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GUIDELINES & RECOMMENDATIONS

Guidance on medical physics expert support for nuclear medicine

[1]LOUISE FRASER, [1]NASREEN PARKAR, [2]KATHRYN ADAMSON, [3]ALISON FLETCHER, [4]PETER JULYAN, [5]CHARNIE KALIRAI, [6]DANIEL MCGOWAN and [7]FERGUS MCKIDDIE

[1]Medical Exposures Group, UK Health Security Agency, Representing ARSAC Secretariat, England, United Kingdom
[2]Nuclear Medicine, Guy's and St Thomas' NHS Foundation Trust, Representing ARSAC, England, United Kingdom
[3]Nuclear Medicine Physics, NHS Lothian, Representing IPEM, Edinburgh, United Kingdom
[4]Nuclear Medicine, The Christie NHS Foundation Trust, Representing ARSAC, England, United Kingdom
[5]Department of Medical Physics and Clinical Engineering, Nuclear Medicine, Nottingham University Hospitals NHS Trust, Representing BNMS, England, United Kingdom
[6]Department of Medical Physics and Clinical Engineering, Oxford University Hospitals NHS Foundation Trust, Representing BIR, England, United Kingdom
[7]Nuclear Medicine, NHS Grampian, Aberdeen, Representing IPEM, United Kingdom

Address correspondence to:
Dr Fergus McKiddie
E-mail: *f.mckiddie@abdn.ac.uk*
Louise Fraser
E-mail: *louise.fraser@phe.gov.uk*

ABSTRACT

The Ionising Radiation (Medical Exposure) Regulations require employers to appoint suitable medical physics experts (MPE) for nuclear medicine services, and they also define the areas where MPEs are required to provide advice and specify matters that they must contribute towards. Applications for employer licences under IR(ME)R require employers to specify the level of MPE support available and if this is provided by onsite MPEs or remotely. Assessment of these applications by the Administration of Radioactive Substances Advisory Committee (ARSAC) has highlighted variability in the levels of MPE support being provided for similar services across the UK. A working party including representatives from IPEM, ARSAC, BIR and BNMS was formed and has produced these recommendations on MPE support. Nuclear medicine services were divided into seven broad categories and MPE support for each category has been considered. However, some services that differ from the scenarios provided in this guidance may require different levels of MPE support. Positron emission tomography (PET)/CT and gamma camera imaging have been considered separately here, although it is recognised that both PET/CT and gamma cameras are often sited within the same department in many centres. The separation has been done for pragmatic purposes, as there are felt to be sufficient differences in the MPE role requirements. This guidance sets out recommendations for MPE support, and broader physics support, to run a safe nuclear medicine service and defines the responsibilities of these staff for a range of clinical nuclear medicine services. The recommendations on MPE support made are advice, but will assist employers in meeting regulatory requirements.

PURPOSE

This guidance sets out recommendations for adequate levels of medical physics expert (MPE) and broader physics support to run a safe nuclear medicine service and defines the responsibilities of these staff for a range of clinical nuclear medicine services. It has been written with representation from IPEM, ARSAC, BNMS and BIR. The guidance is endorsed by those organisations and it is also supported by the Clinical Radiology Faculty of The Royal College of Radiologists.

INTRODUCTION

The Ionising Radiation (Medical Exposure) Regulations 2017[1] and the Ionising Radiation (Medical Exposure) Regulations (Northern Ireland) 2018,[2] henceforth collectively referred to as IR(ME)R, consolidated the role of the medical physics expert (MPE) and introduced a requirement for licensing of employers who administer radioactive substances to patients. IR(ME)R requires employers to appoint a suitable MPE for the service being provided, defines the areas where MPEs are required to provide advice and specifies matters that they must contribute towards. The application process for employer licences under IR(ME)R requires employers to specify the assigned level of MPE support available and to provide details of how this support is provided. The assessment of these applications by the Administration of Radioactive Substances Advisory Committee (ARSAC) has highlighted the variability in levels of MPE support being provided for services across the UK.

A working party was set up by the IPEM nuclear medicine special interest group to provide UK specific guidance on adequate levels of MPE support for services of different sizes and complexity. The working party includes representatives from IPEM, ARSAC, BIR and BNMS. Proposed levels of MPE support have been guided by information submitted as part of employer licence applications and the practical experience of the working party.

