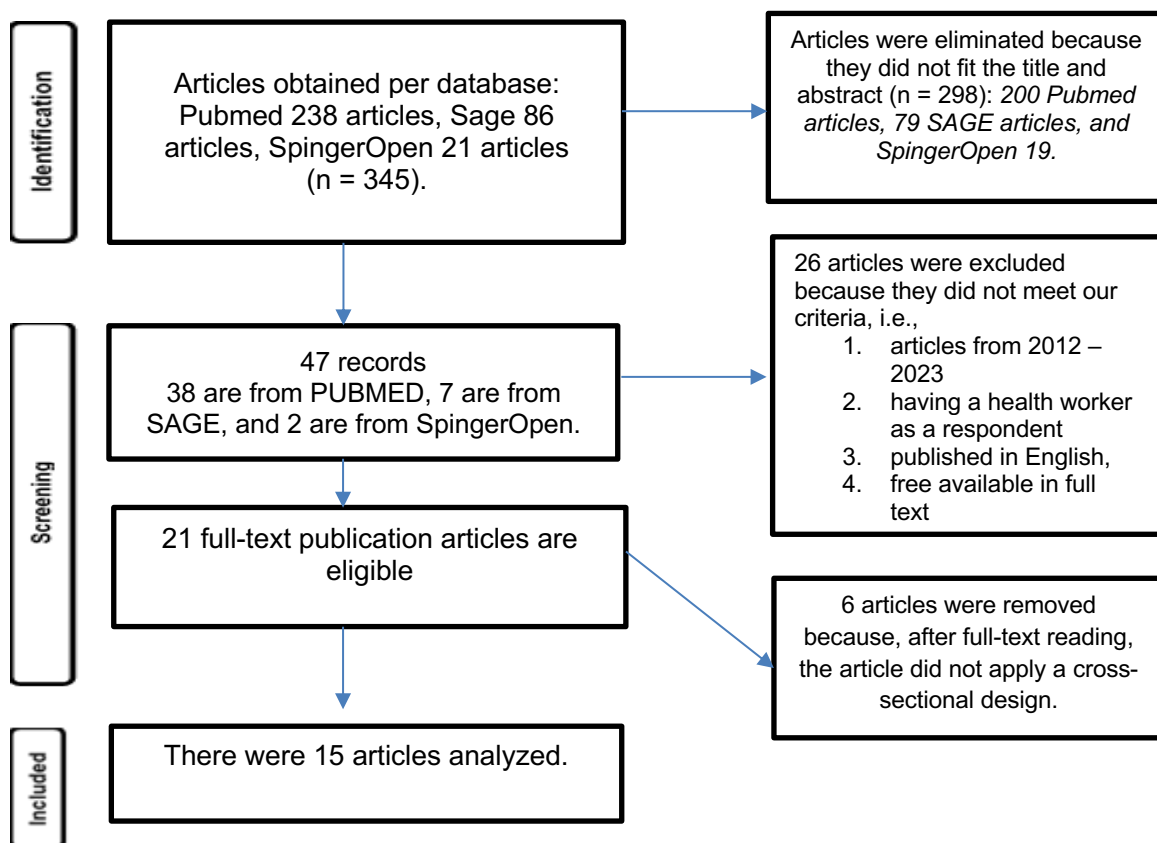


Figure 1. PRISMA diagram result of this study

Table 1. Article synthesis of this study

No	Author and Year	Article Title	Method (design, sample, variable, instrument, analyses)	Result
1	Mary Eyram Ashinyo, Stephen Dajaan Dubik, Vida Duti, Kingsley Ebenezer Amegah, Anthony Ashinyo, Brian Adu Asare, Angela	Infection prevention and control compliance among exposed healthcare workers in COVID-19 treatment centers in Ghana	D: Descriptive cross-sectional S: Convenience sampling V: clinical and nonclinical healthcare workers working in COVID-19 treatment centers	The research results stated that gender, age, work experience, place of residence, and training had no relationship with compliance with PPE. However, there are risk factors for PPE

