

# Rationalizing personal protective equipment (PPE) in radiology in the time of COVID-19

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## Introduction

The COVID-19 pandemic, also known as the coronavirus pandemic, is caused by severe acute respiratory syndrome coronavirus 2 (SARSCoV2). The outbreak was first identified in Wuhan, China, in December 2019. The World Health Organization declared the outbreak a public health emergency of international concern on January 30, 2020 and a pandemic on March 11, 2020. As of May 31, 2020, the Ministry of Health and Family Welfare have confirmed a total of 89995 cases, 86983 recoveries (including 1 migration), and 5164 deaths in the country.<sup>[1]</sup>

The virus primarily spreads among people during close contact, most often via small droplets produced by coughing, sneezing, and talking.

## Personal Protective Equipment (PPE)

Personal Protective Equipments (PPEs) are protective gears designed to safeguard the health of workers by minimizing the exposure to a biological agent. Occupational Safety and Health Administration (OSHA) defines PPE as “specialized clothing or equipment worn by an employee for protection against an infectious material”.<sup>[2]</sup>

### Components of PPE

Coverall, gloves, shoe cover, triple-layer mask, N95 respirator, head cover (hood), face shield, and goggles.

### Levels of PPE

*Level 1 PPE:* For Standard Infection control precautions – It includes disposable gown and disposable gloves. If risk of spraying or splashing is anticipated, surgical mask and face shield/goggles are recommended.

*Level 2 PPE:* For direct/indirect contact precautions/droplet precautions/airborne precautions – It includes fluid-resistant disposable gown and disposable gloves. If

risk of spraying or splashing is anticipated, surgical mask and face shield/goggles are recommended. Head cover and N95 respirator are to be considered in cases of airborne infection.

*Level 3 PPE:* Enhanced precautions for suspected or confirmed infectious diseases of high consequence which spread by direct/indirect contact or by airborne route – It includes fluid-resistant coverall with hood/long-sleeved gown with disposable fluid-resistant hood, N95 mask, face shield, two sets of gloves, and shoe covers.

## Details of Each Element of PPE

**Fluid-resistant coverall:** The coverall should have following specifications - Impermeable to blood and body fluids, single use, meets or exceeds ISO 16603 class 3 exposure pressure, or equivalent. The coverall should be SITRA or DRDO approved if manufactured in India.

**Disposable gown:** Impermeable to blood and body fluids, single use.

**Disposable gloves:** Nitrile nonsterile, powder-free gloves are preferred.

*Value of gloves in COVID-19 scenario:* Gloves should be worn when providing direct care for a COVID-19 case and then removed, followed by hand hygiene. Extended use of gloves for caring COVID-19 cases is not recommended. Changing gloves between dirty and clean tasks during care to a patient and when moving from a patient to another, accompanied by hand hygiene, is absolutely necessary. Double gloving is not recommended, except for surgical procedures that carry a high risk of rupture.

**Triple-layer surgical mask:** The triple-layer surgical mask should be made of a melt-blown polymer, most commonly polypropylene, placed between nonwoven fabrics.

**Table 1: Appropriate use of PPE in non COVID areas in diagnostic radiology<sup>[3-7]</sup>**

Diagnostic radiology non-covid areas					
Setting	Target personnel	PPE	Level of PPE	Remarks	Patient oriented
Radiology Reception Area/ Help Desk	Receptionist/Data entry operator	Triple-layer mask	-	Ideally, build glass/plastic screens to create a barrier between health care workers and patients	Physical distancing to be followed at all times Patients should wear a cloth mask/triple-layer mask at all times
X-ray	Radiologist/Technician	Gown and triple-layer mask	-	-	Patients should wear a cloth mask/triple-layer mask at all times
Fluoroscopy procedures	Radiologist/Nurse/Technician	Gown, triple-layer mask, gloves	Level 1	Face shield/goggles with a visor, when splash of body fluid is expected	Patients should wear a cloth mask/triple-layer mask at all times
Ultrasound	Radiologist/Nurse/Attendant	Gown, triple-layer mask	-	Ideally, build glass/plastic screens with a hole for hand to create a barrier	Patients should wear a cloth mask/triple-layer mask at all times
Mammography <sup>[7]</sup>	Radiologist/Technician	Gown, triple-layer mask, gloves	Level 1	-	Patients should wear a cloth mask/triple-layer mask at all times
CT	Radiologist/Nurse/Technician	Gown, triple-layer mask	-	Face shield/goggles with a visor, when splash of body fluid is expected or a patient being imaged is on ventilator	Patients should wear a cloth mask/triple-layer mask at all times
MRI	Radiologist/Nurse/Technician	Gown, triple-layer mask	-	Face shield/goggles with a visor, when splash of body fluid is expected or a patient being imaged is on ventilator	Patients should wear a cloth mask/triple-layer mask at all times