There are several models for the delivery of MPE support; however, it is expected that the MPE should spend some time onsite and, where remote support is provided, should not be situated so far away as to make attendance onsite impractical as required by the nature and urgency of the situation. Complex services, or services that differ from the scenarios provided in this guidance may require different levels of MPE support. Where any remote support is provided, employers should ensure that appropriate standards of quality of care are maintained.

MPE support levels in this guidance are referred to as whole time equivalent (WTE) values. This represents the amount of dedicated MPE time available for the support of that service and includes time spent supporting onsite and remotely. One WTE MPE support should be considered as 5 days a week of support (approximately 37.5 h). Where an individual provides support at less than full time, this is represented as a fraction of a WTE, *e.g.* 0.6 WTE would be support for 3 days a week. This principle should also be applied where an individual's job plan specifies they work as an MPE for a fixed period of their working time, *e.g.* if an MPE is also acting as a Radiation Protection Advisor (RPA) and Radioactive Waste Advisor (RWA). The RPA role is defined in the Ionising Radiations Regulations 2017 (IRR17)[3] and the RWA role is a requirement of permit holders under The Environmental Permitting (England and Wales) Regulations 2016[4] or The Environmental Authorisations (Scotland) Regulations 2018.[5] It may be appropriate for multiple individuals to collectively provide MPE support to a service, *e.g.* to provide a range of services where training requirements differ or for annual leave and sickness absences.

The recommendations on MPE support in this guidance are advice and will assist employers in meeting regulatory requirements. There are other methods available for the calculation of MPE staffing levels from national and international bodies. However, these may not be reflective of local practice due to the variation in the role of MPE across Europe. The exact job plans of MPEs are beyond the scope of this work and individuals may carry out other job roles in addition to the MPE role. Although positron emission tomography (PET)/CT and nuclear medicine sit side-by-side in many departments they are considered separately here, for the purposes of MPE support, as there are felt to be sufficient differences in the MPE role requirements to justify this and to clarify the breakdown of overall MPE requirement calculations.

Medical physics expert role in nuclear medicine

The title of MPE has existed for many years, but when IR(ME)R came into force in 2018, the role was clarified and the appointment of suitable persons was mandated. IR(ME)R requires the employer to appoint suitably qualified MPEs for all areas involving medical exposures, including nuclear medicine. This also set out the requirement for all MPEs to be formally accredited through a recognised scheme. Details of this can be found on the RPA 2000 website.[6]

MPEs are generally Health and Care Professions Council (HCPC) registered Clinical Scientists and IR(ME)R 14(2) and 14(3) describe the role of the MPE and their required level of involvement in various tasks. Broadly, the level of involvement is determined by the level of hazard and risk from the procedure and the benefit expected from the involvement of the MPE. Schedule 2(b) of this legislation also states that the scope of practice of each MPE, in their role as an operator, should be defined in their employer's procedures.

The range of roles expected of an MPE in nuclear medicine is wide ranging and the same individual may also perform other specialist roles such as the RPA and RWA. Broad guidance as to the typical roles expected can be found in the documents from the Department of Health and Social Care (DHSC)[7] and UK professional bodies[8] around the practical implementation of the IR(ME)R legislation. Detail can also be found in the MPE curriculum document from the European Commission.[9]

Some of the core duties that would usually be performed by an MPE, or where the expertise of an MPE is considered essential, are described below. However, an MPE will also participate in a number of other duties such as the planning, delivery and signing-off of training for a range of staff groups in the department.

Diagnostic nuclear medicine imaging, non-imaging procedures and PET/CT

The MPE involvement in routine imaging and non-imaging procedures is generally around the optimisation of radiation exposures to patients, ensuring that these are as low as practicable and compliant with appropriate legislation. They will also be involved in the development of complex imaging processing and data analysis techniques, often in an advisory capacity. These tasks require the involvement of an MPE but are not sufficiently complex to require the close involvement of the MPE. Therefore, these tasks may be overseen by an MPE who is not present at the site most of the time. The MPE may also contribute to research trials and their design to ensure consistency of image quality and the optimisation of all radiation exposures to trial subjects.

The involvement of the MPE in PET/CT will depend upon the complexity of the services being offered. Routine FDG-based services will require a high level of MPE involvement during the setting up and commissioning of the service but will not require close involvement thereafter. Departments offering complex

PET/CT services will require close involvement of their MPEs, and there may well be MPE posts which are dedicated to the service. Examples of complex PET/CT services could include radiotherapy treatment planning, advanced quantification (including blood sampling and dynamic acquisition), participation in research studies where MPE input is required, non-FDG tracer imaging and contrast-enhanced CT imaging.