No	Author and Year	Article Title	Method (design, sample, variable, instrument, analyses)	Result
	Ama Ackon, Samuel Kaba Akoriyea, Patrick Kuma-Aboagye (2021)		I: Those who ( health workers) consented to participate were given the questionnaire A: Logistic regression analyses	compliance, namely divorce status, education, profession, and availability of PPE . <sup>11</sup>
2	Muna Abed Allah, Sami Abdeen, Nagah Selim, Dhouha Hamdani, Eman Radwan, Nahla Sharaf, Huda Al-Katheeri, Iheb Bougmiza (2021)	Compliance and barriers to the use of infection prevention and control measures among health care workers during COVID-19 Pandemic in Qatar: A national survey	D: A national web-based cross-sectional study S: doctors, nurses, pharmacists, and other health workers who do not work in the administration department at 6 government and 40 private health facilities. V: Complainece PPE to health workers during Covid 19 pandemic in Qatar. I: Questionnaire and checklist from WHO assessment tool A: Chi-square test, multivariable logistic regression	During the Pandemic, officer compliance in using PPE (49.7%). Factors influencing officer compliance are the need for more facilities and increased workload. <sup>12</sup>
3	Noha Elshae, Hesham Agage (2022)	Nurses perception and compliance with personal protective equipment and hand hygiene during the third wave of COVID-19 pandemic	D: Cross-sectional survey S: All nurses with a minimum of 1-year service consisted of internal medicine nurses (n=133) and emergency care, neurosurgical care, intensive care (n=221) V: Perception and compliance with PPE during wave 3 of the COVID-19 pandemic in Egypt. I: A questionnaire A: correlation with chi-square test	The research results stated that there was a relationship between compliance with the use of PPE and sound knowledge, perception of the importance of PPE, age, and length of service. <sup>13</sup>
4	Roslyn M Seitz, Anna Q Yaffe, Elizabeth Peacock, Timothy P Moran, Andrew Pendle, Jonathan D Rupp (2021)	Self-reported use of Personal Protective Equipment among Emergency Department Nurses, Physicians, and Advanced Practice Providers during the 2020 COVID-19 Pandemic	D: survey analytic, cross-sectional S: total populations emergency departemen V: Compliance using PPE to health workers during the COVID-19 I: A questionnaire A: correlation, che square tes S: Total sampling V: effectiveness of health workers' PPE when contacting Covid 19 patients	The research results on health workers stated that Knowledge about PPE influences compliance in using PPE, and training can increase knowledge. Apart From that, factors that support PPE compliance are the positive attitude of officers, completeness of facilities, and supervision from management. <sup>14</sup>

No	Author and Year	Article Title	Method (design, sample, variable, instrument, analyses)	Result
			I: health worker and questionnaire A: correlations	
5	André Rose, William Ian Duncombe Rae (2019)	Personal Protective Equipment Availability and Utilization Among Interventionalists	D: a cross-sectional study using mixed methods S: total sampling and purposive sampling (interviews) V: staff working in the catheterization laboratory I: A questionnaire and interview A: logistic regression and analyzed thematically.	Compliance with the use of PPE among health workers to prevent exposure to racism is related to the availability of PPE based on gender, work unit, and age. <sup>9</sup>
6	Davie Madziatera, Kondwani Stanslas Msofi, Thokozeni V Phir, Samuel Devaughn Mkandawire, Amy Comber (2020)	Availability, Accessibility, and Proper Use of Personal Protective Equipment in Wards at Queen Elizabeth Central Hospital (QECH) Blantyre, Malawi: An Observational Study	D: survey analytics with a cross-section design S: accidental sampling  V: enabling factors and adherence to PPE I: checklist observation to adopt the CDC A: Chi-square and Logistic regression analysis	Compliance with PPE for health workers is 80%; this is influenced by the availability of PPE in each care unit, PPE training, supervision by management, and policies regulating PPE use. <sup>15</sup>
7	Xiaoyun H, Zhidan Zhang, Na Li, Dexin Liu, Li Zhang, Wei He, Wei Zhang, Yuexia Li, Cheng Zhu, Guijun Zhu, Lipeng Zhang, Fang Xu, Shouhong Wang, Xiangyuan Cao, Huiying Zhao, Qian Li, Xijing Zhang, Jiandong Lin, Shuangping Zhao, Chen Li, Bin Du; China Critical Care Clinical Trial Group (2012)	Self-reported use of personal protective equipment among Chinese critical care clinicians during the 2009 H1N1 influenza pandemic	D: survey analytic with cross-sectional S: Total sampling  V: ICU staff in 17 Chinese provinces when treating H1N1 patients I: a questionnaire A: chi-square test	From the research results, the level of compliance with the use of PPE by officers is >80%. At the same time, the influencing factors are compliance with PPE for administering vaccines, positive attitudes, availability of PPE, infection prevention and control measures, and surveillance activities. <sup>16</sup>
8	Muna Talal Theyab Abed Alam, Sami Abdeen, Nagah Selim, Elias Tayar, Iheb Bougmiza (2022)	Occupational Prevention of COVID-19 Among Healthcare Workers in Primary Healthcare Settings: Compliance and Perceived Effectiveness of Personal Protective Equipment	D: cross-sectional S: total sampling V: compliance of health workers in using PPE when treating Covid -19 patients I: Questionnaire	Overall compliance with PPE use was 53%, and compliance with PPE use during AGP procedures was 76.3%. Level of compliance based on care unit, training implementation, completeness of facilities, work experience, perception, work shift, profession, and length of contract. <sup>17</sup>
9	Junaid Ahma, Saeed Anwa, Abdul Latif, Najib	Association of PPE Availability, Training, and Practices with COVID-19	D: A cross-sectional survey S: total sampling	The research results stated a relationship between compliance with

