



## Philippine COVID-19 Living Clinical Practice Guidelines

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### EVIDENCE SUMMARY

## What is the appropriate PPE to use during surgeries to reduce SARS-CoV-2 virus transmission?

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### RECOMMENDATION

We recommend the use of appropriate PPE to include mask (N95 or higher standard), fluid repellent sealed well-fitting long gown, double gloves, apron, full face shield or goggles or visor, scrub hat, and disposable shoe covers or dedicated closed footwear among surgeons engaged in aerosol generating procedures of suspected or confirmed COVID-19 patients. (*Very low quality of evidence; Strong recommendation*)

### Consensus Issues

Although shoe cover was not mentioned in the assessed studies and in the recommendations from other groups, the panel agreed to include this in the minimum PPE required in surgery as it is part of the standard precaution. A strong recommendation was given despite the very low quality of evidence since the enumerated PPE is the existing minimum standard protection recommended for healthcare workers directly caring for COVID-19 patients. The panel also emphasized strict adherence to protocols and the appropriate use of this minimum PPE to prevent COVID-19 infection.

### Key Findings

Five observational studies (2 cohorts, 2 cross-sectional, and 1 case series) investigated the effectiveness of PPE use in reducing SARS-CoV-2 transmission among healthcare workers involved in surgical aerosol-generating procedures (AGP).

Very low evidence suggests the protective effect of an appropriate PPE on surgeons engaged in AGP procedures of suspected or confirmed COVID-19 patients. Consistent N95 mask use reduced the odds of SARS-CoV-2 infections significantly (OR 0.37 [95% CI 0.21, 0.67], 1 study, n= 195 participants) than inconsistent N95 use among healthcare workers involved AGP. Consistent gown use significantly reduced the odds of SARS-CoV-2 infections (OR 0.59 [95% CI 0.46, 0.77] I<sup>2</sup>= 0%, 2 studies, n= 941 participants) than inconsistent gown use amongst healthcare workers performing AGP. Consistent glove use reduced the odds of SARS-CoV-2 significantly (OR 0.42 [95% CI 0.43, 0.55] I<sup>2</sup>=34%, 3 studies, n=978) than inconsistent glove use among healthcare workers performing AGP. Very low evidence suggests the protective effects of N95 mask, gown,



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gloves, face shield/goggles, apron, and scrub hat in reducing SARS-CoV-2 transmission among healthcare workers performing AGP procedures.

## Introduction

COVID-19 transmission mainly occurs through respiratory droplets generated by coughing or sneezing or through contact with contaminated surfaces. During aerosol-generating procedures, the risk of spreading SARS-CoV-2 via aerosols is significantly increased. Endotracheal intubation, non-invasive ventilation, and administration of nebulized medications increased healthcare workers' odds for contracting SARS-CoV-1 or SARS-CoV-2 infections by 3 to 10 times [1]. Several surgical procedures<sup>1</sup> were classified as AGPs [2]. Since the COVID-19 pandemic affected patients requiring elective and emergency surgical procedures [3] and since PPE supply is limited, guidance on the appropriate PPE to use for surgical procedures is urgently needed.

## Review Methods

A systematic search of electronic databases MEDLINE and Cochrane Central base was performed last March 21, 2021, using a combination of subject headings and keywords for SARS-CoV-2, PPE, and surgery. We included studies that determined the effectiveness of PPE by healthcare workers during surgery of suspected or confirmed COVID-19 patients. We excluded studies that used PPE for non-surgical interventions, articles not written in English, and other types of articles (e.g., abstracts, posters, review articles, book chapters, letters, guidelines, points of view).

## Results

### Characteristics of included studies

Five observational studies (2 cohorts [4,5], 2 cross-sectional [6,7], and 1 case series [8]) investigated the effectiveness of PPE use in reducing SARS-CoV-2 transmission among healthcare workers involved in AGP procedures. Three systematic reviews [9–11] reported PPE guidelines during AGP and non-AGP procedures.