Radionuclide therapy

The level of involvement of the MPE in therapy services will depend upon the complexity of the procedures being carried out. A routine iodine-131 service offering thyrotoxicosis and standardised thyroid cancer treatments may not require the day-to-day involvement of the MPE and could be supported by an MPE who is not always physically present. For more novel, or complex, therapies the MPE should be closely involved and that generally means being present onsite and available at all times while the treatments are being carried out. The MPE should also be closely involved in the development of patient radiation risk assessments, radiation safety advice and development of dosimetry assessment techniques and calculations prior to novel therapies going ahead. Due to the potential for significant clinical consequence of under- or overdosing patients, the MPE should also have oversight of all dosimetry calculations for the target area(s) of the treatments, and organs at risk.[10]

Equipment procurement and quality assurance (QA)

The MPE must have responsibility for the drawing up of specifications and tender documents for new imaging equipment and other large pieces of capital equipment within the department. This also includes the scoring of tenders and selection of the preferred bidder with the involvement of other key stakeholders. They will then be responsible for the development of a programme of commissioning tests and ensuring that this is carried out effectively and efficiently to allow any issues to be raised with the manufacturers within agreed timeframes. The MPE must also have responsibility for the introduction of the new equipment into routine use.

The MPE must have responsibility for establishing equipment QA programmes and to make recommendations regarding liaison with manufacturers on complex fault diagnosis and the resolution of these issues. They must also have oversight of programmes of routine preventative maintenance, fault repair on equipment and decommissioning of clinical equipment when it is no longer fit for purpose.

Radiation safety

The MPE will be responsible for carrying out or supervising others in carrying out dose audits to ensure that dose optimisation and risk reduction is being correctly achieved. They will also be closely involved in the development and dissemination of local diagnostic reference levels (LDRLs) for all exposures being carried out in the department. The MPE will also be closely involved in the investigation of any radiation incidents within the department and the reporting of these to the appropriate internal and external bodies. In all of these aspects of the role, the MPE will work closely with the appropriate colleagues, such as RPAs, RWAs and MPEs from radiation safety.

Regulatory compliance

The MPE will advise the employer on the appropriateness of relevant procedures and their compliance with IR(ME)R. They will be closely involved in the drawing up of procedures and ensuring their correct implementation. This may be achieved by means of compliance audits overseen by the MPE, possibly in co-operation with the relevant RPA. The MPE will also work with clinical colleagues, and others, as part of the multidisciplinary team to provide appropriate input into the reviewing of clinical pathways.

Role of general physics support (not necessarily MPE)

A physicist in nuclear medicine will undertake a variety of roles, the exact range depending upon the organisational structure and the availability of other healthcare professionals working in the department. Some tasks, such as those associated with statutory requirements (*e.g.* MPE, RWA and RPA roles) can be clearly assigned to appropriately certified competent physicists. However, physicists will perform work to support all four core domains of an MPE role (optimisation, dosimetry, equipment management and regulatory compliance), as well as work to support the RWA and RPA. Other tasks, such as the radiation protection supervisor (RPS) role, stock and waste management, although frequently performed by physicists, could be undertaken by other staff groups, depending on the local setup. The RPS role is also defined in IRR17. In addition, physicists may take on tasks which are not related to an immediate service provision, *e.g.* funded research.

Some of the core duties that would usually be performed by a physicist, or where the expertise of a physicist is considered essential, are described below.[11–14] These duties will be delivered by individuals with training in appropriate elements of medical physics, but usually generally delivered by HCPC registered clinical scientists. However, there may be local variation in centres based upon their service delivery model.

Diagnostic nuclear medicine imaging and non-imaging procedures

A physicist is often required to give advice on the range and suitability of investigations and techniques, have a role to play performing complex imaging processing and data analysis, and assist in the presentation and interpretation of results. HCPC registered clinical scientists may be involved in authorising and reporting some clinical studies, particularly non-imaging studies.

Physicists also often take on a troubleshooting and advisory role during complex imaging procedures and support the clinical staff with the review of existing procedures and protocols. Working with clinical staff, such as technologists, radiographers and doctors, physicists are often engaged in the design of protocols as well as the creation and validation of image processing and quantification tools, although any optimisation work would be performed in collaboration with an MPE. In addition to supporting routine clinical procedures, physicists will also support clinical trials by contributing to the protocol design, performing dose and risk assessments for regulatory approvals and performing phantom measurements to ensure consistency of images in multicentre research trials.

