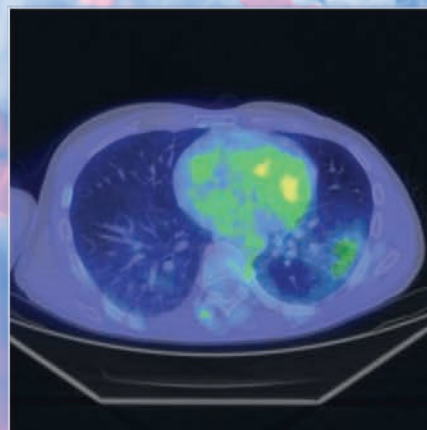
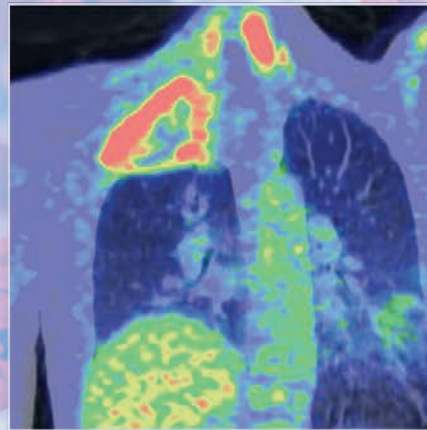


COVID-19 Pandemic: Technical Guidance for Nuclear Medicine Departments



IAEA
International Atomic Energy Agency

**COVID-19 PANDEMIC:
TECHNICAL GUIDANCE FOR
NUCLEAR MEDICINE DEPARTMENTS**

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COVID-19 PANDEMIC: TECHNICAL GUIDANCE FOR NUCLEAR MEDICINE DEPARTMENTS

ENDORSED BY THE
EUROPEAN ASSOCIATION OF NUCLEAR MEDICINE,
THE INTERNATIONAL SOCIETY OF RADIOGRAPHERS AND RADIOLOGICAL TECHNOLOGISTS
AND THE WORLD FEDERATION OF NUCLEAR MEDICINE AND BIOLOGY

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2020

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COVID-19 PANDEMIC: TECHNICAL GUIDANCE FOR NUCLEAR MEDICINE DEPARTMENTS
IAEA, VIENNA, 2020
IAEA/COV/19-1

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Printed by the IAEA in Austria
July 2020

FOREWORD

In January 2020, researchers isolated a new type of coronavirus, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), associated with cases of atypical pneumonia. The name of the novel virus was chosen to reflect its similarities to another coronavirus, the SARS coronavirus (SARS-CoV), which was identified in 2002 and infected over 8000 people in 29 different countries and territories, with over 700 deaths globally between 2002 and 2004. The outbreak lasted about 8 months; however, additional SARS cases were reported until May 2004.

Today, SARS-CoV-2 and the disease it causes, coronavirus disease or COVID-19, have become the subjects of intense study in the scientific community. Within a short time, hundreds of publications have been published on the virus; its transmission, detection and diagnosis; possible complications; and treatment alternatives. While this research indicates that most people with COVID-19 will experience only mild to moderate respiratory symptoms, older people and those with underlying medical problems such as cardiovascular disease, diabetes, chronic respiratory disease and cancer are more likely to develop more serious respiratory symptoms such as shortness of breath, difficulty breathing and fluid in their lungs or may present with multisystem manifestations of a COVID-19 infection caused by a combination of specific host defence responses with associated inflammatory activity, and microvascular involvement with the propensity to develop blood clots. Patients with severe or critical conditions require immediate medical care, often in an intensive care unit. They may experience respiratory failure, septic shock and organ failure, and some may die.

The human to human transmission of COVID-19 poses challenges to health care providers. In view of the hazards that health care workers are exposed to every day, this publication aims to provide guidance to nuclear medicine departments on adjusting standard operating procedures so that they can continue to provide essential services while protecting staff, patients and the public and preventing further spread of the virus.

The present publication expands on editorials by the IAEA and a team of international experts in the European Journal of Nuclear Medicine and Molecular Imaging entitled “COVID-19 pandemic: Guidance for nuclear medicine departments”, published in April 2020, and “Nuclear medicine services after COVID-19: Gearing up back to normality”, published in May 2020. It provides detailed information for nuclear medicine departments on operating during the COVID-19 pandemic. The guidance included here can also be applied in any outbreak with human to human transmission.

This publication was prepared by the IAEA. It has been endorsed by the European Association of Nuclear Medicine (EANM), the International Society of Radiographers and Radiological Technologists (ISRRT) and the World Federation of Nuclear Medicine and Biology (WFNMB).

The IAEA is grateful to all those who contributed to the drafting and review of this publication, to the experts who participated in the three webinars organized by the IAEA in March, April and May 2020 to provide guidance to nuclear medicine departments during the COVID-19 pandemic, and to the co-authors of the editorials on the topic. The webinars and editorials established the foundation for the guidance in this publication. The IAEA wishes to acknowledge the contributions of M. Perez of the World Health Organization (WHO) and the support of the EANM, ISRRT and WFNMB. The IAEA officers responsible for this publication were N. El-Haj, F. Giammarile, P. Orellana and D. Paez of the Division of Human Health.

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1. INTRODUCTION

1.1. BACKGROUND

The world is currently going through an unprecedented health crisis. On 31 December, 2019, the World Health Organization (WHO) office in China was informed of the existence of cases of atypical pneumonia of unknown ethology in the City of Wuhan, Hubei Province in China. More than 40 cases of pneumonia occurred between 31 December and 3 January. On 7 January 2020, scientists in China identified a coronavirus, previously unknown, as the cause of the pneumonias. The virus was isolated, from the lower respiratory tract samples of several patients. On 12 January 2020 the genome sequence of the new coronavirus was identified as the 2019-nCoV/SARS-CoV-2 causing the disease COVID-19.

The newly identified virus is part of the betacoronavirus family. A type of virus that is known for its ability to infect humans and has been associated with recent outbreaks of diseases such as Severe Acute Respiratory Syndrome (SARS) or the Middle East Respiratory Syndrome (MERS). It is known that betacoronaviruses can infect human hosts through the angiotensin-converting enzyme 2 (ACE-2), a membrane-bound protein that it is mainly expressed in vascular endothelial cells, the renal tubular epithelium, epithelium of the small intestine and cardiovascular tissue.

By 30 January 2020, 18 countries outside of China had reported cases of COVID-19. On 11 March, the WHO declared COVID-19 a pandemic.

The human to human transmission of COVID-19 represents a challenge for health care providers. It has been demonstrated that one infected person can transmit the virus 2 or 3 people. The main mechanism of transmission is through contact with droplets and fomites from an infected person that is produced when coughing, speaking or breathing. It is suspected that COVID-19 droplets can also be airborne which poses an additional risk for health care workers. Asymptomatic patients infected with COVID-19 can also transmit the virus.

1.2. OBJECTIVE

The objective of this publication is to advise nuclear medicine departments on the importance of adjusting their standard operation procedures to continue providing their essential services, while protecting their staff, patients and the public and subsequently preventing further spread of the virus.

This publication is focused on the infection prevention and control measures that have to be taken into consideration while executing all the steps needed to perform nuclear medicine diagnostic or therapeutic procedures, and provides detailed guidance on the adjustment of all the steps involved in the delivery of nuclear medicine services, from scheduling to reporting, during the COVID-19 pandemic. While many institutions will have their own guidelines for clinicians and imaging experts to follow, these recommendations are meant to support nuclear medicine departments interested in developing or refining such policies, in addition to the existing ones.

1.3. SCOPE

As with other imaging departments, the nuclear medicine technologists, nurses and healthcare assistants are generally the most at risk for exposure to COVID-19.

Infection exposure in nuclear medicine departments can occur in the waiting area, during patient registration, recording of history, clinical examination, transportation and imaging examination. Therefore, it is important to identify individuals who may pose an exposure risk to others and take the appropriate precautions to prevent contact and droplet infection transmission. This publication provides guidance for the safe practice of nuclear medicine to prevent COVID-19 infection transmission through the consecutive steps of a patient journey in the unit. This guidance could be also useful for other similar scenarios of public health emergencies from infectious diseases.

As this situation is shifting rapidly, the information contained within this document is likely to evolve. It is therefore advisable that healthcare providers keep informed regarding future updates from the relevant organizations and professional societies on strategies for protecting patients and health workforce from COVID-19 infection, while deciding on the optimal timing of outpatient and inpatient exams.

1.4. STRUCTURE

The chapters are structured for workers in nuclear medicine departments. The first part of the document includes all the measures that should be adopted in the present crisis. After a short outline regarding general measures, a description of Personal Protective Equipment (PPE) is addressed, followed by the classification of working areas, the measures to adopt during patient arrival, waiting area, nuclear medicine exams, and the protections of nuclear medicine staff. Incidental pulmonary findings in patients at risk of COVID-19 exposure are described and finally, the optimization of nuclear medicine devices is discussed. This part is completed by a conclusion with a list of key points.

The second part of the document is presented as an appendix summarizing check lists for nuclear medicine frontline staff such as Nuclear Medicine Radiographers/Technologist or nurses who will have the most potential close contact with infected patients.

2. NUCLEAR MEDICINE DEPARTMENTS DURING THE COVID-19 OUTBREAK

2.1. GENERAL PRINCIPLES

The first step of the process involving preventive measures for COVID-19 disease is to identify basic operations [1–11]. The World Health Organization (WHO) has published an Operational Guidance on COVID-19 for maintaining essential health services during an outbreak, which includes six main processes that could be extrapolated to nuclear medicine facilities (table 1).

TABLE 1: OPERATIONAL PROCESSES

OPERATIONAL PROCESSES (ADAPTED FROM [5])	
I.	Establish simplified purpose-designed governance and coordination mechanisms a. Establish a COVID-19 Incident Management Team; b. Designate a focal point.
II.	Identify context-relevant essential services a. Reallocate financial and material resources; b. Mobilize additional resources.
III.	Optimize service delivery settings and platforms a. Develop a contingency and business continuity plan.
IV.	Establish effective patient flow (screening, triage, and targeted referral) at all levels.
V.	Rapid redistribution of health workforce capacity, including reassignment of tasks a. Apply same precautions and screening tests that apply to patients; b. Stay home if feeling unwell or there is suspicion of COVID-19 infection; c. Consider segregating staff into teams; d. Consider re-training of staff to cover other positions within the department; e. All necessary personal protective equipment available must always be made available for staff at all working sites; f. Consider providing staff transportation and, if necessary, staff accommodation; g. Ensure environmental services staff are appropriately trained and protected; h. Establish periodic virtual staff meetings to update on the local status of the pandemic and to enquire about their well-being; i. Facilitate psychological consultation for staff.
VI.	Identify mechanisms to maintain the availability of essential equipment and supplies a. Identify mechanisms to maintain the availability of essential equipment and supplies; b. List required supplies and all possible suppliers and distribution channels.

Nuclear Medicine services should be flexible and adapt, considering the stage of the epidemic in the population they serve. Several general principles have been suggested by international organizations with key goals to minimize disease transmission, protect healthcare workers, preserve healthcare system functioning and, ultimately reduce morbidity and mortality [1-5]. Consideration is needed for the adoption of appropriate personal and institutional infection control practices tailored to the overall situation, as well as to the different areas of workplace and different levels of risks among the patients.

