



## Cross-sectional Study

# Does wearing personal protective equipment affect the performance and decision of physicians? A cross-sectional study during the COVID-19 pandemic

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## A B S T R A C T

**Background:** The use of personal protective equipment (PPE) decreased the probability of viral transmission during the COVID-19 pandemic. However, some drawbacks have been observed with its extensive use, such as headaches, anxiety, and stress among physicians, which could affect decision-making processes, the performance of physicians, and consequently patients' safety. Few articles have studied the impact of PPE on physicians from different specialties. This study assessed the effect of wearing PPE on the performance and decision-making of physicians during the COVID-19 pandemic and compared the effects of wearing PPE on physicians from different specialties.

**Methods:** A descriptive cross-sectional study was carried out through an anonymous 39-item online questionnaire. The physicians were divided according to the probability and frequency of performing invasive procedures. Group 1 included emergency medicine and critical care physicians, intensivists, and anesthetists, group 2 included physicians from different surgical subspecialties, and group 3 included physicians from different medical fields.

**Results:** This study included 272 physicians; group 1 included 54, group 2 included 120, and group 3 included 98 physicians. Approximately, 90.4% of the participants aged between 30 and 40 years, and 72.8% of the participants were specialists. Results indicated that the comfort, vision, and communication were significantly reduced in all groups (81.1%, 88.7%, and 75.5%, respectively). In contrast, the handling of instruments was not significantly affected in the second group only. In addition, the decision-making and the rate of complications were not significantly affected.

**Conclusion:** There was a negative impact of wearing PPE on the non-technical skills (vision, communication and overall comfort), and the technical skills of the physicians. The decision-making and patients' safety were not significantly affected. Recommendations include additional improvement of the PPE design due to its crucial effect on both non-technical and technical skills of physicians.

## 1. Introduction

In January 2020, the outbreak of a new Coronavirus Disease (COVID-19) was announced as a public health emergency by the World Health Organization (WHO). In March 2020, the WHO evaluated the pandemic characterization of COVID-19 [1]. The COVID-19 pandemic created a strenuous challenge to the whole society, particularly to the health care system [1]. During this pandemic, healthcare providers (HCPs) were the first line of defense. They managed on daily basis the suspected, confirmed, and even asymptomatic COVID-19 patients [2,3]. Indeed, there is a higher risk of COVID-19 transmission to HCPs in their workplace [2].

The abrupt surge of COVID-19 infection among physicians was claimed to be due to the inadequate protective measures which could be, to a great extent, prevented by the correct use of appropriate personal protective equipment (PPE). Therefore, the interim guidance of a high level of PPE was issued by the WHO in February 2020, including the use of medical masks, double gloves, face shields, and gowns for all HCPs [4, 5]. In addition, full respiratory protection was recommended during aerosol-generating procedures (AGPs) for patients with suspected or confirmed COVID-19 or in emergent circumstances when COVID-19 status was uncertain [4,6]. The N95 respirator is suitable for safety during standard airborne precautions. However, the high-risk AGPs can cause high viral load aerosolization, which increases the transmission risk. Improved respiratory safety with 99, 100, or high-efficiency

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<https://doi.org/10.1016/j.amsu.2021.102488>

Received 16 April 2021; Received in revised form 3 June 2021; Accepted 5 June 2021

Available online 10 June 2021

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group performed procedures on positive cases ( $P < 0.001$ ). However, the physicians in the first group performed a non-significant higher number of procedures as well as a significant higher number of procedures while wearing full PPE ( $P = 0.041$ ). The majority of performed procedures were emergencies ( $P = 0.001$ ). Table 2 provides a summary of the studied groups in regards to the work circumstances at the hospitals.

Regarding physicians' performance, there were no significant differences between the three groups. The comfort, vision, and communication were significantly reduced in all groups by wearing PPE (81.1%, 88.7% and 75.5% respectively). The tactile movement was significantly reduced in the first and third groups while the handling of instruments was not significantly affected in the second group only. The relation between PPE and performance among the three groups is displayed in Table 3.

While wearing PPE, decision-making was not significantly affected during performing a procedure in all groups. See Table 3. The participant physicians reported different strategies for decision-making during dealing with positive and/or suspected cases. Table 4 provides a display of the effect of PPE on decision making among specialties.

In relation to the complication rates, most physicians noticed no change in the complication rates while wearing PPE. Statistically, the rate of complications was not significantly affected while wearing PPE in all groups as shown in Table 5.