Radionuclide therapy

A multidisciplinary team approach is required for radionuclide therapy procedures, and physicists are a core component of this team. Physicists will perform patient radiation risk assessments, provide radiation safety advice and oversee the practicalities of the patient management, with respect to radiation safety, prior to therapies going ahead. Physicists often have a patient-facing role, explaining the radiation risks to patients and delivering the therapy alongside clinical colleagues. When required, physicists will also perform dosimetry calculations for the target area(s) of the treatment, and organs at risk using quantitative imaging.

Equipment quality assurance (QA)

A large part of a physicist role in nuclear medicine is to participate in QA programmes for a range of nuclear medicine equipment. Physicists may work with an MPE in equipment specification and perform acceptance testing of equipment.

Regular testing and routine QC procedures may be performed by physicists or other staff groups under the direction of a physicist, but physicists will usually be responsible for performing trend analysis and recommending actions based on the results of QC procedures, and liaise with manufacturers on complex fault diagnosis and the resolution of these issues. Physicists may also be responsible for arranging preventative maintenance and fault repair on equipment.

Computing and IT

Nuclear medicine physicists are frequently involved in the quality management of software tools and clinical programs used for patient data analysis, as well as in undertaking audits to evaluate clinical protocols and procedures. They may also provide ongoing support for clinical software, PACS and archiving clinical images.

Radiation safety

Nuclear medicine physicists may be appointed as RPAs and/or RWAs, and as part of this role they will be involved with any associated site inspections. Depending on the department setup, physicists may also be appointed as an RPS. The RWA, RPA, RPS, as well as other physicists, will be involved in ensuring their department complies with the appropriate legislation and guidance, will address any radiation safety issues and play a part in the investigation and follow up of incidents.

Training and education

Teaching and training are important aspects of the nuclear medicine physicist's role, and these roles are often carried out in addition to the duties required to run a clinical service. Physicists will not only deliver in-house training and supervision of junior physicists working towards becoming HCPC registered clinical scientists, but also support and train other staff groups within the department, and give bespoke radiation safety training for staff groups outside the department, such as domestic staff and laboratory, theatre or ward staff. Physicists are often involved in more formal academic teaching too, by either delivering lectures or supervising academic projects, and they may have a significant role in the organising and running of academic training programmes for other nuclear medicine staff groups, or modules within these programmes. Alongside training of healthcare staff, physicists also have a key role in outreach activities designed to encourage young people to pursue science subjects and a career in healthcare.

Scientific leadership

Physicists are likely to attend clinical meetings, hospital management briefings and departmental meetings, and they may also have a role within hospital committees, such as a Radiation Safety Committee. Additionally, physicists are often members of national and international scientific committees and groups, and as part of these roles they will organise scientific meetings, help develop clinical guidelines to support evidence-based practice and may advise on the potential impact of new legislation and standards.

As well as the core duties discussed, physicists may also have a significant role in managing the nuclear medicine service, including budgetary control, delivery of scientific support and act as a radiopharmacy production, or quality, manager. It should also be recognised that in some radiological installations, physicists play a significant role in the overall leadership and development of nuclear medicine services.

NUCLEAR MEDICINE SERVICES IN THE UK

To develop this guidance, a review of information submitted as part of employer licence application forms was carried out. This looked at 268 applications and recorded the types of procedures applied for, the MPE support quoted and the equipment profile of each department. Services were divided into seven broad categories and MPE support for each category was used to develop the following guidance.

Departments with no imaging equipment

Services which use gamma probes and sample counting devices to deliver a range of investigations which do not require the use of imaging devices such as gamma cameras and PET scanners tend to stand alone from any routine nuclear medicine service. This type of service can be found within the private healthcare and research and innovation sectors, and there are 15 listed in the UK. Typically these services may offer:

- investigations measuring the amount of radioactivity in biological samples taken from patients or volunteers as part of clinical investigations or clinical trials
- sentinel lymph node injections using ^{99m}Tc based radiopharmaceuticals to assist in the staging of axillary lymph node involvement in breast cancer.

Many of the investigations would be done on an outpatient or day case basis, but some scenarios in the research and innovation sector may require overnight stays for multiple pharmacokinetic samples to be taken.