### Overall quality

The overall body of evidence on the effectiveness of PPE for surgery was rated very low. Downgrading occurred due to serious risk of bias (as all included non-randomized studies had biases related to confounding, participant selection, intervention classification, recall

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<sup>1</sup> autopsy, surgery/postmortem procedures with high-speed devices, intubation and extubation procedures, bronchoscopy, sputum induction, manual ventilation, airway suctioning, cardiopulmonary resuscitation, tracheostomy and tracheostomy procedures, non-invasive ventilation, high-flow oxygen therapy, breaking closed ventilation systems (intentionally or unintentionally), nebulized or aerosol therapy, nasopharyngoscopy or laryngoscopy, high-frequency oscillatory ventilation, coughing mechanical ventilation, chest physiotherapy, and nasopharyngeal aspirate



bias, intervention deviation, and publication bias), inconsistency, and imprecision (total participants <980).

Appendix 2 reports the GRADE Evidence Profile on N95, gown, glove, and PPE use of healthcare workers during AGP.

### **Outcomes**

Five observational studies provided direct evidence on N95, gown, glove, and PPE effectiveness in reducing SARS-CoV-2 transmission during AGP [4–8]. No studies reported on the use of PPE equipment on non-AGP.

### **PPE for AGPs**

#### **Consistent PPE use vs. inconsistent PPE use**

There is very low evidence reported by Khalil et al. (2020) that PPE use did not significantly reduce the odds of SARS-CoV-2 (OR 0.54 [95% CI 0.12, 2.38]) among healthcare workers performing AGP (6). Most physicians had to reuse their PPEs which may have increased their likelihood of getting COVID-19 infection. A cross-sectional study from Wuhan, China, reported contrasting findings, with all 420 healthcare workers who wore a complete PPE (i.e., N95, medical suit, isolation gown, apron, gloves, eye protection, and hair cover) while engaging in AGPs reporting no SARS-CoV-2 infections [7]. In this study, the healthcare workers were trained in donning and doffing PPE and performing AGPs. They suggested that wearing appropriate PPE and adherence to standard recommendations effectively protected the healthcare workers from SARS-CoV-2 transmission during AGPs [7].

#### **Consistent N95 use vs. inconsistent N95 use**

Very low quality evidence from 1 cross-sectional study suggested that consistent N95 mask use reduced the odds of SARS-CoV-2 infections significantly (OR 0.37 [95% CI 0.21, 0.67]) compared to inconsistent N95 use among 195 healthcare workers involved in AGP [6]. A case series study reported no COVID-19 infection among 25 healthcare workers who wore N95 masks during AGP [8].

#### **Consistent gown use vs. inconsistent gown use**

Based on 2 studies with low quality evidence, consistent gown use significantly reduced the odds of SARS-CoV-2 infections (OR 0.59 [95% CI 0.46, 0.77]  $I^2=0\%$ , 2 studies,  $n=941$  participants) compared to inconsistent gown use amongst healthcare workers performing AGP. Figure 1 shows the Forest plot on gown use by healthcare workers during AGP.



### **Consistent glove use vs. inconsistent glove use**

There is low evidence from 3 observational studies that consistent glove use reduced the odds of SARS-CoV-2 significantly (OR 0.42 [95% CI 0.43, 0.55]  $I^2=34%$ , 3 studies,  $n=978$ ) than inconsistent glove use among healthcare workers performing AGP. In the study of Liu et al. (2020), none of the 420 healthcare workers wearing complete PPE (i.e., N95, medical suit, isolation gown, apron, gloves, eye protection, and hair cover) was infected with SARS-CoV-2 when performing AGPs [7]. Figure 2 shows the Forest plot on glove use by healthcare workers during AGP.

### **Consistent face shields/goggles use vs. Inconsistent face shields/goggles use**

Very low-quality evidence showed that consistent use of face shields/goggles did not significantly reduce the odds of SARS-CoV-2 transmission (OR 0.70 [95% CI 0.31, 1.59]) than inconsistent face shields/goggles use among healthcare workers performing AGP.

### **Recommendations from Other Groups**

Different societies formulated separate PPE guidelines for surgical procedures comprising aerosol-generating or non-aerosol-generating procedures.

### **Surgical procedures with AGP**

The following PPE is recommended for tracheostomy procedures for COVID-19 patients based on a systematic review of 17 international tracheostomy guidelines: full PPE, which includes N95 or N99 (USA) / FFP2 or FFP3 (Europe) mask, double gloves, goggles or eye protection, face shield, and an apron or gown [9]. Three guidelines (USA, UK, Singapore) recommended the use of a powered air-purifying respirator (PAPR) [9].