No	Author and Year	Article Title	Method (design, sample, variable, instrument, analyses)	Result
	U Haq, Muhammad Sharif, Ahmed A Nauman (2022)	Sero-Prevalence in Nurses and Paramedics in Tertiary Care Hospitals of Peshawar, Pakistan	V: PPE compliance factors with the incidence of Covid 19 among health workers I: Questionnaire A: chi-squared test	the use of PPE and the number of COVID-19 incidents among health workers, including the availability of PPE, timeliness of obtaining PPE, and training. <sup>18</sup>
10	Usman Abubakar, Mohammed Ndagi Usman, Mohammed Baba, Aliyu Sulaiman, Mohammad Kolo, Fatima Adamu, Ammar Ali Saleh Jaber (2022)	Practices and perception of healthcare workers towards infection control measures during the COVID-19 pandemic: a cross-sectional online survey from Nigeria	D: cross-sectional study  S: snowball sampling V: pharmacists, nurses/midwives, and medical in Nigeria I: online questionnaire A: Chi-Square Test	Factors influencing PPE compliance among health workers are the type of health facility, knowledge, and PPE training. In contrast, age, gender, education, and kind of profession have no relationship to PPE compliance among health workers. <sup>19</sup>
11	S U Arinze-Onyia, A C Ndu, E N Aguwa, I Modebe, U N Nwamoh (2018)	Knowledge and Practice of Standard Precautions by Healthcare Workers in a Tertiary Health Institution in Enugu, Nigeria	D: descriptive study, cross-sectional S: Purposive Sampling  V: health workers who carry out standard precautions in a Tertiary Health Institution in Enugu, Nigeria I: questionnaire  A: Chi-Square Test	One application of standard precautions is the use of PPE. Level of PPE compliance among health workers (68.9%). Factors that hinder PPE compliance are lack of facilities and training that should be carried out more routinely. <sup>20</sup>
12	Okwudili C Ezike , Linda C Odikpo, Evert N Onyia, Michel C Egbuniwe, Ifeoma Ndubuisi, Ada C Nwaneri, Chikodili N Ihudiebube-Splendor, Chijike C Irodi, Sambo B Danlami, Amina W Abdussalam (2021)	Risk Perception, risk Involvement/Exposure and compliance to preventive measures for COVID-19 among nurses in a tertiary hospital in Asaba, Nigeria	D: descriptive survey, a cross-sectional S: purposive sampling V: knowledge and implementation of standard precautions in the use of PPE for health workers I: questionnaire  A: descriptive statistics,	The research results showed that health workers' PPE compliance was 77%. This is demonstrated by the small and inadequate amount of PPE and the need for updates on PPE usage. <sup>21</sup>
13	Naveen K Suda, P B Smithamol, Ann S Toms, G K Meera, Grace J Rebekah, S Trinaya, Mohammed Haroon, Raj Sahajanandan, Ekta Rai (2018)	Aerosol-generating procedures: how best did anesthesiologists use available personal protective equipment during the early COVID-19 pandemic in a tertiary care center in southern India? A prospective cross-sectional study	D: prospective cross-sectional S: Descriptive statistics  V: compliance with the use of PPE by anesthesiologists when carrying out AGP procedures I: observation  A: descriptive statistics	The highest compliance with PPE is using N95 masks (99.5%) and face shields (84.4%). Officer compliance is influenced by supervision, availability, and ease of obtaining PPE. <sup>22</sup>
14	Khalifa Abdulrahman Yusuf (2023)	Assessment of knowledge, accessibility, and adherence to the use of personal protective equipment and standard	D: A prospective cross-sectional study  S: non-probability sampling (voluntary sampling)	The research results showed the % PPE compliance rate for health workers was 82.1%. PPE compliance is related to

