

# COVID-19: guidance for infection prevention and control in nuclear medicine

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This guidance document is a brief consensus document covering the range and breadth of nuclear medicine practice in the UK, and identifies a few steps individual nuclear medicine practitioners and departments can take in the best interests of their patients. This guidance document should be used to inform local practice and does not replace local Trust policies or any relevant legislation. At all times, the best interests of the patients should be paramount. Please read this guidance in conjunction with previous editorial (COVID-19- Nuclear Medicine Departments, be prepared! by Huang HL, Allie R, Gnanasegaran G, Bomanji. *J Nucl Med Commun* 2020;

41:297–299). Although some aspects of this guidance are time-sensitive due to the nature of the global emergency, we believe that there is still sufficient information to provide some key guiding principles. *Nucl Med Commun* 41: 499–504 Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved.

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## Introduction

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The COVID-19 pandemic has affected the way people live and work globally. As the pandemic has spread, countries have sequentially imposed restrictions on population movement, social distancing, and isolation in an effort to contain it. This has affected how organisations work; there is the added strain of not only restrictions for patients and staff, but also a huge increase in workload for health services throughout the world.

In the UK, this is having a profound effect on how the NHS works and adapting to cope with this is an enormous challenge. Every speciality and department has been affected, and nuclear medicine departments are

no exception. The challenge is around ensuring essential services are provided whilst keeping the patients and staff as safe as possible by reducing the potential exposure to COVID-19. At the moment the measures are mainly aimed at controlling the early rapid spread of COVID-19, however, it is becoming clear these measures may have to be maintained for some time, to deal with repeated surges of the pandemic until such time as the threat to the community is negligible. The measures suggested in this communication are for the initial rapid control of the pandemic and may have to be reviewed and adopted for a longer-term once the pandemic is fully under control.

Social distancing and self-isolation are key measures to slow down the spread of the Coronavirus. This is in particular for vulnerable groups (people over the age of 70 and those with co-morbidities such as lung, renal and heart disease) when prolonged (12 weeks or more) isolation is strongly recommended. In keeping with this and the fact that a higher proportion of those attending clinics and hospital investigations often have co-existing risk factors, we advise that non-urgent out-patient appointments be postponed until such time that these measures can be relaxed. In this way, the pressure being placed on the NHS to create and maintain capacity for critically ill patients can be eased, and the risk of COVID-19 infection to patients, their relatives and to NHS staff can be reduced. Nuclear medicine involves specialised procedures and staff cannot be easily replaced in the event of

shortage. This can have a big impact on the ability to provide services due to the possible reduction in workforce due to the restrictions and possible redeployment of staff to other more frontline services.

### General workplace adjustments

There are a number of measures which can be taken in the imaging department which help to reduce the impact of possible COVID-19 on the routine and emergency work. Digital imaging is the standard mode in most hospitals, particularly in nuclear medicine departments. During more recent years patient management including requests, vetting, bookings, letters and reporting are increasingly being done electronically using various PACS and digital imaging software. All these aspects of imaging can be accessed and conducted remotely. This puts imaging, and in particular nuclear medicine, in a unique position of considering working from home, which has the advantage of not only maintaining the required social distance, but also enabling self-isolated staff to continue work from home. WFH should therefore be considered as much as possible; however, there are many aspects of nuclear medicine which require direct interaction with patients and the following guidelines are aimed at ensuring this is done safely.

It is worth considering rotating the staff into 'remote' and 'hands-on' working groups, so in case of contamination, not all the staff are affected and the essential work can be taken over by deploying the "remote" group for the essential direct work.

### Postponing appointments

Nuclear medicine departments often have administration staff dedicated to their services. Many are likely to have hundreds of scans booked over the next 3 weeks, with many other appointments pre-planned over the next 2 months. To act on these quickly, administration

staff from other modalities may have to assist, hence nuclear medicine should co-ordinate with other imaging modalities when considering the approach to postponing appointments as help may be needed, especially as some may begin to isolate. Conversely, nuclear medicine staff may have to assist other departments in managing their patient load.

