Australasian Health Facility Guidelines

Part B - Health Facility Briefing and Planning

0500 – Nuclear Medicine / PET Unit

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Australasian Health Facility Guidelines

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01 INTRODUCTION

1.1 PREAMBLE

This Health Planning Unit (HPU) has been developed by the Australasian Health Infrastructure Alliance (AHIA). This revision has been informed by an extensive consultation process that was completed in 2021.

The document is intended to be used by design teams, project managers and end users to facilitate the process of planning and design.

1.2 INTRODUCTION

This HPU describes the specific requirements to plan and design a Nuclear Medicine Unit, including PET which will be required in selected healthcare facilities.

Nuclear medicine may also be referred to as 'molecular imaging' however for the purposes of this HPU, the term nuclear medicine will be used.

This HPU should be read in conjunction with the Australasian Health Facility Guideline (AusHFG) generic requirements and Standard Components described in:

- Part A: Introduction and Instructions for Use;
- Part B: Section 80: General Requirements;
- Part B: Section 90: Standard Components, Room Data and Room Layout Sheets;
- Part C: Design for Access, Mobility, Safety and Security; and
- Part D: Infection Prevention and Control.

It is recommended that where nuclear medicine modalities incorporate magnetic resonance imaging (MRI) and computed tomography (CT), information contained in HPU 440 Medical Imaging Unit should be reviewed.

1.3 POLICY FRAMEWORK

Codes of practice and guidelines relating to radiation and protection are available from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) website:

https://www.arpansa.gov.au/regulation-and-licensing/regulatory-publications/radiation-protection-series

In particular, project staff should familiarise themselves with:

- Radiation Protection Series (RPS) C-1 Code for Radiation Protection in Planned Exposure Situations (ARPANSA 2020);
- RPS C-2 Code for the Safe Transport of Radioactive Material (ARPANSA 2019);
- RPS C-5 Code for Radiation Protection in Medical Exposure (ARPANSA 2019);
- RPS C-6 Code for Disposal of Radioactive Waste by the User (ARPANSA 2018);
- RPS No. 4 Recommendations for the Discharge of Patients Undergoing Treatment with Radioactive Substances (ARPANSA 2002):
- RPS No. 11 Security of Radioactive Sources (ARPANSA 2019):
- RPS No. 14.2 Safety Guide for Radiation Protection in Nuclear Medicine (ARPANSA 2008);
- RPS No. 16 Safety Guide for the Predisposal Management of Radioactive Waste (ARPANSA 2008).

The Australian and New Zealand Society of Nuclear Medicine publish a range of technical standards such as the Requirements for PET Accreditation (3rd Edition, 2017).

For safety requirements within laboratories and precautions needed to prevent the exposure of workers and members of the public to excessive levels of radiation where sources of ionising radiation are used, refer to AS/NZS 2243.4: 2018 Safety in Laboratories, Part 4: Ionizing Radiations.

Project teams should also refer to jurisdictional legislation, regulations and licensing requirements for radiation sources.

Project teams should also refer to the National Safety and Quality Health Service (NSQHS) – Partnering with Consumers Standard.

A range of additional standards and guidelines relating to Nuclear Medicine are listed in the Further Reading section of the Appendices.

1.4 DESCRIPTION

1.4.1 Description of Nuclear Medicine

Nuclear medicine and PET are medical specialties which employ unsealed radioactive sources (radiopharmaceuticals or tracers) for diagnosis and therapeutic procedures.

Nuclear medicine studies primarily show the physiological function of the system or organ being investigated using radioactive substances.

Increasingly, nuclear medicine images are being superimposed on appropriately registered images from modalities such as CT or MRI. This is known as image co-registration or hybrid imaging and is performed to provide anatomical context to improve diagnostic accuracy.

Nuclear medicine imaging works by administering a radioactive substance or 'tracer' or 'biomarker' to the patient that releases energetic photons or beta particles. In a normal functioning organ, the radiopharmaceutical will have characteristic patterns of uptake, clearance or distribution. Organs not functioning normally may have variations on these characteristic patterns of uptake and therefore indicate potential disease. Using computer processing, image analysis and functional assessments of organs and tissues are then produced to assess and diagnose quantitatively.

Nuclear medicine services are usually provided in a dedicated unit or suite of rooms within a healthcare facility. Key elements of the unit include:

- scanning equipment, which may comprise:
    - gamma cameras, single and multi-head types, noting almost all gamma cameras are now single photon emission computed tomography (SPECT) capable;
    - SPECT / CT;
    - PET / CT;
    - PET / MRI (specialised services only);
    - total body / large field of view PET (specialised services only); and
    - bone densitometry and occasionally, ultrasound;
- day therapy procedural area;
- laboratory areas for the receipt, storage, preparation, manufacture and dispensing of radiopharmaceuticals depending on the service scope. This may include hot labs, radiopharmaceutical labs and in specialised facilities, a cyclotron; and
- a range of clinical and non-clinical support areas.