Specifically, these general principles include:

- (i) Distancing: Distancing should include both the patient waiting room as well as work areas for staff. Adopt international guidelines for social distancing at least 1m (three feet) and adapt best practice to local or national guidelines [8, 12–19];
- (ii) Hand Hygiene: Practising hand hygiene is one of the most effective way to removing germs from yourself and preventing the spread of germs to other as well as surfaces. Understanding when you should perform hand hygiene will be key in preventing the spread of COVID-19. Incorporating best practice protocols should include hand hygiene with either soap and water or, if not readily available, with hand sanitizer that contains at least 60% alcohol. This should be performed before and after contact with a patient;
- (iii) Rescheduling non-urgent procedures: Practitioners should work closely with referring physicians to define the appropriateness and timing of each study on a case by case basis, considering the local epidemiology of COVID-19 and local institutional guidelines for practice, until effective measures are in place to provide a full nuclear medicine service to all patients in a safe environment for patients and staff;
- (iv) Ensuring supplies are available: Leadership will need to ensure enough Personal Protective Equipment (PPE) is made available for staff. Centralizing PPE supplies and allocating based on clinical priority needs can help ensure that PPE will remain available for the evolving pandemic. Storing PPE in a secure location can also help prevent theft;
- (v) Promoting use of telehealth.

2.2. GOVERNANCE

It is important to set up at the departmental level a special infection emergency management team. The essential role of this team will be to implement infection containment and control procedures, according to local recommendations that allow the continuation of imaging examinations of those patients with suspected, probable and / or confirmed infection¹ and to prevent intradepartmental spreading of infection. Infection prevention and control measures, such as reconfiguration of department areas, personal protection, and anti-infection training of all staff, as well as standardized procedures including contact minimization for examinations and timely disinfection of examination rooms should be implemented properly.

¹ According to WHO definition, “a **suspected case** is a patient with acute respiratory illness AND a history of travel to or residence in a location reporting community transmission of COVID-19 disease during the 14 days prior to symptom onset; or a patient with any acute respiratory illness AND having been in contact with a confirmed or probable COVID-19 case in the last 14 days prior to symptom onset; or a patient with severe acute respiratory illness AND requiring hospitalization AND in the absence of an alternative diagnosis that fully explains the clinical presentation. A **probable case** is a suspect case for whom the result of the test for the COVID-19 virus is reported as “inconclusive” by the laboratory OR a suspect case for whom testing could not be performed for any reason. A **confirmed case** is a person with laboratory confirmation of COVID-19 infection, irrespective of clinical signs and symptoms” [6].

2.3. ESSENTIAL SERVICES

2.3.1. Critical activities

The considerations for critical nuclear medicine services during the COVID-19 pandemic are the following (table 2):

- (a) Review hospital's license for authorized users and radiopharmaceuticals to ensure that facilities have appropriate radiopharmaceuticals and authorized users needed to perform appropriate tests needed. If needed, apply for emergency amendment to your license to allow for isotopes to be delivered appropriately;
- (b) During crisis, radiopharmaceuticals supply should be confirmed as there may be some disruption;
- (c) If multiple facilities are available, designate one facility for symptomatic / unconfirmed / confirmed COVID-19 only patients. Also, if possible, designate a portable gamma camera for the COVID-19 floor in hospital and when possible leave in unit;
- (d) The exams should be prioritized, in discussion with the referring clinician, according to the impact of the result in the patient's history (table 2).
 - (i) Non-essential nuclear medicine studies should be postponed;
 - (ii) Urgent studies must be performed whenever clinically appropriate to expedite the management of outpatients, as well as assess and dispose of inpatients and emergency department patients;
 - (iii) The guiding principle that imaging is appropriate if it leads to short term change in patient management, should be used [9].
- (e) Lung Scan:
 - (i) Consider not performing ventilation scans and only performing perfusion imaging as part of procedures with hybrid Single Photon Emission Computed Tomography (SPECT) Computed Tomography (CT), if available;
 - (ii) If current chest radiograph or lung CT demonstrates lung opacification, patients should be referred for alternative testing;
 - (iii) If the lungs are clear, the patient should proceed to perfusion scintigraphy, using either planar or tomographic imaging.
- (f) Cardiac scan:
 - (i) Cardiac Positron Emission Tomography (PET) if available may be preferred for rapid throughput and to help minimize time spent by the patient in the laboratory;
 - (ii) Exercise stress testing should be generally avoided.
- (g) Therapeutic Nuclear Medicine:
 - (i) Each patient needs to be assessed on an individual basis;
 - (ii) Radioiodine therapy appointments for benign Hyperthyroidism may have to cease, since they are in the main, non-urgent, and would pose radiation protection issues should they be admitted to intensive care. However, consideration should be given to giving the treatment to those patients who are unable to tolerate anti-thyroid medications, or those who have other severe comorbid issues, whereby a delay in treatment would cause more harm than good;
 - (iii) Administration of radioiodine ablation therapy to thyroid cancer patients needs careful consideration. Thyroid Cancer guidance should be followed for actions to be taken for

- low, medium and high-risk patients in terms of delay of treatment and measures to be taken should the decision be made to go ahead with treatment;
- (iv) Lu177-DOTATOC/PSMA for patients with neuroendocrine tumours or prostate cancer, respectively, will need to be reviewed in light of local risk assessments/guidelines. However, since these patients could be considered at risk due to possible marrow depletion post procedure, it may be safer to defer treatment for a few months. Each patient should be reviewed in his/her own clinical and local contexts;
- (v) Radium-223 dichloride can be administered as an outpatient procedure, provided the patients do not have comorbidities that would put them at high risk due to low immunity.

TABLE 2. CLASSIFICATION OF EXAMS (NO Tc-GENERATOR SHORTAGE)

Priority 1 To be maintained as scheduled	Priority 2 Consider postponing	Priority 3 Can be postponed
<i>Oncology</i>		
Bone scan (oncology)		Bone scan (non-oncology)
Sentinel lymph nodes		Lymphoscintigraphy
F-18 FDG cancer: diagnosis, evaluation of therapy and relapse	FDG follow-up	
Octreotide/ Ga68-DOTATATE new cancer diagnosis, evaluation of therapy and relapse	Octreotide/ Ga-68-DOTATATE follow-up	
F-18-choline/ Ga-68-PSMA new cancer	F-18-choline/ Ga-68-PSMA follow-up	
	mIBG	
<i>Cardiology</i>		
MUGA (oncology)	MUGA cardiac	
MPS in order to discard significant coronary disease	MPS routine	mIBG (heart)
<i>General NM</i>		
F-18 FDG infection	Labelled White Blood Cell	Labelled Platelet
GI bleeding / Meckel Diverticulum Scan		Thyroid
DTPA scan for GFR	MAG3	Parathyroid Scan
DMSA scan for Acute Pyelonephritis		HIDA
Lung perfusion	Lung VQ	SPECT and PET for neurological diseases
<i>Therapy</i>		
Y-90 SIRT		
Lu-177 DOTATATE		
Ra-223		
I-131		

Table based on consensus only. Responsibility lies with each Nuclear Medicine Department to ensure their written policy adheres to that outlined by National Public Health Guidance or recommendations in their respective countries and institutions. Each case should be analysed individually, ideally with the referring physician.

2.3.2. Optimization of nuclear medicine devices

In case of a difficult situation, when the institution requires and when appropriate, the CT part of hybrid SPECT or PET systems should be used for CT diagnostic scans, if the CT component fulfils diagnostic procedures (i.e. over 16 slices) [3–6, 20, 21].

2.3.3. Shortage of supplies

A possible shortage in Tc-99m generator should also be considered (table 3).

TABLE 3. CLASSIFICATION OF EXAMS (Tc-GENERATOR SHORTAGE)

Essential exams	Consider replacement
Oncology	
Bone scan (oncology)	NaF-18
Sentinel Lymph Node	n.a.
Octreotide	Ga68-DOTATATE (when available)
Cardiology	
MUGA (oncology)	n.a.
MPS acute chest pain	Rb-82 (when available)
General NM	
White labelled cell	F18FDG
GI bleed / Meckel Diverticulum Scan	n.a.
DTPA scan for GFR	n.a.
Lung perfusion	n.a.

The proposed limitations indicated in table 2 and 3 do not advocate a total ban of any of the included procedures, but are suggestions for a short-term delay of some nuclear medicine procedures in selected patients, when temporary logistics around handling the COVID-19 epidemic dictate the streamlining of a nuclear medicine service. Thus, this approach does not suggest or imply a delay of any specific procedure as such, but it rather allows all essential nuclear medicine procedures to be performed uninterruptedly, while departments can put effective measures in place to again provide a full nuclear medicine service to all patients in a safe environment for patients and staff, adhering to local and national rules.

2.4. PATIENT FLOW

2.4.1. Introduction

When faced with major public health emergencies from infectious diseases, such as the current COVID-19 outbreak, infection prevention and control procedures should commence at the outpatient clinic. A notice at the reception desk for outpatients to self-declare would be helpful for this purpose:

When visiting [Name of Nuclear Medicine department] please remember that we are a diagnostic imaging unit, not an infectious disease control location. If you have symptoms of the virus or have been in contact with a person at-risk, please let our staff know at check-in.

WHO criteria should be adopted to categorize patients as either suspected, probable or diagnosed with COVID-19. Due to the incubation time the probability of contagion should always be considered [22-24]. Healthcare workers should recognize the symptoms of COVID-19 infection, including fever, dry cough, fatigue and dyspnoea. However, since there are asymptomatic carriers of the virus, when the patient arrives at the unit, the patient's epidemiological history and temperature measurement should be taken (Figs 1 and 2).

Patients must wear masks throughout his/her visit in the department and during the imaging procedure according to national or international guidelines. Immunocompromised patients (e.g. oncology patients) should be separated from other patients, and have separate personnel attending to them for their testing.

Novel Coronavirus COVID-19

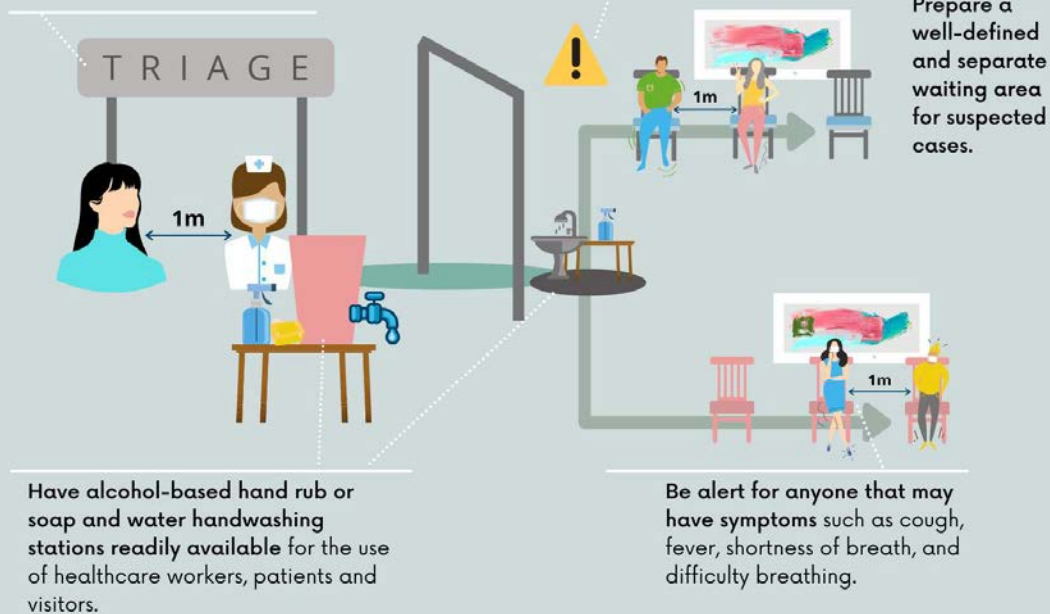
FOR: HEALTHCARE FACILITY MANAGEMENT

Preparing for COVID-19 at your healthcare facility

Have a triage station at the healthcare facility entrance, prior to any waiting area, to screen patients for COVID-19. This limits potential infection throughout the healthcare center.