The most important consideration is the assessment of the risk of postponement. It is important that those patients who urgently need their Nuclear Medicine tests are still able to have them, and that having the scan will have a big impact on their immediate management. The prioritisation of patient appointments must therefore be carefully considered. Those patients with chronic, stable or mild conditions may have lower priority compared to acute, progressive or severe conditions.

A traffic light system is proposed in Table 1 to assist with the decision-making process for most Nuclear Medicine tests using the following guidelines:

- (1) Tests in Green category can be deferred (i.e. postponed) and possibly held in a queue until the situation is clear and/or rebooked as and when needed.
- (2) Amber appointments must be discussed with a clinician before if considering cancelling/rebooking. Note: patients may have had withdrawal of some of their existing drug treatment, and this should be considered when making the decision on whether to postpone or not (for example, thyroid and parathyroid scans when using I<sup>123</sup>)
- (3) Red appointments should not be cancelled as they are deemed essential, unless under extreme circumstances.

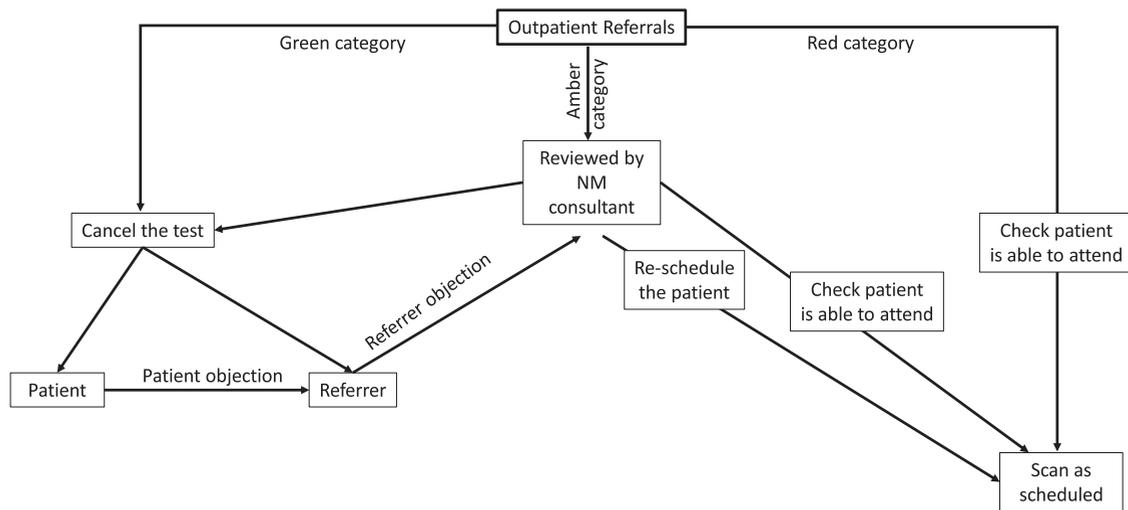
It is recommended that the examinations are not re-booked until further advice has been received; rather