Access to the Unit should be well controlled and all patient areas must be designed to support optimal patient flow with separation of dosed (‘hot’) and undosed (‘cold’) patients.

A description of contemporary Nuclear Medicine and PET imaging technologies is provided below. Further detail regarding therapeutic procedures and laboratory areas is provided in Section 2.1

1.4.2 Single Photon Emission Computed Tomography (SPECT)

SPECT is a nuclear medicine tomographic imaging technique using gamma photons. It is similar to conventional nuclear medicine planar imaging using a gamma camera but provides 3D (tomographic) information.

To acquire SPECT images, the gamma camera is rotated around the patient. In most cases, a rotational motion is used to obtain an optimal reconstruction. The time taken to obtain each projection is also variable with a total scan time of 15 to 20 minutes.

A SPECT camera may be combined with a CT unit to form a hybrid system and co-registration imaging of the physiology and anatomy of the area/s being scanned. SPECT / CT requires a separate control room and radiation shielding in accordance with CT requirements.

1.4.3 Positron Emission Tomography (PET)

'Positron Emission Tomography (PET) is a nuclear medicine technology that uses relatively short-lived positron emitting radionuclides for the imaging of metabolic functions within the body. While CT and MRI provide information about anatomical structure, PET can image and quantify metabolic, biochemical and/or physiological function. This is important because various molecular functional changes caused by disease are often detectable before any structural abnormalities become evident' (Australian Government Department of Health 2021, Nuclear Medicine and PET: https://www1.health.gov.au/internet/main/publishing.nsf/Content/pet-nuclear-medicine-imaging).

All modern PET cameras now incorporate a CT scanner as an integral component of the equipment **(PET / CT)**. Whereas PET detects molecular information and changes, CT detects anatomical changes, offers superior attenuation correction and the images can be co-registered.

To optimise the utilisation of PET / CT machines, they are also being increasingly used as a full diagnostic CT with or without contrast. In some services, particularly rural facilities, they are also used for radiation therapy simulation to improve access for patients to a full suite of cancer services. This will require additional design considerations including laser positioning lights. Staff and licence requirements associated with these additional functions are governed by jurisdictional regulations and licence conditions.

PET / MR is typically only provided in specialised facilities such as Children's Hospitals and specialised research-oriented units due to the significant capital cost, as well as costs associated with staff credentialing and training. The provision of PET / MR will ideally include close proximity to a radiopharmaceutical laboratory, particularly given the significant level of research commonly associated with these machines.

Total body / large field of view PET scans are typically performed as a series of image sets acquired at discrete positions to cover most or all of the body in one take. This new technology is anticipated to grow significantly over the next 10 years. There are a number of specific planning and design requirements related to these scanners including special considerations for uptake rooms and support spaces due to the very high throughput; different shielding requirements compared to conventional PET rooms; and the need to support associated research activities.

02 PLANNING

2.1 OPERATIONAL MODELS

2.1.1 Scope of Services

The number and type of scanning equipment to be provided will be informed by clinical services planning.

In large centres, the Nuclear Medicine Unit will be a discrete unit. In small departments, the service may be a discrete area within a Medical Imaging Unit.

Where PET services are provided, they will routinely be collocated with other nuclear medicine services where possible. PET services are occasionally located separately to nuclear medicine services, for example where it is provided as part of an integrated cancer service and/or where nuclear medicine services are delivered separately by an external provider.

In addition to confirming the range of nuclear medicine scanning equipment required, the following planning parameters should also be defined early in the planning process:

- the range of nuclear medicine therapeutic procedures to be provided including the projected number of inpatient and day only spaces required;
- access to radiopharmaceuticals including the level of production to be undertaken 'in-house' (refer to Section 2.1.5 for further information);
- other specialised service requirements. This may include gamma counters that measure radioactivity in blood samples and may be provided in a low radiation area of the nuclear medicine unit. These are typically only provided in large teaching hospitals and will have specific design implications given their significant size and weight.

2.1.2 Patient Casemix

The majority of patients having PET studies are managed as outpatients while the patient caseload for nuclear medicine studies is split between inpatients and outpatients. The anticipated volume of presentations will require confirmation to inform patient support areas including outpatient waiting areas and inpatient holding bays.

The patient casemix is changing with an increasing proportion of patients who are elderly, more unwell, and with multiple comorbidities. This has translated to a high volume of patients being transferred to the unit on a bed or trolley, requiring higher levels of care, and patients from ICU.

The local cultural context must be considered during the planning and design process. The cultural safety of patients and staff can assist in mitigating patient apprehension and promotes staff wellbeing. For further information refer to the AusHFG resource 'Culturally Sensitive Planning & Design Guideline'.