Post information, like posters and flyers, that remind patients and visitors to practice good respiratory and hand hygiene.

Prepare a well-defined and separate waiting area for suspected cases.



Have alcohol-based hand rub or soap and water handwashing stations readily available for the use of healthcare workers, patients and visitors.

Be alert for anyone that may have symptoms such as cough, fever, shortness of breath, and difficulty breathing.

Protect your workforce

Be ready! Ensure your healthcare and triage workers:



- Are trained on the importance, selection and proper use of personal protective equipment.
- Are trained to spot symptoms of a potential COVID-19 infection and offer a medical mask to suspected cases.
- Know the case definition and have a decision flow diagram available and accessible for reference at the triage station.
- Isolate a suspected case promptly.
- Perform hand hygiene frequently.

FIG. 1. Healthcare Facilities Measures. The image illustrates the measures recommended by WHO regarding patient management in a healthcare facility [23].

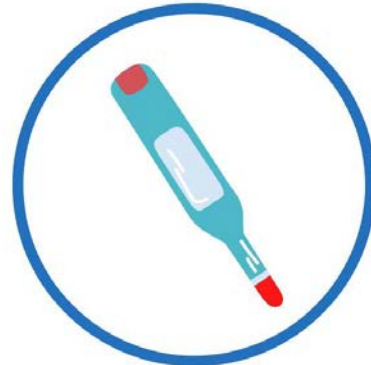
BEFORE ARRIVAL for the test

- Screen patients by history on the phone
- Triage for COVID-19 risk
- Postpone non-urgent tests



ON ARRIVAL for the test

- PPE for health care professionals
- Screen patients by history again
- Consider temperature screen
- Separate patients spatially, minimize attendants
- Review test indications again



DURING the test

- Minimize contact for written consent/consider verbal consent
- Preferentially use rapid protocols
- Preferentially use vasodilator stress/ Avoid exercise stress
- Room/equipment handling per local infection control policies



AFTER the test

- Avoid sharing computers and sanitize keyboards
- Use telehealth, where possible, for image interpretation and reporting
- Use telehealth, where possible, to discuss results with teams
- Review lung findings on hybrid SPECT-PET/CT



FIG. 2. Key measures. The image illustrates key steps to minimize COVID-19 exposure during the patient's journey in a nuclear medicine department.

2.4.2. Unit front desk

The unit front desk serves as a screening site, with similar screening to that performed at the hospital front door. The screening questions regarding symptoms and contact with someone suspected to have, or diagnosed with COVID-19, should be asked.

In the case of suspected or confirmed COVID-19 infection, all imaging and related procedures that are not urgent must be postponed until the patient has recovered with no more risk of being contagious. For time-sensitive procedures, ensure that the patients wear an appropriate mask and that a clean sheet is placed over the patients when traveling to the imaging department. Patients must be placed in a separate waiting area and the appropriate consultations with the relevant infectious disease team should be sought, according to local indications.

The following measures should be considered:

- (a) Before the test:
 - (i) Call patients to verify health status (Screening Checklist).
- (b) Arrival at the Nuclear Medicine Department:
 - (i) Reception staff behind a glass or plastic screen;
 - (ii) Distancing;
 - (iii) Hygiene.
- (c) Reception area:
 - (i) Display information announcements, indicating possible symptoms;
 - (ii) Display posters to promote handwashing and proper respiratory hygiene measures.
- (d) Upon arrival:
 - (i) Patients are asked to declare (Screening Checklist):
 - Possible exposure to COVID-19;
 - Symptoms.
 - (ii) COVID-19 risk status verification:
 - Measure temperature.
- (e) Provide clear instructions:
 - (i) Only one caregiver per person;
 - (ii) Minimize permanence of patients in the department.
- (f) Screening Checklist:
 - (i) Have you had a fever? A temperature above 37.3°C (99.14°F)?
 - (ii) Have you had a cough?
 - (iii) Have you had difficulty breathing?
 - (iv) Have you been unusually tired?
 - (v) Have you had muscle aches?
 - (vi) Have you had diarrhoea recently?
 - (vii) Is your sense of smell less than usual?
 - (viii) Is your sense of taste less than usual?
 - (ix) Have you been exposed to any person with the virus in the last 2 weeks?
 - (x) Have you been exposed to any person who has a high risk of getting the virus, in the last 2 weeks?

2.4.3. Waiting areas

The waiting area must have enough space so that waiting patients may sit far enough away from each other to be in accordance with international guidelines for social distancing of at least 1m (three feet) or in accordance with local or national guidance (if different).

While waiting, ensure that patients always wear masks. All sources of infection must be removed from the waiting room to decrease transmission of virus, including magazines, and disposable cups. Ensure that the waiting area has access to hand washing facilities and tissue boxes and masks are within easy reach and encourage the patients to follow basic hand and respiratory hygiene practices.

In the case of inpatients, injecting of radiopharmaceuticals and the subsequent uptake phase can be performed in the patient hospital room, thus decreasing the number of patients in the waiting areas.

2.4.4. Administration of radiopharmaceutical

According to HUANG, H.L., et al., “the nuclear medicine frontline staff such as nuclear medicine radiographers/technologists or nurses will have the most potential close contact with infected patients. It is therefore crucial that potentially infected patients should be identified prior to this step. Since physical contact is inevitable for cannulation, and therefore a significant amount of time may be spent with the patient, appropriate PPE is always mandatory” [7].

2.4.5. During uptake phase

According to HUANG, H.L., et al., “nuclear medicine scans require an uptake phase ranging from a few minutes to a few hours. During this time, the patients may be waiting in separate radioactive patient areas (or in uptake bays if waiting for PET). Similar considerations as those for patients in the initial post registration waiting area would then apply for all other procedures. If it is possible, the patients can wait in their cars” [7].

2.4.6. When the patient is scanned and goes home

Regular cleaning of surfaces should be performed using appropriate PPE (as per local policies and standards), including doorknobs, table surfaces, computer keyboards, telephones and dictation equipment at least daily and, preferably, between users. This can be with locally available wipes or soaps, in keeping with institutional recommendations. Stretcher, treadmill, blood pressure equipment, and infusion pumps should be cleaned after each test and sheets/linen replaced in compliance with local infection control recommendation.

Appropriate environmental cleaning and decontamination of rooms through thorough cleaning of the surfaces by a staff member with appropriate PPE as per local institutional guidelines for droplet disease is essential. Appropriate training of environmental maintenance staff is recommended. After each patient, the room should be appropriately cleaned, closed, and after a delay of 30–60 minutes (based on local practice recommendations) for decontamination and passive air exchange, the imaging room can be reused.

For patients with suspected or confirmed COVID-19, equipment including cameras and beds must be decontaminated between patients, using appropriate PPE (as per local policies and standards), by locally available cleansing agents and as per manufacturer’s recommendations.;

additionally, air/ventilation system disinfection may be performed per local infectious disease recommendations.

2.4.7. Incidental pulmonary findings

There are an increasing number of reports of CT findings of COVID-19 associated pneumonia, and recently a short article regarding incidental findings suggestive of COVID-19 seen on CT images acquired on SPECT/ or PET/CT was published [1, 4, 5, 7, 13]. As COVID-19 patients present a spectrum of pulmonary symptoms ranging from normal lungs to acute respiratory distress syndrome, it is essential that nuclear medicine physicians analyse carefully the lung windows on each CT imaging, [3–6].

In case of typical or atypical pulmonary CT findings, especially in case of asymptomatic patients, consultation with a radiologist with thoracic expertise is encouraged. Upon identification of potential cases with the appropriate clinical context of acute illness and contact history, relevant patient management and contact tracing should be instituted, according to local regulations.

2.4.8. Promoting use of telehealth

Decreasing in-person consultation with referring physicians in the reporting room should be considered, as well as implementation by nuclear medicine physician's use of video or phone for remote patient's consultation during therapeutic procedures. Practice protocols should include remote reviewing or screen sharing wherever possible and/or telephone discussions when nuclear medicine radiographers /technologists are checking images with physicians. The uses of communication technologies are:

- Teleconsulting prior to scheduling;
- Teleconsulting before attending the appointment;
- Attend alone (only one caregiver per patient, ideally without risk factors);
- Remote reporting (national or local rules should be followed);
- Teleconsultation after radionuclide therapies;
- Virtual multidisciplinary and staff meetings;
- Remote communication channels with referring physicians.

2.4.9. In summary

- (a) During the injection and scan:
 - (i) Aseptic and antiseptic techniques;
 - (ii) Standard radiation protection and optimisation principles;
 - (iii) Use the appropriate PPE;
 - (iv) Place special attention when removing it;
 - (v) Disinfect devices;
 - (vi) Thoroughly sanitize hands after each procedure;
 - (vii) Dispose in a container for biosafety waste.
- (b) During the scan:
 - (i) Apply all standard radiation protection and optimization principles;

- (ii) Use the appropriate PPE and ensure that patients and staff wear surgical masks to protect particularly immunocompromised patients;
 - (iii) Use disposable protective elements for the scanners;
 - (iv) The patient must wear at least a facial mask, depending on the patient's classification risk.
- (c) When the patient is scanned and goes home:
- (i) If a COVID-19 patient is scanned, scanners and the room must be disinfected accordingly;
 - (ii) If the hybrid study involves a CT of the chest, it is imperative to look for incidental COVID-19 findings before the patient is released;
 - (iii) CT images acquired on SPECT/ or PET/CT scans should be interpreted in the context of possible COVID-19 pulmonary findings, and images should be reviewed before the outpatient is released;
 - (iv) Avoid in-person image reviews with referring services and use remote reviewing or screen sharing wherever possible and/or telephone discussions.

3. PROTECTION OF NUCLEAR MEDICINE STAFF

3.1. INTRODUCTION

One of the major concerns is how best to protect the staff of the imaging department, so they do not become infected and serve as additional vectors spreading the disease. Exposure to infectious organisms is not limited to clinical staff such as physicians, technologists, and nurses; receptionists, cleaning personal and transport and monitoring personnel are also at risk. All practices should minimize the risk of COVID-19 exposure to healthcare workers and patients during the performance of nuclear procedures [4, 5, 6, 25-30].

The following measures always apply in the workplace and throughout the patient journey:

- (a) Screen staff, patients and visitors before they enter the department;
- (b) Minimize non-essential visitors into the department;
- (c) Record symptoms at the start of the shift;
- (d) Record patient temperature daily as per local policies and standards;
- (e) Ensure proper use of personal protective equipment (PPE) for healthcare workers, and if available for patients (due to concern of asymptomatic transmission of COVID-19), as per local policies and standards;
- (f) Patient facing staff in the waiting room and laboratory should always wear a facemask;
- (g) Maintain strict hand hygiene;
- (h) Maintain at least 1 meter (3 feet) distance in all patient/staff interactions when possible;
- (i) Minimize crowding in workplace;
- (j) Rotating staff schedules for onsite and offsite work;
- (k) Limit interaction between inpatients and outpatients;
- (l) When possible consider the possibility of separate imaging teams to handle inpatients and outpatients;
- (m) Work remotely whenever feasible;
- (n) Use of virtual conference tools for meetings and educational conferences;
- (o) Rotating staff schedules for onsite and offsite work;
- (p) Training in local infection control recommendations;
- (q) Senior clinicians and/or management take a more proactive stance to advise staff that they should not come to work if they are not well;
- (r) Some units may consider segregating staff into teams so as to reduce the potential of transmission of virus between healthcare providers causing a catastrophic inability of the department to function.