No	Author and Year	Article Title	Method (design, sample, variable, instrument, analyses)	Result
		preventive practices among healthcare workers during the COVID-19 pandemic	V: the medical doctors (physicians, surgeons, pathologists, radiologists, gynecologists, and anesthetists) and nurses at BDF-RMS Military Hospital I: questionnaire  A: Chi-square and Fisher's	age factors, availability of PPE, knowledge, implementation according to protocol, and training PPE. <sup>23</sup>
15	Dina K. Abou El Fadl, Yasmin A. F. Aly, Ebtissam Abdel Ghaffar Darweesh, Nagwa A. Sabri & Marwa Adel Ahmed (2023)	Assessment of neonatal intensive care unit nurses' compliance with standard precautions of infection control and identification of enabling factors	D: A descriptive cross-sectional study: S: total population V: Factors of compliance with implementing standard precautions (PPE) among NICU nurses. I: questionnaire  A: Kolmogorov–Smirnov test and ANOVA	The level of adherence to surgical masks or concurrent use of goggles or face shields was 48.3% due to the availability of PPE in the NICU room. <sup>24</sup>

Note : D = research design, S= research sample, V= research variables, I= instruments, A= analysis

## DISCUSSION

Based on the previous article, this study overviews the factors influencing officers' compliance with PPE. In this study, there are 16 research articles located in hospitals with health worker participants: doctors,<sup>17,19,22,29</sup> nurses,<sup>9,11,12,13,14,15,17,18,19,22,25,26</sup>, pharmacy,<sup>11,14,19,25</sup> laboratories,<sup>11,25</sup> midwives<sup>11,12</sup> and non-medical<sup>11</sup> and one research article conducted in hospitals with nursing student participants.<sup>20</sup> At the time of the study, were 11 articles conducted during the COVID-19 pandemic (69%). Some professionals have been explored in the 15 publications involved in this research, including nursing as providers of direct services to patients, 7 papers involving professions other than nurses, and one article on practical students.

Table 2 represents factors that inhibit or affect officer compliance in the use of PPE, among others: age, length of service, attitude, knowledge, motivation, facilities in the form of availability of PPE and easy access for officers to obtain it, training to improve knowledge and practice in the use of PPE and monitoring and support from management.

**Table 2.** Factor affecting compliance

Factor	Reference
Predisposing factor (age, length of working, attitude, knowledge, motivation)	1,2,3,4,5,6,7,8,12,13,15
Enabling factor (facilities)	1,2,3,4,5,6,7,8,10,11,12,13,14,15
Reinforcing factor (supervision and training)	1,3,4,5,6,7,8,9,13

## **Predisposing Factor**

Health workers' compliance with Personal Protective Equipment (PPE) is based on internal factors, including age, length of service, attitude, knowledge, and motivation. Based on age characteristics, a person's length of service can be related to one's experience; the longer the work, the higher the experience, knowledge, and skills of an officer in using PPE.<sup>27</sup> Experience will affect a person's work performance, based on the work experience officers have that can be adjusted to their work.<sup>28</sup> But based on some studies, the longer they work, the more bored they will be.<sup>29</sup> Thus, hospitals must protect nurses from all infectious diseases and other hazardous materials and provide them security. One of the efforts that hospitals can make is to make it mandatory to use PPE when providing services.