**Table 1** Traffic light system for prioritisation of nuclear medicine procedures

Red	Amber	Green
Do not cancel or rebook unless patient at risk	Discuss with clinician if there is a need to cancel/rebook.	Rebook without need for discussion with a clinician
Book all new referrals	New referrals to be discussed	Do not book new appointments
F-18 FDG new cancer	F-18 FDG follow-up	2 phase bones and non-oncology whole-body bone
F-18 FDG sepsis	Ga-68 DOTATATE follow-up	Amyloid DPD for heart
Ga-68 PSMA/F-18 Choline new cancer	Ga-68 PSMA/F-18 Choline follow-up	Benign I131 thyroid therapy
Ga-68 DOTATATE (staging / therapy decision)	Ga-68 PSMA follow-up	C13 Urea Breath Test
GFR	Lung VQ	Colonic Transit
GI bleed	MAG3	CSF studies
In-111 Pentetreotide (Octreoscan)	MIBG pheochromocytoma	Dacryoscintigraphy
Lu-177 DOTATATE	MPS routine (SOB)	DMSA
Lung perfusion	MUGA – cardiac	Gastric Emptying
Meckel's scan	Parathyroid (bear in mind cessation of drug therapy in lead up)	HIDA
MPS acute chest pain	Platelet	I-123 Ioflupane (DaTSCAN)
MUGA Oncology	Thyroid Tc-99 m/ I-123 (paeds)	Lymphoscintigraphy
Oncology Bones	White cell (also consider FDG)	MIBG heart
Radium-223 dichloride		Morphine HIDA
SLN		Platelets
99mTc-EDDA/HYNIC-TOC (Tektrotyd)		Proctoscintigraphy
Y90-SIRT/Theraspheres		Red Cell Mass
		Salivary
		Se-75 /Tauroselcholic acid (SeHCAT)
		Small bowel transit
		Thyroid Tc-99 m/ I-123 (adults)
		Tl-201 hibernation

VQ, ventilation perfusion.

Fig. 1



Schema outlining a suggested process to prioritise and schedule patients in times of COVID-19 pandemic.

it should be kept on file and once the department is in a position to reschedule the patient’s appointment, then they should be contacted at that point. We understand that patients may have been waiting for these tests for a long time and for some, the test may have a significant impact on their life; if the patient wants to appeal the decision, then they should contact their referring doctor, who should then have a discussion with the Nuclear Medicine Clinician regarding the urgency of the request, if appropriate (Fig. 1).

A letter of deferment of the appointment should be sent to the patients, which should ideally explain the reason for cancellation reassuring them that they are still on the waiting list and that the department would automatically be sending them a new appointment as soon as possible. Ideally, a notification of temporary deferment should also be sent to the referring clinician, as patients may get in touch with them regarding the test. This may involve additional administration activity, and maybe conducted telephonically and recorded as such on the booking system.

Departments should consider how they will approach these postponed referrals when the Coronavirus threat has gone. Postponed studies should be easily identified. There will likely be a ‘batch’ of certain studies which on review, may be more efficient and less expensive to perform when booked together, rather than perform in the order they were received. It is possible that some studies may not be required, and there should be an opportunity to review the continued usefulness of the scan within the clinical context.

**Delivery of radiopharmaceuticals**

Nuclear Medicine Europe issued a statement on 25 March 2020. At present, there has been no problem with

production facilities in both Europe and those centres outside Europe that we depend upon. However, there may be issues with delivery of these radiopharmaceuticals within Europe partly related to the paucity of flights, especially where radiopharmaceuticals are carried as hold luggage in passenger airliners. Also, there may be future issues with road transport both across borders and within borders. Please be aware of these possible issues and it is also important for imaging nuclear medicine departments to liaise with their local radiopharmacy departments, as there could be restriction in the availability of radiopharmaceuticals and labelling due to potential staff shortages.

**Booked appointments**

Even for those appointments which are deemed to be urgently required, there is an increased risk of absences (DNAs) as patients may develop symptoms of COVID-19 themselves, or may be self-isolating because of social or medical reasons. It is advised that departments contact patients by phone on the day before the appointment to check that they are still planning to attend. Symptoms could be vague and include high temperature, cough, and more recently reported, a loss of taste or sense of smell. There should be a low threshold to deferring the appointments, especially if there is a possibility of cross-contamination of staff and other patients.

**Symptomatic patients**

Any patient showing symptoms of the virus (fever, recent onset of persistent dry cough or shortness of breath) should be told not to attend, and sent home if they do present at the department, and the procedure rebooked, even if they are attending for a high priority (red) procedure, or even if they have been injected with the radiopharmaceutical.

## Expensive tests

Where possible delay such tests until this crisis is over. If expensive radiopharmaceuticals are already bought in to be used imminently, appointments should be reviewed before booking to avoid expensive absences, and when rebooking the patients, it should be confirmed that the product can still be supplied as there may be some disruption to this.