3.2. PERSONAL PROTECTIVE EQUIPMENT

Healthcare personnel who manage confirmed or suspected COVID-19 patients should wear the appropriate personal protective equipment. PPE (Fig. 3) consisting of eye protection with goggles or face shield, surgical masks at least (if N95 masks are unavailable), fluid resistant isolation gown and disposable gloves [24].

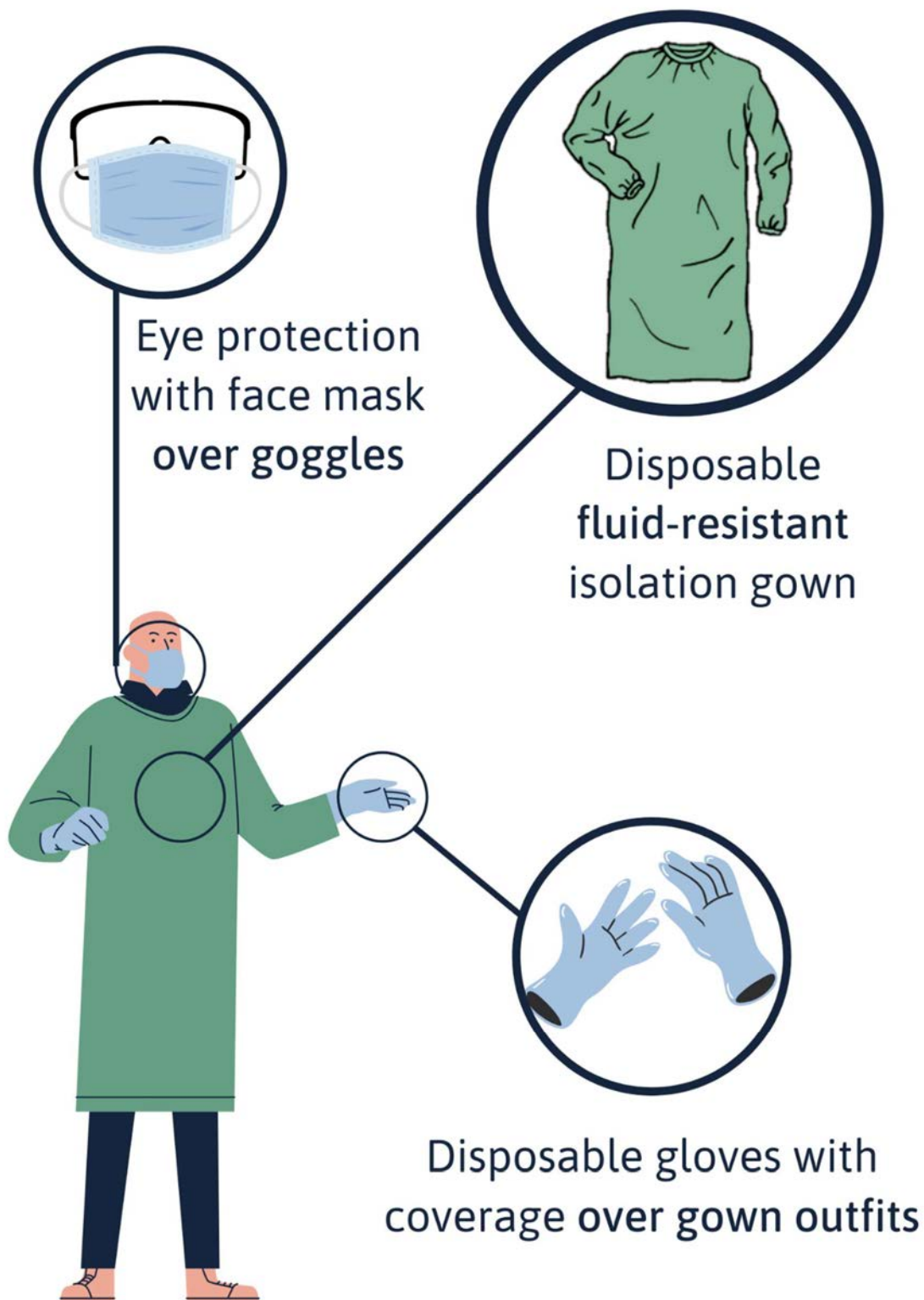


FIG. 3. Imaging measures [27]. The figure illustrates the measures in a nuclear medicine department, including the protection of healthcare workers.

3.2.1. Instruction for use

Healthcare personnel should learn when to use PPE, which PPE is necessary, how to properly don, use, and doff PPE in a manner to prevent self-contamination, and the limitations of PPE. Any reusable PPE must be properly cleaned, decontaminated, and maintained after and between uses.

The PPE recommended when caring for a patient with known or suspected COVID-19 includes:

- (a) Respirator or facemask:
 - (i) Put on a facemask before entry into contact with patients or care area;
 - (ii) N95/FFP2/FFP3 medical protective mask or Powered Air Purifying Respirators (PAPR) or respirators that offer a higher level of protection should be used instead of a facemask when performing an aerosol-generating procedure. Disposable respirators and facemasks should be removed and discarded after exiting the patient's room or care area and closing the door. Perform hand hygiene after discarding the respirator or facemask.
- (b) Eye Protection:
 - (i) Put on eye protection (i.e., goggles or a disposable face shield that covers the front and sides of the face) upon entry to the patient room or care area. Personal eyeglasses and contact lenses are NOT considered adequate eye protection;
 - (ii) Remove eye protection before leaving the patient room or care area;
 - (iii) Reusable eye protection (e.g., goggles) must be cleaned and disinfected according to manufacturer's reprocessing instructions prior to re-use. Disposable eye protection should be discarded after use. During times of PPE shortages face shields may also be cleaned and disinfected according to the manufacturer's reprocessing instructions prior to re-use as well.
- (c) Gloves:
 - (i) Perform hand hygiene, and put on clean, non-sterile gloves upon entry into the patient room or care area;
 - (ii) Change gloves if they become torn or heavily contaminated;
 - (iii) Remove and discard gloves when leaving the patient room or care area, and immediately perform hand hygiene.
- (d) Gowns:
 - (i) Put on a clean isolation gown upon entry into the patient room or area. Change the gown if it becomes soiled. Remove and discard the gown in a dedicated container for waste or linen before leaving the patient room or care area. Disposable gowns should be discarded after use. Cloth gowns should be laundered after each use;
 - (ii) If there are shortages of gowns, they should be prioritized for:
 - aerosol-generating procedures;
 - care activities where splashes and sprays are anticipated;
 - high-contact patient care activities that provide opportunities for transfer of pathogens to the hands and clothing of healthcare workers. Examples include:
 - Dressing;
 - Bathing/showering;
 - Transferring;
 - Providing hygiene;

- Changing linens;
- Changing briefs or assisting with toileting;
- Device care or use;
- Wound care.

(iii) During times of limited access to respirators or facemasks, facilities could consider having healthcare workers remove only gloves and gowns (if used) and perform hand hygiene between patients with the same diagnosis (e.g., confirmed COVID-19) while continuing to wear the same eye protection and respirator or facemask (i.e., extended use). Risk of transmission from eye protection and facemasks during extended use is expected to be very low:

- Healthcare workers must take care not to touch their eye protection and respirator or facemask;
- Eye protection and the respirator or facemask should be removed, and hand hygiene performed if they become damaged or soiled and when leaving the unit.

3.3. CLASSIFICATION OF WORKING AREAS AND RELATED PROCEDURES

According to Zhang et al., “due to the shortage of medical supplies, some institutions adopted district management and hierarchical protection where the entire department is divided into a contaminated area, a mixed zone, a transition zone and a clean area” [30]. Hierarchical protection refers to the different levels of protection measures taken in areas with different degrees of infection risk.

If possible, classify the zones in your unit, and if there are more than one SPECT and PET scanner in a hospital, only one of them should be assigned to suspected cases.

According to Zhang et al., “the first level protection area refers to the area where healthcare workers are engaged in the general diagnosis and treatment activities in ordinary clinics and wards. Healthcare workers here need to wear disposable work caps, medical surgical masks and work clothes. Patients are forbidden to enter the unit clean area, which refers to the diagnostic room, which contains the workstations physicians use for interpretation, and storage room for medical supplies, as contamination of these areas will spread the virus to many parts of the medical centre” [30].

According to Zhang et al. [30], in case patients are suspected of infection, the procedures are the following:

a) “The examination room (SPECT or PET) is isolated and used to examine patients suspected of being infected with the COVID-19 virus.

b) The passage area from the clinic where the temperature is measured to the examination room is defined as the contaminated area.

c) Healthcare workers performing medical activities in these areas must comply with the secondary protection standards defined locally or internationally.

d) Healthcare workers who have close contact with suspected or confirmed patients must adhere to strict medical protection, which includes:

- (i) Wearing disposable work caps;
- (ii) Wearing protective glasses or face masks (antifog type);
- (iii) Wearing medical protective masks (N95);
- (iv) Wearing protective clothing or isolation clothing;
- (v) Wearing disposable latex gloves (double layered);
- (vi) Wearing disposable shoe covers;
- (vii) Strictly implementing good hand hygiene”.

3.4. CONSIDERATION FOR PREGNANT HEALTHCARE WORKERS DURING THE OUTBREAK

(a) Pregnant healthcare workers should not provide direct patient care to suspected or confirmed COVID-19 positive patients;

(b) Pregnant healthcare workers must wear a surgical mask at work throughout the duration of their shift.

4. CONCLUSION

An adequately prepared nuclear medicine department can properly deal with COVID-19 outbreak, despite challenges and emergency (Fig. 4). The experience of preparing for this virus will help improve readiness and response in case of a new outbreak in the future.