When working in high-risk units (e.g., ICU, high-dependency unit, accident, and emergency, resuscitation, wards with non-invasive ventilation or continuous positive airway pressure ventilation, operating rooms, endoscopy units) or in operating rooms where AGPs are being undertaken, then a respirator (N99 or FFP3 equivalent, which can be valved or unvalved) is recommended instead of a surgical mask along with a fluid repellent long gown (WHO), and full-face shield or visor (WHO, Public Health England) [10].

### **Surgical procedures without AGP**

Agrawal et al. (2021) reviewed 41 surgery guidelines during COVID-19. The guidelines were written by national associations (27/41), regional societies (9/41), and international societies (5/41). Eight of the 41 guidelines were from LMICs. These guidelines are not evidence-based in terms of evidence level and methodology adopted for guideline development. The level of evidence was uniformly rated "low," as assessed by GRADE guidelines, as they were based on level 3 evidence and grade C recommendations [11].



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The common recommendations include gloves, head cap, N95 respirator, gown, and face shield. All staff should wear enhanced EPPE in operating rooms and during AGP. Appendix C reports the PPE recommendations from the 41 guidelines.

### Research Gaps

The PPE recommendation was invariably based on two primary considerations: the patient's COVID-19 status and the procedure's risk of infection (i.e., AGP or non-AGP). Most of the PPE recommendations were not based on preoperative test results, and about 25% of the included studies did not specify the PPE need about AGP. Also, limited data is available for resource-constrained settings. The economic repercussions of PPE wastage and the cost-effectiveness of various PPE or PPE combinations were also not studied. PPE recommendation was guided by fear over science. This was obvious with EPPE recommendation by all staff in the operation room by most studies [11].



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### Appendix 1A. Characteristics of Included Studies and Summary of findings on use of N95, gown, glove and PPE during AGP.

Author, Year	Study design	Virus	Population	Total (intervention: control)	Intervention: Consistent use	Comparator: Inconsistent use	OR (95% CI)	Risk of Bias
Chatterjee et al. (2020)	Prospect cohort	SARS-CoV-2	Doctors, nurses, housekeeping staff guards, laboratory technicians, and others	378:373	Gown	Gown	0.62 (0.46, 0.83)	Serious
					Glove	Glove	0.38 (0.26, 0.55)	
					Glove	Glove	not estimable	
Heinzerling et al. (2020)	Prospect cohort	SARS-CoV-2	Nurses, respiratory therapists, nursing assistants, physicians, and others	3:34	Glove	Glove	4.40 (0.21, 91.92)	Serious
Liu et al. (2020)	Cross-sectional	SARS-CoV-2	Doctors, nurses	420	PPE use	None		Serious
Periyasamy et al. (2020)	Retro case series	SARS-CoV-2	Healthcare workers	25	N95	N95		Serious
Khalil et al. (2020)	Cross-sectional comparative study	SARS-CoV-2	Physicians	98:92	Faceshield/goggles	Faceshield/goggles	0.70 (0.31, 1.59)	Serious
					N95	N96	0.37 (0.16, 0.87)	
					Glove	Glove	0.52 (0.28, 0.94)	
					Gown	Gown	0.50 (0.28, 0.90)	
					Water-proof apron	Water-proof apron	0.40 (0.24, 1.03)	
					PPE	PPE	0.54 (0.12, 2.38)	



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Figure 1. Forest plot on effects of gown use on SARS-CoV-2 transmission during AGP