## Patient areas

Look at patient waiting areas and try to ensure that these do not get crowded. Ask patients not to arrive more than 5 minutes before their appointment. Ideally, the patient should attend by themselves, but if they need to have another person with them – for example, a carer, interpreter or driver, a maximum of one adult could come with them. No children should accompany them. After injection of the radioactive tracer, patients should be asked to keep safe distance and if necessary (by local agreement) to wait outside (including in their cars) and arrive back 5 minutes before the given imaging time. Designate the hot waiting room for those who cannot physically leave the department. Consider blocking off every alternate chair in the waiting room with a sign or tape to keep patients apart. All patient waiting areas should be wiped down with appropriate sanitiser at least once every 2 hours.

## Patient hand hygiene

Patients should be asked to clean their hands when they arrive and before they come in to the scanning rooms, preferably by handwashing, although alcohol gel can also be used. Appropriate signage can be used.

## Staff hand hygiene

Staff should clean their hands at regular intervals during the day for 20 seconds each time using soap and running water. Gloves should be worn when handling patients, for example, when helping them on and off the bed. These must be changed between each patient contact. Staff should also wash/sanitise hands before/after every patient, even if wearing gloves. Hand moisturisers must be used to ensure the skin does not become affected by repeated washing. Avoid touching face with hands.

## Personal protective equipment

Please follow your local policy for which personal protective equipment (PPE) to wear and when to wear it. PPE should be kept in all injection rooms (i.e. more than one location) in case of inaccessibility due to radioactive contamination. Different PPE may need to be worn outside of Nuclear Medicine, for example, on the ward. Follow Local Trust Policies for this. PPE will be in high demand hence Trust's will be tracking usage, as this data is fed back centrally (NHS Providers). For this reason, regular

stock checks should be made to inform the Trust but also to ensure there will be no shortages.

## Equipment

- (1) If possible, one camera should be set aside for non-symptomatic patients only (out or inpatients) with different camera(s) being reserved for symptomatic/unconfirmed/confirmed patients whenever possible.
- (2) Cleaning and Decontamination: camera rooms should be cleaned down after each patient and surfaces such as couch, chairs wiped down with chlorine (or 70% alcohol) wipes or equivalent. After every symptomatic/confirmed COVID-19 patient allow sufficient time between patients to allow for air re-circulation. Please refer to your room specification (often held by hospital estates department) as to how much time is needed for room re-circulation which is room/air-con specific. National guidance states 'A minimum of 20 minutes, that is, 2 air changes, in hospital settings where the majority of these procedures occur is considered pragmatic'
- (3) Symptomatic/unconfirmed/confirmed COVID-19 patients should be brought immediately into the camera room and not left waiting anywhere else.
- (4) The ideal time to perform scans on infectious patients is in the afternoon to minimise cross-contamination after use. However, in the afternoon, you will end up injecting more particles of macroaggregates of albumin (MAA) (unless the MAA is prepared at lunchtime). Also, the Kr generator will be weaker. So morning appointments are preferred.

## Legal considerations

### Environmental permitting regulations/radioactive substances act (for Northern Ireland)

If applicable, departments should review their procedure for timing of radioactive waste collection. A slightly earlier prompt to start the consignment procedure is advised in case of disruption to the courier service. For example, those with a 90-day permit, may want to consider a prompt to begin preparing for consignment at 65 rather than 70 days, assuming the contents can be consigned at this date from a transport regulations perspective.

### Ionising radiation medical regulations

Departments should keep to their usual equipment QC procedures and schedules. But it is advised to consider contingency planning for lack of immediate MPE advice, such as provision of MPE advice remotely if possible. Effective communication is important, particularly in the event of borderline results and the MPE is not available for advice.

Departments should perform vetting procedures as usual, but prepare for situations where the practitioner, or those

delegated to authorise tests, are not physically available in the department due to COVID-19.