In summary, the considerations for critical nuclear medicine services during the COVID-19 pandemic, suggested by Huang et.al. [7] and Choi et.al. [21], are the following:

- (a) Robust screening process for outpatients in line with hospital policy should be in place. Screen patients and visitors for symptoms of acute respiratory illness (e.g., fever, cough, difficulty breathing) or gastrointestinal symptoms and coronavirus exposure in the last 2 weeks before entering one's healthcare facility;
- (b) Limit points of entry to the facility;
- (c) Develop clear escalation pathway to ensure cases are identified in a timely manner;
- (d) Training for all healthcare workers (identifying and handling COVID-19 patients; hygiene procedures; disinfection procedures) to ensure maximum compliance and vigilance;
- (e) Display posters to promote hand washing and good respiratory hygiene measures within the department. Combine this with other communication measures such as briefings at meetings and information on the intranet to promote handwashing;
- (f) All camera gantries, blood pressure cuffs, surfaces (desks & tables) and image viewing station mice and keyboards should be wiped with disinfectant regularly and after every contact with suspected patients;
- (g) Place sanitizing hand rub dispensers in prominent places around the workplace. Make sure these dispensers are regularly refilled;
- (h) Environmental services staff members who clean all departmental areas during and out of work hours must be specifically trained for professional cleaning of potentially contaminated surfaces after each high-risk patient contact;
- (i) Communicate and promote the message to staff to stay at home even if they have just mild symptoms of COVID-19;
- (j) Develop a contingency and business continuity plan if one of your staff becomes sick with COVID-19;
- (k) Social distancing — keeping at least 1 meter (3 feet) between individuals in waiting rooms and workspaces and adapt best practice to local or national guidelines;
- (l) Encourage sick employees to stay home. Personnel who develop respiratory symptoms (e.g., cough, shortness of breath) or unexplained fever should be instructed not to report to work;
- (m) Ensure that your sick leave policies are flexible and consistent with public health guidance and that employees are aware of these policies. Make contingency plans for increased absenteeism;
- (n) Ensure healthcare workers has hand hygiene best practices. If soap and water are not readily available, use of a hand sanitizer that contains at least 60% alcohol;
- (o) Consider standard contact and droplet precautions for patients and healthcare workers as per institutional infection prevention and control protocols;
- (p) Prioritize essential procedures (i.e. oncology, cardiology), postpone other activities until effective measures are in place to provide a full nuclear medicine service to all patients in a safe environment for patients and staff;

- (q) Increase scheduling intervals or appointment times to allow adequate time to clean equipment as needed;
- (r) Use telemedicine technologies when possible and isolated workstations to allow for reading and interpretation, thereby allowing for social distancing to limit staff exposure;
- (s) Assign a team member to monitor and incorporate regular updates from appropriate national and local jurisdictions.

KEY PROTECTION MANAGEMENT OF NMDI DURING COVID-19 OUTBREAK



SCHEDULING

1. Screen patients by history on the phone.
2. Triage for COVID-19 risk patients.
3. Postpone non-urgent tests of potential risk and COVID-19 confirmed cases.
4. In case of emergency schedule the potential risk or confirmed COVID-19 patients as the last studies of the day.



ADMISSION

1. Measure the body temperature of patients and companions.
2. Handout masks to patients and companions and instruct them to use the mask during the entire time.
3. Disinfect the worktop in time.
4. Hand sanitizer containers should be displayed in the workplace.



RADIOPHARMACEUTICAL INJECTION

1. Sanitize your hands after injection.
2. Dispose the used medical items in a special container.
3. All surface, devices and instruments used in the procedure must be disinfected.
4. Rapid and minimum contact protocols should be implemented (e.g. vasodilator stress should be used; exercise stress should be avoided).



BEFORE INJECTION

1. Arrange COVID-19 patients in a isolated room.
2. Instruct patients that walking around is prohibited.
3. Ordinary patients should keep a distance of minimum one meter.



AFTER INJECTION

1. Arrange COVID-19 patients in a isolated room.
2. Instruct patients that walking around is prohibited.
3. Ordinary patients should keep a distance of minimum one meter.
4. If the study requires stress proceed with vasodilator stress, avoid exercise stress.



IMAGING ACQUISITION

1. Use disposable shoe covers and replace the disposable pad.
2. Instruct the patients to wear the mask during the scan.
3. Once the protective device or object is contaminated, replace them as soon as possible and disinfect your hands.



DEPARTURE

1. Replace the disposable pad before the next examination.
2. Disinfect the waiting rooms and/or places in which patients had contact.
3. After the last patient finishes the examination, disinfect the machine and environment.



AFTER SCANNING

1. Arrange COVID-19 patients in a isolated room.
2. Instruct patients that walking around is prohibited.
3. Ordinary patients should keep a distance of minimum one meter.
4. The use of telemedicine must be encouraged for image interpretation, reporting and to discuss results.

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[HTTPS://ZENODO.ORG/RECORD/5758020#XOR6RTM205](https://ZENODO.ORG/RECORD/5758020#XOR6RTM205)



AN INITIATIVE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY.

FIG. 4. Nuclear Medicine Workflow. The image represents a general patient chart in nuclear medicine.

Appendix I.

ADVICE ON THE USE OF PPE EQUIPMENT – DONNING AND DOFFING (REMOVAL AND DISPOSAL)

I.1. DONNING OF PERSONAL PROTECTIVE EQUIPMENT (PPE) COVID-19 (Fig. 5)

- (a) Perform Hand Hygiene
- (b) Put on long sleeve fluid resistant gown
- (c) Put on N95/FFP2/FFP3 or PAPR (If Nuclear Medicine Radiographer/Technologist wears glasses take off until FFP is secured in place- put glasses back on)
- (d) Place Face mask (if reuses N 95 mask face serves as barrier) or goggles in place (If N95/FFP2/FFP3 put surgical mask over your N95/FFP2/FFP3) (The facial mask should be put on first, then head/hair cover that covers all hair and both ears)
- (e) Clean hands with antibacterial liquid before putting on gloves and put on non-sterile Nitrile gloves (be sure gloves cover cuffs of gown)
- (f) You may now enter patient room

I.2. DOFFING REMOVAL AND DISPOSAL OF PERSONAL PROTECTIVE EQUIPMENT (PPE) COVID-19 – see appendix III

- (a) Do not step into clean area when removing PPE
- (b) Safely remove gloves by first grasping outside of the glove with the opposite gloved hand, peel off, hold the removed glove in gloved hand peel off glove and throw away
- (c) Clean hands with hand gel
- (d) Remove gown slowly undo necktie and waist tie, pull gown away from neck and shoulders touching the inside of the gown only using a peeling motion as outside of gown is contaminated, roll into bundle discard in garbage. Clean hands with antibacterial solution. between every removal of PPE device/clothing
- (e) Remove visor, stand straight reach for elastic strap at back of head, close eyes and lift the strap upward than over the hear using both hands, place visor into clinical waste bin. Clean hands with antibacterial solution.
- (f) Step into clear area wearing respirator and now clear hands again with alcohol hand gel
- (g) If glasses are worn remove glasses and clean with alcohol wipe, don't put back on until you have completed doffing and washed your hands. PPE should be removed in controlled area between "infected" and "clean" room. Facemask should be kept on until clean area.
- (h) Remove FFP3 respirator without touching the front of the respirator which is contaminated (both hands find bottom strap and bring it up to the top strap, lift both straps over the top of the head, let the respirator fall away from your face and drop into waste bin)
- (i) Wash hands with soap and water for 20 seconds with antibacterial solution.

COVID-19

Coronavirus Disease 2019

HOW TO PUT ON PERSONAL PROTECTIVE EQUIPMENT (PPE)



*Surgical mask or respirator (N95 or similar), depending on the level of care. For aerosol generating procedures (AGP), wear a respirator (N95 or similar)
 †e.g. visor, face shield, goggles (consider anti-fog drops or fog-resistant goggles)

HOW TO TAKE OFF PPE

- Avoid contamination of self, others and environment
- Remove the most heavily contaminated items first



Level of care	Hand hygiene	Gown	Surgical mask	Respirator (N95 or similar)	Goggle (eye protection) OR face shield (facial protection)	Gloves
Triage						
Collection of specimens for laboratory diagnosis						
Suspected or confirmed case of COVID-19 requiring healthcare facility admission and NO aerosol-generating procedure						
Suspected or confirmed case of COVID-19 requiring healthcare facility admission and WITH aerosol-generating procedure‡						

‡AGPs include positive pressure ventilation (BiPAP and CPAP), endotracheal intubation, airway suction, high frequency oscillatory ventilation, tracheostomy, chest physiotherapy, nebulizer treatment, sputum induction, and bronchoscopy.

PAHO Pan American Health Organization World Health Organization

BE AWARE. PREPARE. ACT.
www.paho.org/coronavirus

FIG.5. Donning and Doffing diagram. The image show put and remove PPE.

Appendix II.

DECONTAMINATION OF COUCHES AND OTHER EQUIPMENT

Decontamination of reusable non-invasive care equipment should be undertaken after suspected or known contamination. Equipment must be cleaned first, then disinfected.

Step 1. Thorough cleaning with water and a neutral detergent, or disposable detergent wipes, to remove substances such as dust, soiling and organic matter, along with a large proportion of micro-organisms. Follow manufacturers' instructions and use suitable cleaning products in line with local policy.

Step 2. Disinfection by use of chemicals to reduce the number of viable micro-organisms to a level that is not harmful to health.

I.1. EQUIPMENT NEEDED

- (a) PPE; disposable plastic apron and single-use non-sterile gloves
- (b) Clean, colour-coded bucket (unless you are using disposable detergent wipes)
- (c) Colour-coded cloth or disposable detergent wipes
- (d) Cleaning trolley
- (e) General purpose detergent or general surface cleaner (unless you are using disposable wipes)
- (f) Non-abrasive cloth (if you are cleaning a mattress)
- (g) Disposable disinfectant wipes – for mattress cleaning.

I.2. THE PROCEDURE

- (a) Wash your hands, put on an apron and a pair of gloves.
- (b) If not using disposable wipes, prepare the cleaning solution in the bucket according to the manufacturer's guidelines and place the bucket on a cleaning trolley.
- (c) Raise or lower the couch to a convenient height.
- (d) If damp dusting, dampen or rinse the cloth in the cleaning solution. If using detergent wipes, take a wipe from the container.
- (e) Clean from top to bottom, working downwards to the base and wheels. If damp dusting, turn the cloth regularly and rinse regularly in the cleaning solution; change the cleaning solution when it becomes soiled. If using wipes, replace when they become dry or soiled.
- (f) Take care to clean the edges and undersides of surfaces after cleaning the tops.
- (g) If cleaning the bed, wipe the impermeable cover clean using an s-shaped motion and non-abrasive cloth. Change the cleaning solution and cloth when soiled or wipes when soiled or dry. Allow the mattress to dry, then wipe all surfaces with a disinfectant wipe.
- (h) When the couch and mattress are dry, replace any items that were removed before cleaning commenced.
- (i) Lower or raise the couch to its original position.
- (j) Dispose of the cloths or wipes and cleaning solution.
- (k) Clean and dry the bucket according to local policy.
- (l) Remove the apron and gloves. Wash your hands.
- (m) Document that cleaning has taken place according to local policy.

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ANNEX

CHECK LISTS
A-1. TABLE 1. GENERAL CHECK LIST FOR NUCLEAR MEDICINE RADIOGRAPHER/TECHNOLOGISTS

Control of COVID- 19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room or Mobile Imaging Environmental Considerations
Preparation <ul style="list-style-type: none"> • Will the imaging procedure change patient management and/or could the procedure be delayed? • Is mobile imaging an option for suspected and positive COVID-19 cases? • Ensure Staff backup in case of A&E-calls in the emergency situation. • Staff risk evaluation (pregnancy, immune, mental health concerns etc.) • Don PPE with all appropriate steps – see appendix ‘A’ 	<ul style="list-style-type: none"> • Is it needed now or could this be delayed? • Is mobile imaging possible? • PPE during transfer to the department when imaging cannot be performed mobile 	<ul style="list-style-type: none"> • Remove unnecessary equipment from the imaging room • Cover equipment that cannot be moved with suitable plastic 	<ul style="list-style-type: none"> • Ensure infection prevention measures are employed when managing the imaging room and imaging equipment. This must be subject to regular cleaning consistent with local IPC guidance and cleaning schedules completed and signed and dated. 	
During <ul style="list-style-type: none"> • Appropriate PPE • Employ “contaminated and non-contaminated technologist” scenario • Ensure single patient attendance to the Imaging department wherever possible to enable further imaging if this is required. 	<ul style="list-style-type: none"> • PPE, comfort, reassurance 	<ul style="list-style-type: none"> • Infection control and barrier precautions 	<ul style="list-style-type: none"> • Control access to imaging room or patient area during mobile Nuclear Medicine 	
Post procedure <ul style="list-style-type: none"> • Review of imaging by Nuclear Medicine Radiographer/ Technologist for suspicious features and organise additional imaging if required • Appropriate staff ‘Doffing’ of PPE equipment – see Appendix A 	<ul style="list-style-type: none"> • PPE during patient transfer, rapid results to guide management 	<ul style="list-style-type: none"> • Appropriate decontamination including air exchange 	<ul style="list-style-type: none"> • Appropriate decontamination including air exchange 	

Note: This check list should complement any agreed standard ‘Control of Infection’ protocols established at your Health Institution.