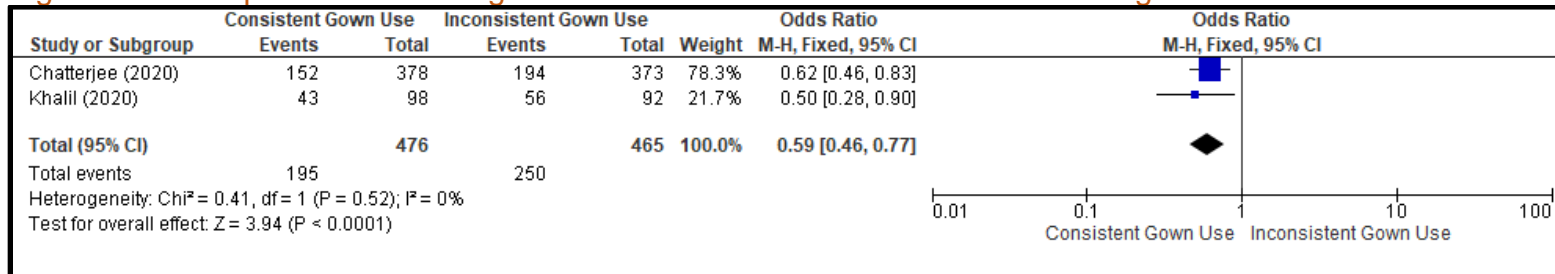
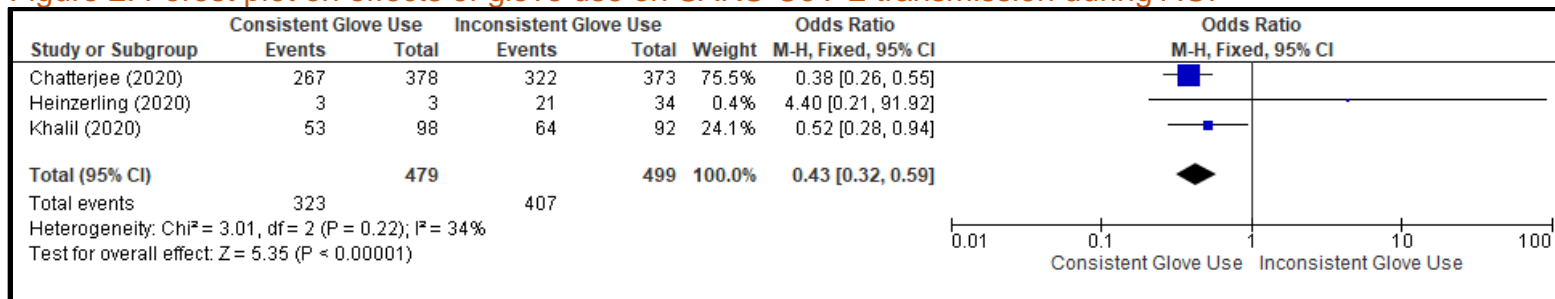


Figure 2. Forest plot on effects of glove use on SARS-CoV-2 transmission during AGP







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## Appendix 2. GRADE Evidence Profile on use of N95, gown, glove and PPE during AGP.

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	consistent PPE use	inconsistent PPE use	Relative (95% CI)	Absolute (95% CI)		
<b>PPE use</b>												
2	observational studies	serious <sup>a</sup>	not serious	not serious	serious <sup>b</sup>	publication bias strongly suspected all plausible residual confounding would suggest spurious effect, while no effect was observed <sup>c</sup>	58/518 (11.2%)	64/92 (69.6%)	<b>OR 0.54</b> (0.12 to 2.38)	<b>143 fewer per 1,000</b> (from 480 fewer to 149 more)	⊕○○○ VERY LOW	Not graded
<b>Consistent N95 use vs. inconsistent N95 use</b>												
2	observational studies	serious <sup>d</sup>	serious <sup>a</sup>	not serious	serious <sup>f</sup>	publication bias strongly suspected strong association all plausible residual confounding would reduce the demonstrated effect <sup>e</sup>	36/101 (35.6%)	56/92 (60.9%)	<b>OR 0.37</b> (0.21 to 0.67)	<b>243 fewer per 1,000</b> (from 362 fewer to 98 fewer)	⊕○○○ VERY LOW	Not graded
<b>Consistent gown use vs. inconsistent gown use</b>												
2	observational studies	serious <sup>h</sup>	not serious	not serious	not serious	publication bias strongly suspected strong association all plausible residual confounding would reduce the demonstrated effect <sup>i</sup>	195/476 (41.0%)	250/465 (53.8%)	<b>OR 0.59</b> (0.46 to 0.77)	<b>131 fewer per 1,000</b> (from 189 fewer to 65 fewer)	⊕⊕○○ LOW	Not graded
<b>Consistent glove use vs. inconsistent glove use</b>												
3	observational studies	serious <sup>j</sup>	not serious	not serious	not serious	publication bias strongly suspected strong association all plausible residual confounding would reduce the demonstrated effect <sup>k</sup>	323/479 (67.4%)	407/499 (81.6%)	<b>OR 0.43</b> (0.32 to 0.59)	<b>160 fewer per 1,000</b> (from 230 fewer to 93 fewer)	⊕⊕○○ LOW	Not graded