## Precautions for lung imaging

### Ventilation perfusion scan for known COVID-19 patients

- (1) The decision on whether to proceed with the ventilation perfusion (VQ) scan should be discussed with the referrer before booking.
- (2) Most in-patient referrals are for VQ scans and these could include suspected or confirmed in-patient COVID-19 positive patients. Please consider all in-patient VQs with uncertain COVID-19 status as potentially positive and wear appropriate PPE.
- (3) The use of a perfusion-only scan is unlikely to be diagnostic if COVID-19 infection is suspected, in particular, if there are changes in chest Xray. Perfusion scans on their own are difficult to interpret when there is inflammatory lung response.
- (4) The majority of referrals to VQ scans in most departments are for pregnant patients and the perfusion only scan is often normal, with no requirement to proceed to more 'intimate' contact through use of masks. However, this is only possible in departments with hot reporting (as the study is finished) to determine if patients need additional ventilation scans in some cases.
- (5) Pregnant patients are in a higher risk category and should be in the department for as short a time as possible.
- (6) If using Krypton, proceed with a dual-energy Tc-MAA/Kr-gas VQ to complete the test quickly.
- (7) Krypton-81m is the preferred agent if simultaneous ventilation is performed. Other ventilation agents may not be suitable due to the time required to be with the patient, and the unsatisfactory distribution due to possible patient non-compliance. If Technegas or aerosol is used follow the manufacturer's guidance <https://www.cyclomedica.com/wp-content/uploads/sites/20/2020/03/Technegas-and-COVID-19-letter.pdf>.
- (8) For non-pregnant, and non-hypertensive patients, consider increasing the diagnostic reference level (DRL) from 200 to 300 MBq to bring about rapid single photon emission computed tomography (SPECT) imaging. It would reduce the time the patients spend in the department as well as reducing time for accompanying ward staff. Note that the administration of an activity greater than the DRL must either be directly justified by the IR(ME)R Practitioner, or detailed in a revised emergency protocol that is approved by the IR(ME)R Practitioner (source: Considerations during COVID-19 pandemic – ARSAC newsletter 27 March 2020 letter).
- (9) Patients with pulmonary hypertension should only receive 200 MBq and always injected soon after preparation of MAA to reduce the number of particles (this usually means in the morning).
- (10) If more than one referral is made, these should be booked and performed consecutively, allowing for sufficient room re-circulation.
- (11) 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.
- (12) Use disposable tourniquets and any disposable waste from the procedure should be bagged in suitable waste bags as recommended by the local hospital.
- (13) 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.
- (14) Government guidance is available on how to minimise spread of infection.
- (15) [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/872745/Infection\\_prevention\\_and\\_control\\_guidance\\_for\\_pandemic\\_coronavirus.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872745/Infection_prevention_and_control_guidance_for_pandemic_coronavirus.pdf).
- (16) From this guidance, the VQ scan may not be considered an actual aerosol. However, given the patient's likely symptoms (cough), the test warrants extra PPE as per local guidance. The operator (injector, and mask fitter) should wear the full PPE – gloves, FFP3 mask, visor, and 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.
- (17) A proposed pathway for VQs can be found in Fig. 2.

### Special advice for booking sentinel lymph node

Nuclear Medicine Departments are advised to liaise frequently with the sentinel lymph node (SLN) services they support, as these procedures are likely to be altered due to their own internal priority systems. It may be necessary to inject and image SLN patients the day before the surgery, with the possible need to increase the injected activity.