In addition to this check list remember that technologists are at the front line of healthcare service so you must follow existing guidance/protocols:

- A-1. Ensure all routine initial key checks are performed i.e. the Imaging Request is justified, suitably protocolled and the patient identification procedures followed;
- A-2. When a patient is suspected or confirmed to have COVID -19 use barrier nursing techniques;
- A-3. Apply standard radiation protection and optimisation principles;
- A-4. Always ensure the image is diagnostic before leaving patient;
- A-5. Always ensure the image is received and available in PACS ready for reporting;
- A-6. Code and job description must always be maintained;
- A-7. Separate cold/blue/clean from hot/red/contaminated areas.
- A-8. Decontamination of couches and other equipment is described in Appendix B

A-2. TABLE 2. NUCLEAR MEDICINE VQ SCAN CHECK LIST

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room Environmental Considerations
<p>Preparation</p> <ul style="list-style-type: none"> • Preprocedure consideration VQ Scan for known COVID-19 patients • The decision on whether to proceed with the VQ should be discussed with the referrer before booking. • Most in-patient referrals are for VQ scans and these could include suspected or confirmed in-patient COVID-19 positive patients • In-patient VQs with uncertain COVID-19 status as potentially positive and wear appropriate PPE • VQ in most departments are the pregnant patients perform perfusion only scan than check if need aerosol procedure • Ensure that patients and staff use the central entrance and do not enter the department without permission and without specific reason. • Do not allow patient to wait in the waiting room for long periods, adopt international guideline for social distancing of at least 1 m (3 feet) and adapt best practice of local and national guideline. • Confirm that medical exposure has been justified as urgent accordingly and/or cannot be rescheduled. • Ensure areas and equipment have been adequately disinfected-decontaminated. • Disinfect. Wash hands. • Don PPE with all appropriate steps – see appendix ‘I’. • Be sure to wear a N95/FFP2/FFP3 mask with eye protection either goggles or face mask, gown etc. and single use gloves when receiving a paper referral, identify the patient and continue with the procedure. 	<ul style="list-style-type: none"> • Controlled arrival and departure of patients and staff in the radiology department and only using the central entrance • Provide patient with mask and gloves to wear during the procedure 	<ul style="list-style-type: none"> • Disinfection/Decontamination with the use of appropriate technique and means according to Hospital Infectious Diseases Control Committee depending on their infection status • Gamma Camera, (immobilization straps, positioning sponges) Auxiliary equipment (suction device, Oxygen mask) 	<ul style="list-style-type: none"> • Disinfection-Decontamination with the use of appropriate technique and means of areas and patient contact surfaces according to Hospital Infectious Diseases Control Committee depending on their infection status (i.e. asymptomatic-suspected-confirmed COVID 19) 	

TABLE 2. NUCLEAR MEDICINE VQ SCAN CHECK LIST (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room Environmental Considerations
<p>During</p>	<ul style="list-style-type: none"> • During a VQ Lung Scan test every effort should be made to minimize the number of staff in contact with the patient imaging in a COVID-19 positive patient is best performed using two Nuclear Medicine Radiographers/Technologist , one donning full personal protective equipment mask with N95/FFP2/FFP3 or PAPR eye protection goggles or facemask, fluid resistant gown to attend to the patient, operate the scanner ,Aerosol unit and the other Nuclear Medicine Radiographer/Technologist will be considered clean and will operate including acquisition and processing equipment . • The use of a perfusion only scan is unlikely to be of any benefit if COVID-19 infection is suspected as the Coronavirus response alters MAA distribution. • Non hypertensive patients, consider increasing the DRL from 200MBq to 300MBq to bring about rapid SPECT imaging (5mins ep 12 mins). It would also reduce the time the patient and accompanying ward staff are in the department. • Patients with pulmonary hypertension should only receive 200MBq and always injected soon after preparation of MAA to reduce the number of particles (this usually means in the morning). • If more than one referral is made, these should be booked and performed consecutively, allowing for sufficient room recirculations. National guidance states “A minimum of 20 minutes i.e. 2 air changes, in hospital settings where the majority of these procedures occur is considered pragmatic” • For all other VQ scans (i.e. those non-symptomatic for COVID-19), whether in-patient or outpatient, the operator should wear a surgical mask, gloves and gown. • Use disposable tourniquets and any disposable waste from the procedure should be bagged in suitable waste bags as recommended by the local hospital • When performing a VQ scan on suspected or confirmed COVID-19 patients, the NM operator of choice would be those with no other medical conditions. 	<ul style="list-style-type: none"> • Patient continues to wear mask and gloves 	<ul style="list-style-type: none"> • Gamma Camera and remote hand control are considered contaminated so they must be used with gloves and the • Gamma Camera couch is covered with single use paper per patient. • Gamma Camera console keyboard, mouse and exposure pad are considered clean so they must be used only by the clean Nuclear Medicine Radiographer/Technologist 	

TABLE 2. NUCLEAR MEDICINE VQ SCAN CHECK LIST (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room Environmental Considerations
	<ul style="list-style-type: none"> • VQ scan may not be considered an actual aerosol. However, given the patient's likely symptoms (cough), the test warrants extra PPE. The operator (injector, and mask fitter) should wear the full PPE – gloves, eye protection Goggles or Facemask, and N95/FFP2/FFP3 or PAPR fluid resistant gown as there is a time during this test when the operator must be in close contact with the patient's mouth in order to fit the aerosol mask. <p>Pregnant Patients</p> <ul style="list-style-type: none"> • Pregnant patients are in a higher risk category and should be in the department for as short a time as possible. • If using Krypton, proceed with a dual energy Te-MAA/Kr-gas VQ to complete the test quickly. • Only perform ventilation at the same time if you have Krypton-81m available. Other ventilation agents may not be suitable due to the time required to be with the patient, and the unsatisfactory distribution due to likely patient non-compliance • If Technegas or aerosol is used follow the manufacturer's guidance <p>General precautions</p> <ul style="list-style-type: none"> • Cover the gamma camera couch with disposable paper • Remove gloves and dispose of them in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the regulation of your Hospital Waste Management Committee. (HWMC) • Remember, when exiting the gamma camera scanner room (contaminated area) clothing may be contaminated. • Don't take off mask! • Disinfect hands with an hand sanitizer before you enter the (clean area) i.e. before touching the keyboard and mouse, the control console, principles of justification, optimization, radiation dose limitation as well as the Nuclear Medicine Radiographer's/Technologist's Ethical Code and RG/RT Professional Rights at all times. 			

TABLE 2. NUCLEAR MEDICINE VQ SCAN CHECK LIST (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room Environmental Considerations
<p>Post procedure</p> <ul style="list-style-type: none"> • When entering the gamma (dirty area), wear disposable gloves. • Carefully remove the used paper cover from the gamma without touching your clothing and dispose of it in the corresponding bin according to hospital policy. • Disinfect gloves and ensure decontamination-disinfection of Gamma couch-gantry keypad, and surfaces / contact points (sponges, fixing pads, and knobs) by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control Committee manufacturer's instructions. • After disinfection/decontamination/deep cleaning, the RG/RT must visually inspect the scanning area, gamma and auxiliary equipment without removing gloves and mask. • Must not remove your mask yet! • Carefully remove your gloves carefully FIRST! • Dispose of them in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the regulation of your HWMC • Disinfect hands immediately as there is danger of being contaminated without gloves! • Remove mask carefully so that the cords or bands of the mask do not touch the face or mucous membranes of the face (and eyes) and dispose of it in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the HWMC. • Disinfect - Wash hands well (again because you touched your mask)! 	<p>Patient keeps mask and gloves on</p>	<ul style="list-style-type: none"> • Single use gamma camera paper cover is removed and deposited into the corresponding bin according to hospital policy. • Disinfection-Decontamination-Deep Cleaning by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control Committee Camera manufacturer's instructions of: <ul style="list-style-type: none"> • Gamma camera, camera heads, remote hand control keypad • Immobilization Velcro straps and positioning sponges, 	<ul style="list-style-type: none"> • Camera room should be closed, and after a delay of up to 2 hours (based on local practice recommendation) the imaging room can be cleaned. • For patients with known active COVID-19 or thought to be high-risk for COVID-19, between patients, equipment including cameras, beds, and anything that has been in contact with any patient and/or staff should be decontaminated, using appropriate PPE (as per local policies and standards), by locally available cleansing agents and as per manufacturer's recommendations • Disinfection-Decontamination-Deep cleaning of: <ul style="list-style-type: none"> • Surfaces desks and tables, chairs 	

TABLE 2. NUCLEAR MEDICINE VQ SCAN CHECK LIST (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room Environmental Considerations
				<ul style="list-style-type: none"> Cameras, imaging viewing stations, Keyboards and mice beds, stretcher, should be cleaned after each test and sheets/linen replaced in compliance with local infection control recommendation contact points (knobs) by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control <p><i>Attention to the knobs, keyboards, console, mouse, phone, mobile phones, pagers, lighting switches, as they are also contaminated.</i></p>

A-3. TABLE 3. FDG PET/CT (ONCOLOGY) STUDY CHECK LIST

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room or Mobile Imaging Environmental Considerations
<p>Preparation</p> <ul style="list-style-type: none"> • Will the imaging procedure change patient management and/or could the procedure to be delayed? • Select the protocol with the shortest duration of scan time and exposure to staff • Review prep and imaging questions, height, current weight virtual visit or telehealth (or equivalent) equipment from the patient before they come to the PET CT laboratory and document it in the electronic health record • Ensure that patients and staff use the central entrance and do not enter the department without permission and without specific reason. • Do not allow patients to wait in the waiting room for long periods. • Adopt international guidelines for social distancing of at least 1 m (3 feet) or adapt best practice of local and national guideline. • Confirm that medical exposure has been justified as urgent accordingly and/or cannot be rescheduled • Inform the referring physician that the patient would not be allowed to enter the department and examination room unless wearing the appropriate mask in accordance with the Hospital Infectious Diseases Committee guidelines. 	<ul style="list-style-type: none"> • Controlled arrival and departure of patients and staff in the radiology department and only using the central entrance • Provide patient with mask and gloves to wear during the procedure 	<ul style="list-style-type: none"> • Disinfection: Decontamination with the use of appropriate technique and means according to Hospital Infectious Diseases Committee depending on their infection status • PET-CT scanner (immobilization positioning sponges) • Auxiliary equipment (i.e. suction device, Oxygen mask) 	<ul style="list-style-type: none"> • Disinfection Decontamination with the use of appropriate technique and means of areas and patient contact surfaces according to Hospital Infectious Diseases Committee depending on their infection status. 	