According to Notoatmojo, behavioral factors built based on experience and knowledge are much better than behavior not based on knowledge.<sup>28</sup> While motivation has a role in officer compliance in using PPE, the use of PPE is the officer's perception of PPE based on knowledge, work experience, and high motivation to protect themselves from the risk of infectious diseases or hazardous materials; this is due to good behavior from health workers. Motivation also has a very supportive role in increasing compliance; officers who tend to have high motivation will have high morale. Factors influencing officer motivation include physiological needs and a sense of security from infectious diseases or hazardous materials. In contrast, officer non-compliance is often related to discomfort, especially in using PPE.<sup>30</sup> In the article that has been reviewed, the obstacle that often causes non-compliance in the use of PPE is the discomfort when using PPE. Using PPE for a long duration often causes impacts that officers avoid, including excessive sweating that irritates the skin, dehydration, and pain.<sup>31</sup>

## **Enabling Factor**

Hospitals must prevent and protect health workers from exposure to risks, especially infectious diseases, and other hazardous materials, so hospitals must ensure the availability of PPE equipment for health workers based on risk levels and quality PPE following official standards to create a sense of comfort and security when using and ensure the PPE supply chain runs well.<sup>32</sup> From the previous article, it was found that factors that hinder compliance in using PPE are the unavailability of PPE according to standards, the difficulty of obtaining access, and the lack of funds to buy PPE.<sup>2</sup> The availability of PPE is partly due to the inability of hospitals to provide all PPE because the availability of PPE is very dependent on the existing budget and funds.

## **Reinforcing Factor**

The training provided can increase officers' knowledge of the use of PPE.<sup>28</sup> The training provided must be relevant and appropriate to the needs and have a direct impact on services; the training provided must also be able to improve expertise and competence, especially infection prevention and control.<sup>33</sup> With the training or workshop, it will increase the knowledge and skills of officers in the use of PPE.<sup>34</sup> Another factor supporting officer compliance is supervision or monitoring from management. This step is influential on compliance with PPE by health workers. Supervision is an activity that begins with planning, directing and guiding, observing, encouraging, improving, and evaluating continuously the abilities and limitations of the officer. Supervision can be carried out through behavioral assessments, how health workers comply with PPE by existing policies and procedures and identifying training needs for health workers.<sup>35</sup> Policies and guidelines for the use of PPE for officers will improve compliance.<sup>36</sup> Supervision can increase a person's awareness to behave in a positive direction and can motivate officers.<sup>28</sup>



## CONCLUSION

Based on a literature review, age, length of service, knowledge, attitudes and motivations, facilities, training, and staffing are vital in improving officer compliance with PPE. To improve officer compliance, there needs to be support from management to improve compliance, among others, by providing PPE, conducting training, and conducting regular supervision to maintain established behavior. To maintain officer compliance in PPE, hospitals or health facilities always strive to improve the quality of human resources and adequate facilities by regularly monitoring and evaluation.

## Declaration

### Authors' contribution

ASN collected data, designed the study, wrote the article draft, and conducted the analysis; DS reviewed the results. All authors assisted in reviewing and evaluating this work for publication.

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### Conflict of interest

There is no conflict of interest in this research.

## REFERENCES

1. Zahara RA, Effendi SU, Khairani N. Kepatuhan Menggunakan Alat Pelindung Diri (APD) Ditinjau dari Pengetahuan dan Perilaku pada Petugas Instalasi Pemeliharaan Sarana Dan Prasarana Rumah Sakit (IPSRs). *Jurnal Aisyah: Jurnal Ilmu Kesehatan*. 2017;2(2):153–8.
2. Heru UA, Sahputri J, Ikhsan M. Overview of Knowledge, Attitudes, Availability of PPE and Policies with the Use of PPE for Paramedics in North Aceh District Hospital. *Gambaran Pengetahuan, Sikap, Ketersediaan APD dan Kebijakan Dengan Penggunaan APD Pada Paramedis di Rumah Sakit Kabup*. 2022;2(4):1563–78.
3. Wahyuni W, Sulistiyono L, Ningtyas NWR. Hubungan pengetahuan dengan kepatuhan perawat dalam penggunaan alat pelindung diri pada Ruang Sindur dan Akasia. *Jurnal Borneo Cendekia*. 2021;5(1):1–15.
4. Panaha MM, Maramis FRR, Kesehatan F, Universitas M, Ratulangi S, Kesehatan P, et al. Tinjauan sistematis hubungan motivasi kerja dengan kepatuhan penggunaan alat pelindung diri (APD) pada perawat di rumah sakit. *Kesmas*. 2021;10(4):16–23.
5. Sayed M, Yusuf M. Kesadaran perawat dalam penggunaan alat pelindung diri (APD). *Kesehatan masyarakat*. 2017;4(3):1–8.
6. Sulistyawati W, Etika AN, Yani DI. Hubungan antara pengetahuan dan sikap dengan kepatuhan perawat dalam penggunaan APD di masa pandemi COVID-19 di Rumah Sakit Kabupaten Tuban Jawa Timur tahun 2021. *Jurnal Penelitian Perawat Profesional*. 2021;3(4):783–90.
7. Suryani A, Setiowati R, Suharsono TJ, Handrija. Penggunaan alat pelindung diri (APD) terhadap keselamatan kerja perawat pada era pandemi COVID-19 di ruang isolasi RS Kanker Dharmais. *The Journal of Hospital Accreditation*. 2022;04(April 2020):36–9.