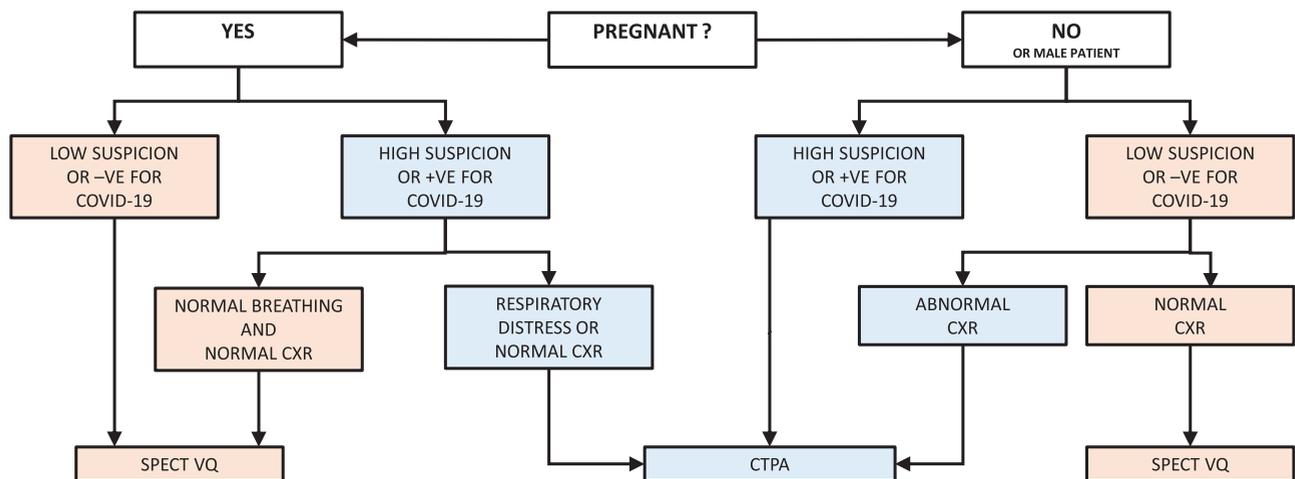
### Reporting nuclear medicine and multi disciplinary teams

- (1) Once scans are being/have been performed, remote reporting options could be explored in conjunction with radiology/PACS/ IT teams.
- (2) Participation in multi disciplinary teams (MDTs) can be limited in line with national guidance, please ensure ability to dial in remotely and rotation of staff attending MDTs.

### PET-CT

- (1) We expect that demand for routine PET-CT imaging using 18F-FDG may reduce a little with less "follow

Fig. 2



Schema outlining a possible process for conducting Ventilation-Perfusion scintigraphy in time of COVID-19 pandemic. CXR, chest Xray; VQ, ventilation perfusion.

up” scans but generally there will still be a significant work load. If you have separate uptake rooms not being used for PET, consider using these areas for ‘at risk’ patients from the rest of imaging.

- (2) Be prepared to use any spare CT capacity on the machine for acute chest CTs as throughput on CT scanners may be reduced by the need to clean rooms between patients.
- (3) We advise reviewing the CT component of PET-CT on lung windows to check that patients do not have incidental signs of viral infection before they leave the scanner. If there are signs, the scanner needs to be cleaned prior to the next patient in case the patient has COVID-19. Please see information on the BSTI website for CT appearances that are seen in COVID-19: <https://www.bsti.org.uk/COVID-19-resources/>.

### Single photon emission computed tomography-CT

- (1) We advise reviewing the CT component of SPECT-CT on lung windows to check that patients do not have incidental signs of viral infection before they leave the scanner. If there are signs, the scanner needs to be cleaned prior to the next patient in case the patient has COVID-19. Please see information on the BSTI website for CT appearances that are seen in COVID-19: <https://www.bsti.org.uk/COVID-19-resources/>.

### Therapeutic nuclear medicine

- (1) Each patient needs to be assessed on an individual basis.
- (2) 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 therapy unit. 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.

- (3) Administration of radioiodine ablation therapy to Thyroid cancer patients needs careful consideration. Please follow the RCR Thyroid Cancer guidance 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.
- (4) Lutetium ( $^{177}\text{Lu}$ ) oxodotreotide (Lutathera) for patients with low and medium grade Neuroendocrine tumours will need to be reviewed in light of local risk assessments/guidelines. However, since these patients could be considered as 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 their own clinical and local contexts.
- (5) 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. Please review each patient in their own clinical and local contexts.

### Summary

In summary, we have attempted to capture some key steps for decision-making by local teams practising nuclear medicine to inform their own local response to the challenging situation.

### Acknowledgements

#### Conflicts of interest

There are no conflicts of interest.