TABLE 3. FDG PET/CT (ONCOLOGY) STUDY CHECK LIST (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room or Mobile Imaging Environmental Considerations
	<ul style="list-style-type: none"> Ensure areas and equipment have been adequately disinfected/decontaminated. Disinfect. Wash hands. Don PPE with all appropriate steps – see appendix ‘A’ Be sure to wear a mask N95/FFP2/FFP3 or PAPR eye protection goggles or face shield, fluid resistant gown etc. and single use gloves when receiving a paper referral, identify the patient and continue with the procedure. 			
During	<p>Injection Phase and Uptake phase of FDG Oncology PET CT Study</p> <ul style="list-style-type: none"> During Injection phase and uptake phase of FDG Oncology PET CT every effort should be made to minimize the number of staff in contact with the patient. It is best practice to have two persons, one donning PPE to attend to the patient, glucose meter, scales, FDG dose after assay and during injection to the patient and the other to operate the dose calibrator, FDG dose before and during assay preparation, blanket warmer and Patient electronic charting during this portion of the test or as per local Institutional guidance Consider the Bathroom contaminated which the patient uses to empty bladder before the imaging procedure 	Patient to wear mask and use hand sanitizer	<ul style="list-style-type: none"> PET-CT Scanner and Gantry controls are considered contaminated so they must be used with gloves and all equipment in the injection/uptake room is considered contaminated, glucose meter, scales dose calibrator and equipment for injecting considered contaminated Consider the bathroom and all equipment in it contaminated after patient uses Uptake chair/ table and other equipment should be covered with single use paper PET -CT scanner couch is covered with single use paper per patient. 	

TABLE 3. FDG PET/CT (ONCOLOGY) STUDY CHECK LIST (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room or Mobile Imaging Environmental Considerations
	<p>Imaging of FDG Oncology PET CT Study</p> <ul style="list-style-type: none"> During PET CT Imaging for FDG Oncology PET CT every effort should be made to minimize the number of staff in contact with the patient imaging in a COVID-19 positive patient is best performed using two nuclear medicine radiographers/technologist , one donning full personal protective equipment to attend to the patient, operate the scanner , and the other nuclear medicine radiographer/technologist will be considered clean and will operate the control room equipment, including acquisition and processing equipment. Ensure that the trolley or stretcher is removed from the examination room Cover the PET -CT Scanner couch with disposable paper Remove any metallic objects in the region of interest from the patient with particular care (especially when it comes to artificial dentures where there is a risk of getting infected). Remove gloves and dispose of them in the clinical waste bin (yellow hazardous-contaminated waste) in accordance with the regulation of your Hospital Waste Management Committee. (HWMC). Remember, when exiting the PET-CT scanner room (contaminated area) clothing may be contaminated. Don't take off mask! 		<ul style="list-style-type: none"> PET -CT Scanner console keyboard, mouse and exposure pad are considered clean so they must be used only by the clean technologist 	

TABLE 3. FDG PET/CT (ONCOLOGY) STUDY CHECK LIST (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room or Mobile Imaging Environmental Considerations
Post procedure	<ul style="list-style-type: none"> Disinfect hands with an hand sanitizer before you enter the PET CT console area (clean area) i.e. before touching the keyboard and mouse, the control console, principles of justification, optimization, radiation dose limitation as well as the Nuclear Medicine Radiographer's/ Technologist's Ethical Code Professional Rights at all times When entering the PET CT scanner room (dirty area), wear disposable gloves. Carefully remove the used paper cover from the PET CT couch without touching your clothing and dispose of it in the corresponding bin according to hospital policy. Disinfect gloves, and ensure decontamination-disinfection of PET CT couch-gantry keypad, CM injector control panel and surfaces / contact points (sponges, fixing pads, knobs) by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control Committee PET CT manufacturer's instructions. 	Patient keeps mask and gloves on	<ul style="list-style-type: none"> Single use PET CT couch paper cover is removed and deposited of into the corresponding bin according to hospital policy. Disinfection-Decontamination-Deep Cleaning by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control Committee Camera manufacturer's instructions of: hand control area, PET CT couch and entire gantry inside gantry and outside Gantry keypad Immobilization Velcro straps and positioning sponges, 	<ul style="list-style-type: none"> Injection and Uptake room and Camera room should be closed, and after a delay of up to 2 hours (based on local practice recommendation) the imaging room can be cleaned. For patients with known active COVID-19 or thought to be high-risk for COVID-19, between patients, equipment including cameras, beds, and anything that has been in contact with any patient and/or staff should be decontaminated, using appropriate PPE (as per local policies and standards), by locally available cleansing agents and as per manufacturer's recommendation.

TABLE 3. FDG PET/CT (ONCOLOGY) STUDY CHECK LIST (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologists Tasks	Patient Considerations	Equipment Considerations	Imaging Room or Mobile Imaging Environmental Considerations
	<ul style="list-style-type: none"> • After disinfection/decontamination/deep cleaning, the Nuclear Medicine Radiographer/Technologist must visually inspect the scanning area, PET CT scanner and auxiliary equipment without removing gloves and mask. • Must not remove your mask yet! • Carefully remove your gloves carefully FIRST! • Dispose of them in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the regulation of your HWMC • Disinfect hands immediately as there is danger of being contaminated without gloves! • Remove mask carefully so that the cords or bands of the mask do not touch the face or mucous membranes of the face (and eyes) and dispose of it in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the HWMC. <p>Disinfect - Wash hands well (again because you touched your mask)!</p>			<ul style="list-style-type: none"> • Disinfection-Decontamination-Deep cleaning of: <ul style="list-style-type: none"> • Surfaces desks and tables, chairs • Cameras gantries, imaging viewing stations, Keyboards and beds, stretcher, Injection room equipment in it, infusion pumps, bathroom should be cleaned after each test and sheets/linen replaced in compliance with local infection control recommendation • contact points (door and cupboard knobs) by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control <p>Attention to the knobs, keyboards, console, mouse, phone, mobile phones, pagers, lighting switches, as they are also contaminated.</p>

A-4. TABLE 4. NUCLEAR CARDIOLOGY STUDY CHECK LIST

Control of COVID- 19 Check List	Nuclear Medicine Radiographer/Technologist Tasks	Patient Considerations	Equipment considerations	Imaging Room Environmental Considerations
<p>Preparation</p> <ul style="list-style-type: none"> • Pre-procedure consideration • Avoid exercise nuclear stress testing due to risk of droplet exposure • Use pharmacological Nuclear stress testing for Cardiac Nuclear Medicine • Select the protocol with the shortest duration of scan time and exposure to staff • Consider using standard dose imaging with rapid imaging protocols • Consider stress first imaging protocols • Consider single day imaging protocols • Consider attenuation corrected imaging • Obtain consent using virtual visit or telehealth (or equivalent) equipment from the patient before they come to the nuclear laboratory and document it in the electronic health record • Ensure that patients and staff use the central entrance and do not enter the department without permission and without specific reason. • Do not allow patient to wait in the waiting room for long periods, adopt international guideline for social distancing of at least 1 m (3 feet) or adapt best practice of local and national guideline. • Confirm that medical exposure has been justified as urgent accordingly and/or cannot be rescheduled • Inform the referring physician that the patient would not be allowed to enter the department and examination room unless wearing the appropriate mask in accordance with the Hospital Infectious Diseases Committee guidelines. • Ensure areas and equipment have been adequately disinfected-decontaminated. 	<ul style="list-style-type: none"> • Controlled arrival and departure of patients and staff in the radiology department and only using the central entrance • Provide patient with mask and gloves to wear during the procedure 	<ul style="list-style-type: none"> • Disinfection- Decontamination with the use of appropriate technique and means according to Hospital Infectious Diseases Control Committee between patients depending on their infection status • Gamma Camera (immobilization straps, positioning sponges) • Auxiliary equipment (i.e. ECG, Defibrillator, suction device, Oxygen mask) 	<ul style="list-style-type: none"> • Disinfection- Decontamination with the use of appropriate technique and means of areas and patient contact surfaces according to Hospital Infectious Diseases Control Committee between patients depending on their infection. 	

TABLE 4. NUCLEAR CARDIOLOGY STUDY CHECK LIST (cont.)

Control of COVID- 19 Check List	Nuclear Medicine Radiographer/Technologist Tasks	Patient Considerations	Equipment considerations	Imaging Room Environmental Considerations
<p>Preparation</p> <ul style="list-style-type: none"> • Disinfect. Wash hands. • Don PPE with all appropriate steps – see Appendix ‘A’ • Be sure to wear a N95/FFP2/FFP3 mask with eye protection either goggles or face mask, gown etc. and single use gloves when receiving a paper referral, identify the patient and continue with the procedure. <p>Stress Test Portion of Cardiac Nuclear Study Stress Testing Protocol</p> <ul style="list-style-type: none"> • If exercise testing is deemed necessary, personnel should use PPE as indicated per local institutional guidance • selection minimize contact for written consent (wiping, gloves, disposing pens), consider verbal consent, or written consent with minimized contact and exchanges of papers and pens (e.g., separate pens, gloves), wiping surfaces before and after use • Pharmacological stress with vasodilators is preferred to minimize droplet exposure to exercise staff and minimize close contact between staff and patients. • Regadenoson may be the preferred stress agent if available and not contraindicated for the patient, since it requires a single 10 second infusion, after which providers can maintain distance from the patient. For adenosine and dipyridamole stress testing, extra-long tubing can be used to keep distance between staff and patients • Automatic BP cuffs should be considered • During Pharmacological Stress portion of study or exercise Stress portion of a nuclear stress test every effort should be made to minimize the number of staff in contact with the patient is best practice to have two persons, one donning full personal protective equipment to attend to the patient, and the other to operate the stress lab equipment during this portion of the test 	<p>Patient continues to wear mask and gloves</p>	<ul style="list-style-type: none"> • Gamma Camera and remote hand r and Gantry controls are considered contaminated so they must be used with gloves and the • Gamma Camera couch is covered with single use paper per patient. • Gamma Camera console keyboard, mouse and exposure pad are considered clean so they must be used only by the clean Nuclear Medicine Radiographer/ Technologist 		

TABLE 4. NUCLEAR CARDIOLOGY STUDY CHECK LIST (cont.)

Control of COVID- 19 Check List	Nuclear Medicine Radiographer/Technologist Tasks	Patient Considerations	Equipment considerations	Imaging Room Environmental Considerations
	<p>Imaging of Nuclear Medicine Cardiac Stress test</p> <ul style="list-style-type: none"> When performing Nuclear medicine Imaging portion nuclear medicine stress test every effort should be made to minimize the number of staff in contact with the patient imaging in a COVID-19 positive patient best practice would be to two Nuclear Medicine Radiographers/ Technologist , one donning full personal protective equipment to attend to the patient, operate the gamma camera and the hand control, and the other Nuclear Medicine Radiographer/Technologist will also be donning as well considered clean and will attend to the acquisition and processing equipment. Ensure that the trolley or stretcher is removed from the examination room Cover the gamma camera couch with disposable paper Remove any metallic objects in the region of interest from the patient with particular care (especially when it comes to artificial dentures where there is a risk of getting infected). Remove gloves and dispose of them in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the regulation of your Hospital Waste Management Committee. (HWMC) Remember, when exiting the gamma camera (contaminated area) clothing may be contaminated. Don't take off mask! Disinfect hands with an hand sanitizer before you enter the console area (clean area) i.e. before touching the keyboard and mouse, the control console, principles of justification, optimization, radiation dose limitation as well as the Nuclear Medicine Radiographer's/ Technologist's Ethical Code and RG/RT Professional Rights at all times. 			