These services are recommended to have access to at least 0.2–1.0 WTE available MPEs. This resource will vary depending on the level of activity and whether investigations are routine, complex or novel.

Departments with a single gamma camera

Services with a single gamma camera (planar/SPECT gamma cameras and/or SPECT/CT systems) may provide a range of diagnostic procedures performed from ^{99m}Tc only radiopharmaceuticals to a range of non-technetium-99m radiopharmaceuticals too. There are over 80 such centres in the UK. Non-imaging studies may also be performed at these centres, and this will require a suitable laboratory and an automatic gamma counter, or access to these facilities at a neighbouring centre. Whilst single camera departments may have an embedded nuclear medicine physics service, often physics support is supplied by larger departments on contract. Where medical physics support is outsourced, it is expected that the MPE would attend onsite regularly. Where there is comprehensive non-MPE physics support provided, then onsite MPE support may be provided every 3–6 months. In all cases, the MPE is required to provide remote MPE support at all times while a clinical service is in operation.

In addition to imaging, these departments may also provide a therapy service, such as a routine outpatient radionuclide therapy (*e.g.* iodine-131 for thyrotoxicosis), routine inpatient radionuclide therapy (*e.g.* iodine-131 for thyroid cancer) or potentially more complex radionuclide therapies (*e.g.* iodine-131-mIBG, lutetium-177-DOTATATE, radium-223, yttrium-90 labelled microspheres) which may involve patient dosimetry.

A single gamma camera department performing only diagnostic procedures (imaging and non-imaging) would require at least 0.5 to 1.0 WTE available MPEs. If therapies are performed, then an additional 0.5 to 1.0 WTE available MPE for routine outpatient therapies and an additional 1.0 to 2.0 WTE available on-site MPEs for non-routine or complex therapies requiring dosimetry.

Departments with two or more gamma cameras (no PET/CT)

Services with two or more gamma cameras (planar/SPECT gamma cameras and/or SPECT/CT systems) will usually perform a wide range of diagnostic procedures, often using a range of radiopharmaceuticals. There are currently 70 such services in the UK. Some departments may have their own radiopharmacy, and these may manufacture and supply radiopharmaceuticals to other centres. Non-imaging studies may be performed at these centres, and this will require a suitable laboratory and an automatic gamma counter, or access to these facilities at a neighbouring centre. Having two gamma cameras onsite is the point at which an embedded medical physics or nuclear medicine physics service is recommended. As such, they may also provide a contracted medical physics support to other nuclear medicine services.

In addition to imaging, these departments may also provide a therapy service, such as a simple outpatient radionuclide therapy (*e.g.* iodine-131 for thyrotoxicosis), simple inpatient radionuclide therapy (*e.g.* iodine-131 for thyroid cancer) or more complex radionuclide therapies (*e.g.* iodine-131-mIBG, lutetium-177, radium-223, yttrium-90 agents, monoclonal antibodies, novel bone pain palliation agents and labelled microspheres) which may involve patient dosimetry.

Departments performing diagnostic procedures only (imaging and non-imaging) require at least 1.0 to 2.0 WTE available MPEs. Increased MPE support would be required if more complex diagnostic procedures are performed. Some element of provision may also be provided by MPE staff in radiation protection / diagnostic radiology for more complex CT examinations using the hybrid imaging equipment.

A further 0.5 to 3.0 WTE available MPEs are required if therapies are performed on-site, 0.5 to 1.0 WTE available MPE for routine outpatient therapies and a further 1.0 to 2.0 WTE available MPEs for non-routine or complex therapies requiring personalised dosimetry. If staff work at multiple locations or provide a service elsewhere, additional MPE support should be included.

Departments with nuclear medicine and fixed PET/CT

Services with nuclear medicine departments with one or more gamma cameras which also have fixed, onsite PET/CT services will generally perform the widest range of diagnostic procedures. There are over 30 such centres in the UK and many have their own radiopharmacy providing a full range of radiopharmaceuticals. These larger sites may also manufacture and supply radiopharmaceuticals to other centres. Some sites have their own cyclotron for the production of FDG and, potentially, non-FDG tracers and may also supply these to other local centres. Other sites may rely upon commercial FDG supply to provide their radiopharmaceuticals. Many of these departments will also provide non-imaging services requiring a suitable laboratory and an automatic gamma counter. Departments of this size will generally have an embedded medical physics or nuclear medicine physics service. As such, they may also provide a contracted medical physics service to other departments.