**Table (2)**  
Comparing the studied groups in regards to the work circumstances at the hospitals.

		(Mean ± SD)			Total N (%)	P-value
		Group 1	Group 2	Group 3		
Do you routinely perform a COVID-19 screening test before assessing a patient?	Yes	6	26	12	44 (17.2)	0.430
	No	46	88	78	212 (82.8)	
Did you encounter a positive COVID-19 patient?	Yes	52	108	88	248 (91.2)	0.413
	No	2	12	10	24 (8.8)	
Did you perform a procedure on a positive COVID-19 patient?	Yes	42	76	36	154 (56.6)	<0.001*
	No	12	44	62	118 (43.4)	
Do you routinely perform a COVID-19 screening test before performing a procedure?	Yes	10	42	20	72 (29.0)	0.150
	No	42	70	64	176 (71.0)	
Number of performed procedures on COVID-19 patients during the last three months		26 ± 49	2 ± 3	6 ± 18		0.062
Number of procedures performed wearing full PPE		24 ± 70	4 ± 11	7 ± 20		0.041*
The type of procedure/surgery	Emergency	20	52	10	82 (46.6)	0.001*
	Elective	4	6	12	22 (12.5)	
	Both	18	30	24	72 (40.9)	

#### 4. Discussion

This study focused on other angles of PPE rather than its protection properties. Using online questionnaire, we studied the different technical and non-technical skills that may be affected by continuous wearing of PPE. We also compared between the performance and decision-making abilities between different categories of physicians who were divided according to the probability of performing invasive procedures while wearing PPE. To the best of our knowledge, no other study has reported such comparison, while few studies reported the impact of PPE on the performance of surgeons only [11,13]. Similar to our study, different studies classified HCPs according to their risk exposure to AGPs and found a higher risk for infection among physicians working in high-risk departments [14,15].

Despite the significant reduction of infection among HCPs with the use of PPE, some studies have raised questions about its effect, especially with the prolonged wearing during the COVID-19 pandemic on physicians' performance, general comfort, exhaustion, non-technical skills and sense of safety [11,16] that may also impact the patients' outcome [13].

For the maximum benefits of PPE, the appropriate training for correct donning and doffing as well as the continuous availability of PPE are critical factors [17,18]. The availability of PPE may be affected by the hospital level and location. In the current study, the majority of participants were working in tertiary and secondary governmental hospitals within urban areas. However, only 45.6% of physicians reported receiving specialized training workshops for PPE use. Improper use of PPE owing to the observed shortage of optimal training carries potential hazards to all HCPs and the entire healthcare system.

In the current study, most of the performed procedures were emergencies and reported in the first group (emergency medicine, critical care and anesthesia) with a statistically significant difference ( $P < 0.001$ ). Overall comfort, vision, and communication were negatively affected in all groups (81.1%, 88.7% and 75.5%, respectively). Handling of instruments was only affected in the first group. The tactile movement was significantly affected in the first and third groups but not affected in the second group. No change in the rate of procedures complications was noted in all groups.

Similar to this study, Yáñez Benítez et al. studied the performance and decision-making while wearing PPE through an online questionnaire, which was sent only to surgeons in 26 countries worldwide. Unlike our study, the authors included only general surgeons. The total number of participants was 134 and most of them reported negative effects of wearing PPE on their surgical performance (54%) and their comfort while performing procedures (66%). The participants also reported visual difficulty (63%), increased surgical fatigue (82%) and communication impediments (54%) [11]. In another study, Loibner et al. reported reduced dexterity, reduced visibility during PPE use. However, Loibner et al.'s study was conducted under experimental condition and the participants used ventilated suits [19]. Hampton et al. reported the negative impact of wearing PPE on communication in the form of a significant reduction in speech discrimination scores [20]. Furthermore, Radonovich et al. studied the reasons for intolerance of different kinds of masks and respirators by HCPs and reported that the interference of visual, auditory, and vocal communication was a major factor [21]. Engelmann et al. recommended taking brief periodic breaks to help sustain excellent performance, lower error rates, and improve the well-being of the surgeons [22].

Although, in this study, decision-making was not significantly affected by wearing the PPE in all groups, in the study by Yanez Benitez et al., 40% perceived that their decision-making was affected by PPE use [11]. In the current study, alternative decisions reported including more conservative, damage-control, and open approaches. Most elective operations were postponed as a strategy to decrease the load on healthcare facilities.