TABLE 4. NUCLEAR CARDIOLOGY STUDY CHECK LIST (cont.)

Control of COVID- 19 Check List	Nuclear Medicine Radiographer/Technologist Tasks	Patient Considerations	Equipment considerations	Imaging Room Environmental Considerations
<p>Post procedure</p> <ul style="list-style-type: none"> When entering the gamma room (dirty area), wear disposable gloves. Carefully remove the used paper cover from the gamma without touching your clothing and dispose of it in the corresponding bin according to hospital policy. Disinfect gloves and ensure decontamination- disinfection of Gamma couch-gantry keypad, CM injector control panel and surfaces / contact points (sponges, fixing pads, knobs) by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control Committee CT manufacturer's instructions. After disinfection/decontamination/deep cleaning, the RG/RT must visually inspect the scanning area, gamma camera and auxiliary equipment without removing gloves and mask. Must not remove your mask yet! Carefully remove your gloves carefully FIRST! Dispose of them in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the regulation of your HWMC Disinfect hands immediately as there is danger of being contaminated without gloves! Remove mask carefully so that the cords or bands of the face (and eyes) and dispose of it in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the HWMC. Disinfect - Wash hands well (again because you touched your mask)! 	<p>Patient keeps mask and gloves on</p>	<ul style="list-style-type: none"> Single use gamma camera couch paper cover is removed and disposed of into the corresponding bin according to hospital policy. Disinfection-Decontamination-Deep Cleaning by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control Committee Camera manufacturer's instructions of: <ul style="list-style-type: none"> Gamma camera, camera heads, remote hand control and entire gantry inside gantry and outside Gantry keypad generator cart Immobilization Velcro straps and positioning sponges, 	<ul style="list-style-type: none"> Stress Lab room and Camera room is appropriately cleaned, should be closed, and after a delay of up to 2 hours (based on local practice recommendation) the imaging room can be cleaned. For patients with known active COVID-19 or thought to be high-risk for COVID-19, between patients, equipment including cameras, beds, and anything that has been in contact with any patient and/or staff should be decontaminated, using appropriate PPE (as per local policies and standards), by locally available cleansing agents and as per manufacturer's recommendations <p>Disinfection-Decontamination-Deep cleaning of:</p> <ul style="list-style-type: none"> Surfaces desks and tables, chairs Cameras gantries, imaging viewing stations, Keyboards and mice beds, stretcher, treadmill, blood pressure cuff and equipment, and infusion pumps should be cleaned after each test and sheets/linen replaced in compliance with local infection control recommendation 	

TABLE 4. NUCLEAR CARDIOLOGY STUDY CHECK LIST (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologist Tasks	Patient Considerations	Equipment considerations	Imaging Room Environmental Considerations
				<ul style="list-style-type: none"> contact points (door and cupboard knobs) by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control <p><i>Attention to the knobs, keyboards, console, mouse, phone, mobile phones, pagers, lighting switches, as they are also contaminated.</i></p>

A-5. TABLE 5. PET CT CARDIAC STRESS TESTING

Control of COVID- 19 Check List	Nuclear Medicine Radiographer/Technologist Tasks	Patient Considerations	Equipment considerations	Imaging Room Environmental Considerations
<p>Preparation</p> <ul style="list-style-type: none"> • Use pharmacological Nuclear Stress testing for Cardiac PET CT • Select the protocol with the shortest duration of scan time and exposure to staff • Consider using standard dose imaging with rapid imaging protocols • Consider attenuation corrected imaging • Obtain consent using virtual visit or telehealth (or equivalent) equipment from the patient before they come to the nuclear laboratory and document it in the electronic health record • Ensure that patients and staff use the central entrance and do not enter the department without permission and without specific reason. • Do not allow patient to wait in the waiting room for long periods, adopt international guideline for social distancing of at least 1 m (3 feet) and adapt best practice of local and national guideline. • Confirm that medical exposure has been justified as urgent accordingly and/or cannot be rescheduled • Inform the referring physician that the patient would not be allowed to enter the department and examination room unless wearing the appropriate mask in accordance with the Hospital Infectious Diseases Committee guidelines. • Ensure areas and equipment have been adequately disinfected/ decontaminated. • Disinfect. Wash hands. • Don PPE with all appropriate steps – see appendix ‘A’ • Be sure to wear a N95/FFP2/FFP3 mask with eye protection either goggles or face mask, gown etc. and single use gloves when receiving a paper referral, identify the patient and continue with the procedure 	<p>Pre- procedure consideration</p> <ul style="list-style-type: none"> • Controlled arrival and departure of patients and staff in the radiology department and only using the central entrance • Provide patient with mask and gloves to wear during the procedure 	<ul style="list-style-type: none"> • Disinfection/ Decontamination with the use of appropriate technique and means according to Hospital Infectious Diseases Control Committee between patients depending on their infection status • PET- CT scanner (immobilization straps, positioning sponges) • Auxiliary equipment (i.e. ECG, Defibrillator, suction device, Oxygen mask) 	<ul style="list-style-type: none"> • Disinfection/ Decontamination with the use of appropriate technique and means of areas and patient contact surfaces according to Hospital Infectious Diseases Control Committee between patients depending on their infection. 	

TABLE 5. PET CT CARDIAC STRESS TESTING (cont.)

Control of COVID- 19 Check List	Nuclear Medicine Radiographer/Technologist Tasks	Patient Considerations	Equipment considerations	Imaging Room Environmental Considerations
<p>During</p> <p>Stress Test Portion of PET CT Cardiac Stress Testing Protocol</p> <ul style="list-style-type: none"> • selection minimize contact for written consent (wiping, gloves, disposing pens), consider verbal consent, or written consent with minimized contact and exchanges of papers and pens (e.g., separate pens, gloves), wiping surfaces before and after use • Pharmacological stress with vasodilators is preferred to minimize droplet exposure to exercise staff and minimize close contact between staff and patients • Regadenoson may be the preferred stress agent if available and not contraindicated for the patient, since it requires a single 10 second infusion, after which providers can maintain distance from the patient. <p>For adenosine and dipyridamole stress testing, extra-long tubing can be used to keep distance between staff and patients</p> <ul style="list-style-type: none"> • Automatic BP cuffs should be considered • During Pharmacological Stress portion of study every effort should be made to minimize the number of staff in contact with the patient is best practice to have two persons, one donning full personal protective equipment to attend to the patient, and the other to operate the stress lab equipment during this portion of the test <p>Pharmacological PET CT Cardiac Stress test</p> <ul style="list-style-type: none"> • During a Pharmacological PET CT Cardiac stress test every effort should be made to minimize the number of staff in contact with the patient imaging in a COVID-19 positive patient is best performed using two nuclear medicine radiographers/Technologist, one donning full personal protective equipment to attend to the patient, operate the scanner , generator injection cart and the other Nuclear Medicine Radiographer/Technologist will be considered clean and will operate the control room equipment, including acquisition and processing equipment . The personal operating the EKG machine and injecting the stress agent should also be Donning in full personal protective equipment and considered dirty as they will also be attending to the patient as well. 	<ul style="list-style-type: none"> • Patient continues to wear mask and gloves 	<ul style="list-style-type: none"> • PET-CT Scanner hand control and Gantry controls are considered contaminated so they must be used with gloves and the • PET -CT scanner couch is covered with single use paper per patient. • PET -CT Scanner console keyboard, mouse and exposure pad are considered clean so they must be used only by the clean Nuclear Medicine Radiographer/Technologist 		

TABLE 5. PET CT CARDIAC STRESS TESTING (cont.)

Control of COVID-19 Check List	Nuclear Medicine Radiographer/Technologist Tasks	Patient Considerations	Equipment considerations	Imaging Room Environmental Considerations
	<ul style="list-style-type: none"> • Ensure that the trolley or stretcher is removed from the examination room • Cover the PET -CT Scanner couch with disposable paper • Remove any metallic objects in the region of interest from the patient with particular care (especially when it comes to artificial dentures where there is a risk of getting infected). • Remove gloves and dispose of them in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the regulation of your Hospital Waste Management Committee. (HWMC) • Remember, when exiting the PET-CT scanner room (contaminated area) clothing may be contaminated. • Don't take off mask! • Disinfect hands with an hand sanitizer before you enter the PET CT console area (clean area) i.e. before touching the keyboard and mouse, the control console, principles of justification, optimization, radiation dose limitation as well as the Nuclear Medicine Radiographer's/Technologist's Ethical Code and RG/RT Professional Rights at all times. 			
Post procedure	<ul style="list-style-type: none"> • When entering the PET CT scanner room (dirty area), wear disposable gloves. • Carefully remove the used paper cover from N95/FFP2/FFP3 or PAPR the PET CT couch without touching your clothing and dispose of it in the corresponding bin according to hospital policy. • Disinfect gloves and ensure decontamination-disinfection of the PET CT couch-gantry keypad, control panel and surfaces / contact points (sponges, fixing pads, knobs) by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control Committee CT manufacturer's instructions. • After disinfection/decontamination/deep cleaning, the RG/RT must visually inspect the scanning area, PET CT scanner and auxiliary equipment without removing gloves and mask. • Must not remove your mask yet! • Carefully remove your gloves carefully FIRST! 	Patient keeps mask and gloves on	<ul style="list-style-type: none"> • Single use PET CT couch paper cover is removed and disposed of into the bin corresponding according to hospital policy. • Disinfection-Decontamination-Deep Cleaning by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control Committee Camera manufacturer's instructions of: 	<ul style="list-style-type: none"> • Camera room should be closed, and after a delay of up to 2 hours (based on local practice recommendation) the imaging room can be cleaned. • For patients with known active COVID-19 or thought to be high-risk for COVID-19, between patients, equipment including cameras, beds, and anything that has been in contact with any patient and/or staff should be decontaminated, using appropriate PPE (as per local policies and standards), by

TABLE 5. PET CT CARDIAC STRESS TESTING (cont.)

Control of COVID- 19 Check List	Nuclear Medicine Radiographer/Technologist Tasks	Patient Considerations	Equipment considerations	Imaging Room Environmental Considerations
	<ul style="list-style-type: none"> Dispose of them in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the regulation of your HWMC Disinfect hands immediately as there is danger of being contaminated without gloves! Remove mask carefully so that the cords or bands of the mask do not touch the face or mucous membranes of the face (and eyes) and dispose of it in the Clinical Waste bin (yellow hazardous contaminated waste) in accordance with the HWMC. <p>Disinfect - Wash hands well (again because you touched your mask)!</p>		<p>PET CT couch control handle and entire gantry inside gantry and outside</p> <ul style="list-style-type: none"> Gantry keypad generator cart Immobilization Velcro straps and positioning sponges, 	<p>by locally available cleansing agents and as per manufacturer's recommendations</p> <ul style="list-style-type: none"> Disinfection-Decontamination-Deep cleaning of: <ul style="list-style-type: none"> Surfaces desks and tables, chairs Cameras gantries, imaging viewing stations, Keyboards and mice beds, stretcher, treadmill, blood pressure cuff and equipment, and infusion pumps should be cleaned after each test and sheets/linen replaced in compliance with local infection control recommendation contact points (door and cupboard knobs) by the use of a suitable disinfectant in accordance to Hospital Infectious Diseases Control <p><i>Attention to the knobs, keyboards, console, mouse, phone, mobile phones, pagers, lighting switches, as they are also contaminated.</i></p>

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