Hospital Attendant and Housekeeping staff in non-COVID areas should wear triple-layer mask, gown, heavy duty gloves, heavy duty boots, goggles or face shield if splash of fluid is expected. Anywhere where there is aerosol generating procedure, Level 3 PPE to be used. PPEs are not alternative to basic preventive public health measures such as hand hygiene, respiratory etiquettes which must be followed at all times. Doctor and nursing staff should wear gloves while handling patients whose clothes are visibly soiled

**Table 2: Appropriate use of PPE in non COVID areas in Interventional Radiology and all COVID areas in radiology<sup>[3-7]</sup>**

Interventional radiology non-covid areas					
Setting	Target personnel	PPE	Level of PPE	Remarks	Patient oriented
Emergency Vascular/ Nonvascular Intervention procedure	Radiologist/Nurse/Technician	Water impervious gown, gloves, shoe cover, head cover or cap, triple-layer mask, and goggles/face shield if aerosol generation/splash expected	Level 3	- Ideally, build glass/plastic screens to create a barrier between health care workers and patients - N95 respirator to be used if patient from hot spot/containment zone	Patients should wear a cloth mask/triple-layer mask at all times if feasible
Elective Vascular/ Nonvascular Intervention procedure	Radiologist/Nurse/Technician	Linen gown, gloves, shoe cover, head cover or cap, triple-layer mask, and face shield if feasible	Level 2	- N95 respirator to be used if patient from hot spot/containment zone - Any procedure involving lung or pleural cavity wear full PPE	Patients should wear a cloth mask/triple-layer mask at all times
Emergency USG/CT guided procedures	Radiologist/Nurse/Technician	Water impervious gown, gloves, shoe cover, head cover or cap, triple-layer mask, and goggles/face shield if aerosol generation/splash expected	Level 2	Ideally, build glass/plastic screens to create a barrier between health care workers and patients - N95 respirator to be used if patient from hot spot/containment zone	Patients should wear a cloth mask/triple-layer mask at all times if feasible
Elective USG/CT/ Mammography guided procedures	Radiologist/Nurse/Technician	Linen gown, gloves, shoe cover, head cover or cap, triple-layer mask, and face shield if feasible	Level 2	- N95 respirator to be used if patient from hot spot/containment zone - Any procedure involving lung or pleural cavity wear full PPE	Patients should wear a cloth mask/triple-layer mask at all times if feasible

**All radiology procedures in covid areas**

All Diagnostic and Interventional procedures	Radiologist/Nurse/Technician/ Housekeeping/ Hospital Attendant	Full component of PPE	Level 3	- Physical distancing to be followed at all times - Ideally, build glass/plastic screens to create a barrier between health care workers and patients	Patients should wear a cloth mask/triple-layer mask at all times if feasible
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Hospital Attendant and Housekeeping staff in non-COVID areas should wear triple-layer mask, gown, heavy duty gloves, heavy duty boots, goggles or face shield if splash of fluid is expected. Anywhere where there is aerosol generating procedure, Level 3 PPE to be used. PPEs are not alternative to basic preventive public health measures such as hand hygiene and respiratory etiquettes which must be followed at all times

N95 mask: Ideally should be NIOSH N95, EN 149 FFP2, or equivalent.

*Triple-layer mask or N95:* N95 masks should be used in COVID suspect and positive cases. Surgical mask should

only be used for routine cases in which there is no suspicion for COVID infection. Only in crisis times and nonavailability of N95 masks, surgical mask with visor may be considered for examining COVID suspect cases with all due precautions.

Face shield: It should be made of clear plastic and provide good visibility to both the wearer and the patient. It should be fog resistant, should have adjustable band to attach firmly around the head and fit snugly against the forehead, and completely cover the sides and length of the face.

Goggles: Goggles should have transparent glasses with zero power. It should be covered from all sides with elastic band/or adjustable holder. It should have good seal with the skin of the face and should be fog and scratch resistant.

Shoe cover: It should be made up of the same fabric as of the coverall and should cover the entire shoe and reach above the ankles.

### Rational Use of PPE in Radiology

Various PPEs that have to be used in diagnostic as well as interventional radiology services are listed in Tables 1 and 2.<sup>[3-6]</sup>

### Conclusion

As the Government is in the process of opening the lockdown and stressing on opening of non-COVID hospitals, diagnostic centers will soon be flooded with patients for imaging. Rational and appropriate use of PPE that is reusable, economical, and recyclable is the need of hour. The above guidelines depend upon the resources available with the institutions, hospitals, and diagnostic centers. One can think of using their own customized PPEs as many local textile manufacturers are coming up with economical solutions as announced by our Honourable Prime Minister for implementing the *Atmanirbhar Bharat Abhiyan scheme*.

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Quick Response Code:	Website: <a href="http://www.ijri.org">www.ijri.org</a>
	DOI: 10.4103/ijri.IJRI_443_20

Cite this article as: Sureka B, Garg PK, Khera PS, Sinha A, Misra S. Rationalizing personal protective equipment (PPE) in radiology in the time of COVID-19. <i>Indian J Radiol Imaging</i> 2021;31:S204-6.	
Received: 13-May-2020	Revised: 29-May-2020
Accepted: 17-Jul-2020	Published: 23-Jan-2021