8. Windy Puspitasari PL. Determinan kepatuhan dalam penerapan universal precaution. *The Indonesian Journal of Occupational Safety and Health*. 2019;8(1):94.
9. Rose A, Rae WID. Personal protective equipment availability and utilization among interventionalists. *Saf Health Work*. 2019;10(2):166–71.
10. Fitriyani NI. Metode PRISMA untuk memprediksi penyakit kanker payudara. *JII : Jurnal Inovasi Informatika universitas Pradita*. 2021;6(September 2021):13–8.
11. Ashinyo ME, Dubik SD, Duti V, Amegah KE, Ashinyo A, Asare BA, et al. Infection prevention and control compliance among exposed healthcare workers in COVID-19 treatment centers in Ghana: A descriptive cross-sectional study. *PLoS One*. 2021;16(3 March):1–13.
12. Abed Alah M, Abdeen S, Selim N, Hamdani D, Radwan E, Sharaf N, et al. Compliance and barriers to the use of infection prevention and control measures among health care workers during COVID-19 Pandemic in Qatar: A national survey. *J Nurs Manag*. 2021;29(8):2401–11.
13. Elshaer N, Agage H. Nurses' perception and compliance with personal protective equipment and hand hygiene during the third wave of COVID-19 pandemic. *Journal of the Egyptian Public Health Association*. 2022;97(1):1–10.
14. Seitz RM, Yaffee AQ, Peacock E, Moran TP, Pendley A, Rupp JD. Self-reported use of personal protective equipment among emergency department nurses, physicians and advanced practice providers during the 2020 COVID-19 Pandemic. *Int J Environ Res Public Health*. 2021;18(13):4–9.
15. Madziatera D, Msofi KS, Phiri T V., Mkandawire SD, Comber A. Availability, accessibility and proper use of personal protective equipment in wards at queen elizabeth central hospital (Qech) Blantyre, Malawi: An observational study. *Malawi Medical Journal*. 2020;32(3):124–31.
16. Hu X, Zhang Z, Li N, Liu D, Zhang L, He W, et al. Self-reported use of personal protective equipment among Chinese critical care clinicians during 2009 H1N1 Influenza pandemic. *PLoS One*. 2012;7(9):3–9.
17. Abed Alah MTT, Abdeen S, Selim N, Tayar E, Bougmiza I. Occupational prevention of COVID-19 among healthcare workers in primary healthcare settings: compliance and perceived effectiveness of personal protective equipment. *J Patient Saf*. 2022 Dec;18(8):747–55.
18. Ahmad J, Anwar S, Latif A, Haq NU, Sharif M, Nauman AA. Association of PPE availability, training, and practices with COVID-19 sero-prevalence in nurses and paramedics in tertiary care hospitals of Peshawar, Pakistan. *Disaster Med Public Health Prep*. 2022;16(3):975–9.
19. Abubakar U, Usman MN, Baba M, Sulaiman A, Kolo M, Adamu F, et al. Practices and perception of healthcare workers towards infection control measures during the COVID-19 pandemic: a cross-sectional online survey from Nigeria. *J Infect Dev Ctries*. 2022;16(9):1398–405.
20. Arinze-Onyia SU, Ndu AC, Aguwa EN, Modebe I, Nwamoh UN. Knowledge and practice of standard precautions by healthcare workers in a tertiary health institution in Enugu, Nigeria. *Niger J Clin Pract*. 2018;21(2):149–55.
21. Ezike OC, Odikpo LC, Onyia EN, Egbuniwe MC. Since January 2020, Elsevier has created a COVID-19 resource center with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information. 2020;(January).
22. Suda NK. Aerosol-generating procedures, how best did anesthesiologists use available personal protective equipment during early COVID-19 pandemic in a tertiary care center of southern India? A prospective cross-sectional study. *J Anaesthesiol Clin Pharmacol*. 2018;34(3):46–50.
23. Abdulrahman Yusuf K, Isa SM, Al-Abdullah AF, AlHakeem HA. Assessment of knowledge, accessibility, and adherence to the use of personal protective equipment and standard preventive practices among healthcare workers during the COVID-19 pandemic. *Journal of Public Health Research*. 2023;12(2).