Consistent face shields/goggles use vs. Inconsistent face shields/goggles use



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Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	consistent PPE use	inconsistent PPE use	Relative (95% CI)	Absolute (95% CI)		
1	observational studies	serious <sup>l</sup>	not serious	not serious	serious <sup>m</sup>	publication bias strongly suspected all plausible residual confounding would suggest spurious effect, while no effect was observed <sup>n</sup>	39/98 (39.8%)	52/92 (56.5%)	<b>OR 0.70</b> (0.31 to 1.59)	<b>89 fewer per 1,000</b> (from 278 fewer to 109 more)	⊕○○○ VERY LOW	Not graded

CI: Confidence interval; OR: Odds ratio

## Explanations

- a. confounding, classification of interventions, selection of participants, recall bias
- b. contrasting results
- c. Only two studies with a study with non-estimable result
- d. selection of participants, classification of intervention, confounding, recall bias, unclear deviation from intervention and missing data
- e. Not estimable results in one study
- f. less than 300 participants
- g. Only two studies with a study with non-estimable result
- h. confounding, classification of intervention, selection of participants, recall bias, unclear deviations from intended interventions
- i. Only two studies were included.
- j. confounding, selection of participants, classification of intervention, unclear deviations from intended interventions
- k. Only three studies were included.
- l. confounding, selection of participants, classification of intervention, unclear deviations from intended interventions, recall bias
- m. sample size is only 190
- n. Only one study was included.



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### Appendix 3. PPE recommendations during the COVID-19 (n=41) [19]

PPE	Recommended		Not recommended		Not mentioned	
	n	%	n	%	n	%
Gloves	37	90.24	0	0	4	9.75
Head cap	37	90.24	0	0	4	9.75
N95 respirator	34	82.92	5	12.19	2	4.87
Front doffing gown	37	90.24	0	0	4	9.75
Face shield	36	87.8	1	2.43	4	9.75
EPPE worn by all staff in OR	28	68.29	5	12.19	8	19.51
Use of EPPE in a negative patient in OR	24	58.53	9	21.95	8	19.51
Use of EPPE in a positive patient in OR	38	92.68	0	0	3	7.32
EPPE in HAGP	30	73.17	1	2.43	10	24.39
Donning PPE	9	21.95	26	63.41	6	14.63
Doffing PPE	9	21.95	26	63.41	6	14.63
PPE disposal	3	7.317	0	0	38	92.68

Legend: EPPE, enhanced personal protective equipment; OR, operating room; HAGP, high-risk aerosol-generating procedure; PPE, personal protective equipment



## Appendix 4. Electronic databases and Search Strategy

**Electronic databases:** Pubmed, MEDLINE, Cochrane Database

**Search strategy:**

1. (((("COVID-19" [Supplementary Concept] OR "COVID-19 diagnostic testing" [Supplementary Concept] OR "COVID-19 drug treatment" [Supplementary Concept] OR "COVID-19 serotherapy" [Supplementary Concept] OR "COVID-19 vaccine" [Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2" [Supplementary Concept] OR "2019-nCoV" OR "2019nCoV" OR "cov 2" OR "Covid-19" OR "sars coronavirus 2" OR "sars cov 2" OR "SARS-CoV-2" OR "severe acute respiratory syndrome coronavirus 2" OR "coronavirus 2" OR "COVID 19" OR "COVID-19" OR "2019 ncov" OR "2019nCoV" OR "corona virus disease 2019" OR "cov2" OR "COVID-19" OR "COVID19" OR "nCov 2019" OR "nCoV" OR "new corona virus" OR "new coronaviruses" OR "novel corona virus" OR "novel coronaviruses" OR "SARS Coronavirus 2" OR "SARS2" OR "SARS-COV-2" OR "Severe Acute Respiratory Syndrome Coronavirus 2") OR ((19[tiab] OR 2019[tiab] OR "2019-nCoV" OR "Beijing" OR "China" OR "Covid-19" OR epidem\*[tiab] OR epidemic\* OR epidemy OR new[tiab] OR "novel"[tiab] OR "outbreak" OR pandem\* OR "SARS-CoV-2" OR "Shanghai" OR "Wuhan") AND ("Coronavirus Infections"[Mesh] OR "coronavirus"[MeSH Terms] OR coronavirus\*[all] OR corona-virus\*[all] OR cov[tiab] OR pneumonia-virus\*[tiab]))) AND 2019/12/1:3000/12/31[PDAT]))
2. Personal protective equipment OR PPE
3. Surgeons OR surgery OR operating room or AGP or aerosol generat\* procedure\*