Many of these centres will also provide a therapy service, such as an established outpatient radionuclide therapy (*e.g.* iodine-131 for thyrotoxicosis), established in-patient radionuclide therapy (*e.g.* iodine-131 for thyroid cancer) or more complex radionuclide therapies (*e.g.* iodine-131-mIBG, lutetium-177, radium-223, yttrium-90 agents, monoclonal antibodies, novel bone pain palliation agents and labelled microspheres) which may involve patient dosimetry. Some departments may also provide regional therapy services or operate as tertiary centres.

The PET/CT service will require different levels of support depending upon the complexity of the services being provided. An FDG only service will require the lowest MPE support but departments offering more complex services will require greater levels of support.

Departments of this type generally require at least 2.5 to 6.0 WTE available MPEs. This would include 1.0 to 3.0 WTE for diagnostic services depending on the number of scanners and complexity of services. A further 0.5 to 3.0 WTE available MPEs are required if therapies are performed onsite, *i.e.* 0.5 to 1.0 WTE available MPE for routine outpatient therapies and a further 1.0 to 2.0 WTE available MPEs for non-routine or complex therapies requiring dosimetry. Some element of provision may also be provided by MPE staff in radiation protection/diagnostic radiology for more complex CT examinations using the hybrid imaging equipment. If staff work at multiple locations or provide a service elsewhere additional MPE support should be included.

Departments with fixed PET/CT or PET/MRI scanners (no nuclear medicine)

Services which have fixed (*i.e.* not mobile), onsite PET/CT or PET/MRI services provide diagnostic or research PET investigations and no nuclear medicine imaging or therapies. There are nearly 40 of these centres in the UK. The majority of these centres will be running FDG services and will either be associated with a larger nuclear medicine department with staff embedded within a medical physics or nuclear medicine physics service or a private provider supplying fixed PET services. This could be an employer with more than one hospital where nuclear medicine is provided at one site and PET at another or a private fixed site providing support to a number of mobile scanners. A smaller number of standalone fixed PET/CT or PET/MRI facilities will fall into another category such as a private hospital providing a routine diagnostic service, a university research facility or PET within the pharmaceutical industry. The majority of these centres will purchase FDG from commercial suppliers, but some centres may have their own cyclotron facilities for radiopharmaceutical production, particularly in the research or pharmaceutical setting.

The PET/CT or PET/MRI facilities will require different levels of physics support depending on the service provided. An FDG only service will require the lowest MPE support but departments offering more complex services will require greater levels of support. In a university or pharmaceutical research facility, a higher level of MPE support is required as the imaging protocols used are likely to be more complex and involve additional equipment and techniques, *e.g.* dynamic scans and blood sampling.

The requirement for MPE support for these different scenarios will vary. For an FDG only service, 0.5 to 1.0 WTE MPEs would generally be required to support the service. A site providing additional services beyond FDG may need 1.0 to 2.0 WTE MPEs. A more complex service within a research facility performing more novel PET/CT techniques would generally require at least 2.0 WTE MPEs. Some element of provision may also be provided by MPE staff from radiation protection/diagnostic radiology for more complex CT examinations using the hybrid imaging equipment.

Mobile PET/CT services

There are over 20 services using mobile PET/CT units in the UK. These services are provided for a range of reasons including:

- the local demand for a clinical PET/CT service cannot justify the financial investment for a fixed onsite facility, *e.g.* the demand can be met using a mobile service on-site 2 days per week
- a service demand is being generated as a pre-cursor to developing a business case for a first (or second) fixed onsite PET/CT scanner
- an existing fixed PET/CT scanner is being replaced and a mobile is bought onsite to provide cover during the downtime period

Mobile PET/CT units can work in collaboration with existing onsite services, or as standalone units. The investigations undertaken on these systems will predominantly only use FDG. MPE support to these mobile units is generally supplied by the provider of the mobile PET/CT unit. It is imperative that all responsibilities of the provider and host are clearly defined in advance of the service commencing.

A minimum of 0.2 WTE available MPE support is required for a single mobile PET/CT unit. If the mobile unit is onsite for part of the week, a pro-rata level of support may be provided. The expectation is that the MPE support will be delivered with a combination of on-unit and remote support. A suggested split is 0.05 WTE on-unit and 0.15 WTE remote, but this will vary depending on the mobile unit, hosting employer and complexity of the investigations undertaken.