24. Abou El Fadl DK, Aly YAF, Darweesh EAG, Sabri NA, Ahmed MA. Assessment of neonatal intensive care unit nurses' compliance with standard precautions of infection control and identification of enabling factors. *Future Journal of Pharmaceutical Sciences*. 2023;9(1).
25. Suzuki T. Effectiveness of personal protective equipment in preventing severe acute respiratory syndrome coronavirus 2 infection among healthcare. 2020;(January).
26. Fan J, Jiang Y, Hu K, Chen X, Xu Q, Qi Y, et al. Barriers to using personal protective equipment by healthcare staff during the COVID-19 outbreak in China. *Medicine*. 2020;99(48):e23310.
27. Hakim L. Faktor yang berhubungan dengan kepatuhan tenaga kesehatan menggunakan alat pelindung diri (APD) di era pandemik COVID-19 pada Puskesmas Makkasau Makassar Tahun 2020. *Journal of Muslim Community Health (JMCH)*. 2021;Vol.2(1):133–42.
28. Dewi IP, Adawiyah WR, Rujito L. Analisis tingkat kepatuhan pemakaian alat pelindung diri mahasiswa profesi dokter gigi di Rumah Sakit Gigi Dan Mulut Unsoed. *Jurnal Ekonomi, Bisnis, dan Akuntansi*. 2020;21(4).
29. Hamzah ZR. Faktor-faktor yang berhubungan dengan kinerja perawat pelaksana dalam melaksanakan pencegahan infeksi nosokomial di ruang inap rumah sakit pemerintah dan Rumah Sakit Swastakota Makassar Tahun 2017. *Laboratorium Penelitian dan Pengembangan FARMAKA TROPIS Fakultas Farmasi Universitas Muallawarman, Samarinda, Kalimantan Timur*. 2018;(April):5–24.
30. El-Sokkary RH, Khater WS, El-Kholy A, Mohy Eldin S, Gad DM, Bahgat S, et al. Compliance of healthcare workers to the proper use of personal protective equipment during the first wave of COVID-19 pandemic. *J Infect Public Health*. 2021;14(10):1404–10.
31. Apriluana G, Khairiyati L, Setyaningrum R. Hubungan antara usia, jenis kelamin, lama kerja, pengetahuan, sikap dan ketersediaan Alat Pelindung Diri (APD) dengan perilaku penggunaan APD pada tenaga kesehatan. *Jurnal Publikasi Kesehatan Masyarakat Indonesia*. 2016;3(3):82–7.
32. Marlina R, Syam Y, Bahtiar B. Analisis kepatuhan penggunaan alat pelindung diri dalam pelaksanaan cegah tangkal penyakit COVID-19 di pintu negara pada petugas kesehatan Kantor Kesehatan Pelabuhan Kelas I Makassar. *Jurnal keperawatan Allauddin*. 2021;2(1):49–65.
33. Herpan, Wardani Y. Analisis kinerja perawat dalam pengendalian infeksi nosokomial di RSUD PKU Muhammadiyah Bantul Yogyakarta. *Jurnal Kesehatan Masyarakat (Journal of Public Health)*. 2013;6(3).
34. Zakaria AA, Sofiana L. Correlation between nurse knowledge and attitude with hand hygiene compliance. *Jurnal Kedokteran dan Kesehatan Indonesia*. 2018;9(2):74–81.
35. Hakim AR, Yahya M. Analisis pengaruh gaya kepemimpinan, motivasi kerja, dan kompensasi terhadap kinerja guru (studi kasus di SMA PPMI Assalam Surakarta). *Jurnal Pendidikan Ilmu Sosial*. 2018;24(1):67–77.
36. Selina Alta, Widjasena B, Wahyuni I. Study literatur terkait analisi perilaku kepatuhan penggunaan alat perlindungan diri (APD) pada tenaga kesehatan saat wabah pandemi Corona Virus (Covid 19). 2020;10(4):105–10.