Various risk factors have been suggested to explain the alteration of

**Table (3)**  
Relation between PPE and performance among specialties.

		Group 1	Group 2	Group 3	Total N (%)	P-value
Comfort	Affected	38	78	56	172(81.1)	0.587
	Not affected	2	2	6	10(4.7)	
	Sometimes	8	12	10	30(14.1)	
P value		<0.0001*	<0.0001*	<0.0001*		
Vision	Affected	44	86	58	188(88.7)	0.459
	Not affected	0	4	8	12(5.6)	
	Sometimes	4	4	4	12(5.6)	
P value		<0.0001*	<0.0001*	<0.0001*		
Communication	Affected	40	74	46	160(75.5)	0.422
	Not affected	4	6	12	22(10.3)	
	Sometimes	4	14	12	30(14.1)	
P value		<0.0001*	<0.0001*	<0.0001*		
Tactile movements	Affected	28	26	32	86(41.7)	0.107
	Not affected	12	40	30	82(39.8)	
	Sometimes	6	24	8	38(18.4)	
P value		0.001*	0.149	0.003*		
Handling of Instruments	Affected	22	18	16	56(26.9)	0.120
	Not affected	14	48	34	96(46.1)	
	Sometimes	12	24	20	56(26.9)	
P value		0.269	0.001*	0.056		
Decision-making	Affected	8	6	12	26 (12.7)	0.081
	Not affected	26	72	38	136 (66.6)	
	Sometimes	14	12	16	42 (20.5)	
P value		0.019*	<0.0001*	0.001*		

**Table (4)**  
The effect of PPE on decision making among specialties.

	Group 1	Group 2	Group 3	Total N (%)	P value
Conservative approach	6	20	18	44(31.9)	0.358
Damage-control approach	0	0	2	2(1.4)	
Open approach	0	2	0	2(1.4)	
Postponing elective cases	0	12	4	16(11.6)	
Combination	20	28	14	62(44.9)	
Others	2	8	2	12 (8.7)	

**Table (5)**  
Rates of complications while using PPE.

	Group 1	Group 2	Group 3	Total N (%)	P-value
Increased	2	2	0	4(1.9)	0.224
Decreased	4	18	26	48(22.2)	
No change	40	72	52	164(75.9)	
P value	<0.0001*	<0.0001*	0.0032*		

physicians' performance and decision-making while wearing of PPE including the progressive fatigability, discomfort, heat stress, pressure, sleeping disturbance, associated headache, associated anxiety, and feeling unsecure [8,10,19,21].

This study provided an insight into the other important consequences of PPE, rather than its protective features, that can impact HCPs and the entire healthcare system. The study's small number of participants was the main limitation. The study was confined to one area to ensure uniform circumstances; however, it might be considered as another limitation. Other significant factors that might affect the use of PPE, such as gender and obesity were not included in this study. Hence, additional well-designed prospective studies are suggested to thoroughly discuss all risk factors for alteration of physicians' performance during wearing PPE.

**5. Conclusion**

There was a clear negative impact of wearing PPE on the non-

technical skills (vision, communication, and overall comfort), and technical skills of the physicians of all specialties. On the other hand, decision-making and patients' safety were not significantly affected. Additional efforts should be directed to improve the PPE design to enhance the performance of physicians especially during prolonged pandemics.

**Funding**

No source of funding.

**Ethical considerations**

The study was approved by the Institutional Review Board, Faculty of Medicine, Alexandria University.

**Consents**

Consent was received from all participants.

**Consent**

All participants consented and agreed to contribute to this online questionnaire and study.

**Author contribution**

**Mohammed S. Foula:** Conceptualization, Methodology, Software, Writing - Review & Editing. **Fayrouz A. Nwesar:** Conceptualization, Methodology, Writing - Original Draft. **Esraa H. Oraby:** Writing - Original Draft, Data curation. **Ahmed Foula:** Writing - Original Draft, Data curation. **Mosab A. Alarfaj:** Conceptualization, Software. **Hassan S. Foula:** Formal analysis, Data curation. **Noha E. Mohamed:** Supervision, Writing - Review & Editing.

**Registration of research studies**

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## Guarantor

Mohammed S. Foula.

## Conflicts of interest

All authors declared NO conflict of interests.

## Provenance and peer review

Not commissioned, externally peer-reviewed.

## Declaration of competing interest

No conflict of interest.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2021.102488>.

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