Therapy only services

A small number of sites provide radionuclide therapy only with no imaging on-site. This may be straightforward therapies on an outpatient basis and/or therapies which may require greater hospital care. By definition, therapy only services can only be those where there is not the specific requirement for post-therapy nuclear medicine imaging to confirm therapy delivery or to more precisely estimate delivered activities for estimation of therapeutic doses (*e.g.* iodine-131 for thyrotoxicosis). Sites may also provide non-imaging services and/or other radiotherapy (brachytherapy and/or external beam).

A minimum of 0.5 WTE MPE should be provided for straightforward therapies with commensurately more for more complex therapies. For the former, it may be appropriate for support to be provided offsite. For the latter especially, support should be provided onsite.

MPE support when changing services

Consideration should be given to the MPE support required when changing services. This support is likely to be for a defined period of time and will lessen once the new services are established. Supporting new and changing services are integral to the role of the physicist and should be considered in any staffing model. Some examples of service change are listed in Table 1.

When looking at overall MPE support for a service, additional support should be factored in for these situations. In some circumstances, the additional MPE support will be included in the funding for the new service but in a lot of situations, this may not be the case and existing staff will be required to provide that

Table 1. Examples of service changes and examples of where MPE support is required for these

Service change example	MPE support required
Implementing a new protocol for an existing technique	Optimisation and update of imaging protocols as new guidance is published
New procedure/Carrying out a procedure that is performed very infrequently	The procedure could be classed as non-established and will need additional MPE support to re-establish including review of protocol and facilities
Establishing a new therapy service	More complex therapies, *e.g.* lutetium-177, require more physics support particularly in the initial stages. MPE will establish radiation risk assessments, procedures and protocols, consider dosimetry requirements, calibrate equipment, etc
Relocating a nuclear medicine department to another site	Substantial amount of MPE support is required to bring new or transferred equipment into clinical use and establish procedures.
Introduction of new technology	An example of this would be the introduction of new hardware and imaging technologies, such as upgrading to solid state or SPECT-CT systems, or new software processing techniques to be implemented. MPE will be involved in optimisation, training and development of procedures.

support. If a department has limited MPE support for established services, they will have difficulty supporting a new or changing service and the existing ones concurrently. The additional MPE support required for new and changing services should be included in the overall MPE requirement for the department, *e.g.* if the department requires 3.0 WTE MPEs to support its established services an additional MPE should be factored in for these situations, therefore the department would require 4.0 WTE MPEs to adequately support established services and any changes that may occur.

SUMMARY

The guidance provided in this document is intended to provide support for nuclear medicine staff contributing to workforce planning as part of a collaborative approach between Heads of Service, clinicians and MPEs with appropriate input from all stakeholders. Table 2 details the recommended levels of dedicated MPE support for different service types that are generally encountered. Consideration should be given to services operating across multiple sites and whether they should be classed as one or more different services. When using these values for staffing purposes, they should be taken in addition to a time component for other non-MPE aspects of an individuals' role such as management responsibilities or duties as an RPA or RWA. Refer to the text for more detail on the WTE MPE support for each service type.

The recommendations in each column of Table 2 should be summed as appropriate to produce the total for each service. For example, if a service has three gamma cameras and provides both routine and complex therapies, the recommended MPE requirement is 2.5–5.0 WTE. If your department is split across multiple sites, consideration should be given to calculating a total for each physical site. Departments providing third-party MPE support to other NM centres should ensure they have sufficient MPE WTE to support their own NM department in addition to those required to support the NM centres covered under a service contract.

Table 2. Recommended levels of MPE support for different service types

	Recommended WTE MPE support		
Service type	Diagnostic imaging and non-imaging	Routine therapy	Complex therapy
Departments with no imaging equipment	0.2–1.0	n/a	n/a
Departments with a single gamma camera	0.5–1.0	0.5–1.0	1.0–2.0
Departments with two or more gamma cameras (no PET/CT)	1.0–2.0	0.5–1.0	1.0–2.0
Departments with nuclear medicine and fixed PET/CT	1.0–3.0	0.5–1.0	1.0–2.0
Departments with fixed PET/CT or PET/MRI scanners (no nuclear medicine)	0.5–2.0	n/a	n/a
Mobile PET/CT services	0.2	n/a	n/a
Therapy only services	n/a	0.5–1.0	1.0–2.0

PET, positron emission tomography.

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