2.1.3 Scanning Process

Nuclear Medicine

Radioactive tracers may be administered by injection, orally or by inhalation (e.g. Technegas). Patients will then wait in a separate waiting area for dosed 'hot' patients. Inpatients and other patients accommodated on beds / trolleys will wait in a 'holding' area. Patients may be scanned during, immediately after, a few hours later, or even several days after administration of the tracer depending on the organs to be studied and the time required for full uptake.

Dosed patients should have access to drinking water and dedicated 'hot' toilets without having to travel through general waiting areas.

Scanning times vary and may range from as little as 10 minutes for oesophageal transit studies to two hours for whole body scan studies.

Patients may be scanned on the imaging table or on their own hospital bed / trolley. Scanning rooms should be able to accommodate transfer of patient from bed to table and space to 'park' the bed.

Once the scan is complete, patients remain in the waiting room, or holding area in the case of inpatients, until the scans have been reviewed by medical staff to avoid unnecessary return for rescan.

Refer to Radiation Protection Series 4 Recommendations for the Discharge of Patients Undergoing Treatment with Radioactive Substances (ARPANSA 2002) for additional information.

PET / CT

Patients presenting for PET / CT require isolation in a shielded 'uptake' room following injection, typically for 60 minutes (uptake phase). Contemporary practice is for patients to be injected via automated PET infusion systems to reduce radiation exposure to staff, improve accuracy of dose administration and support efficient workflows. Infusion systems may be delivered via a port in the wall of the uptake room or within the room. Where it is provided via a port, it is recommended that an alcove is provided to accommodate the infusion system and enable ready access to the patient. The alcove may be shared between two uptake rooms.

Patients will have access to a dedicated 'hot' toilet to ensure separation from undosed patients.

Following the PET / CT scan, patients will be managed in a discharge lounge.

Patient Throughput

It is possible to scan up to 20 PET / CT patients per scanner per day, however this requires an appropriate level of staffing and uptake rooms. Many services currently provide around 15 scans per PET / CT per day, however this number will vary according to local protocols, the number of uptake rooms available and staffing.

Patient throughput for nuclear medicine scanners is variable. Requirements will depend on the types of scans provided such as bone, cardiac, lung and/or renal scans, and the projected workflows. For example, some facilities may have a dedicated camera for cardiac scans if there is a sufficient volume of projected activity. Future throughput growth should be considered in the planning of the unit which can impact shielding and infrastructure designs.

2.1.4 Therapeutic Procedures

Therapeutic procedures are a significant growth area for nuclear medicine. The use of radioactive iodine-131 is well known for treating an overactive thyroid (hyperthyroidism) or thyroid tumours, however there are a range of radionuclides that are used as unsealed sources in targeted cancer therapy and other therapeutic applications.

In therapeutic nuclear medicine, the radionuclides used differ from those in diagnostic nuclear medicine in that they are usually beta or alpha emitters with longer physical and biological half-lives. These services are predominantly delivered as day only services, however some services require inpatient admission. This distinction relates to the characteristics of the therapy radionuclide utilised, and the radiation hazard they pose to the public when discharged.

A dedicated space is required to accommodate patients undergoing therapeutic procedures, as well as facilities to ensure the safe preparation and administration of the radiopharmaceutical.

Patients requiring inpatient admission, e.g. for iodine-131, will be managed in a radiation shielded room on an inpatient unit. Specific planning and design considerations are outlined in Section 5.3 including consideration of cleaning and waste requirements. This service is typically only provided in tertiary facilities.

Patients attending for day procedures are ideally managed in a dedicated area within or collocated with the nuclear medicine department. This commonly requires the patient to receive an intravenous infusion and monitoring over a four to six hour period and will require appropriately shielded patient bays or room/s with access to dedicated bathroom facilities. Many services choose to deliver this service to multiple patients at a time to improve workflows associated with receiving and compounding the radionuclide.

The number of patient spaces required to accommodate day procedures in the Unit will depend on the types and volume of treatments provided. This may also require consideration of clinical trials.

Increasingly, services will combine both nuclear medicine and medical imaging modalities. An example is microsphere administration used to treat non-resectable liver tumours. Patients are transferred between the angiography suite and Nuclear Medicine Unit during the procedure. This type of procedure also requires the transfer of radioactive materials and the resultant waste between the hot lab and angiography suite.

2.1.5 Production of Radiopharmaceuticals

A radiopharmaceutical consists of a radionuclide attached to a pharmaceutical. After entering the body, the radio-labelled pharmaceutical will accumulate in a specific organ or tumour tissue. The radionuclide attached to the targeting pharmaceutical will undergo decay and emit radiation that may be used for diagnosis or therapy.

Radionuclides may be produced by irradiating a specific target inside a nuclear research reactor or in particle accelerators, such as cyclotrons. Some specialised hospitals will have their own cyclotron, which are generally used to manufacture radiopharmaceuticals with short half-lives.

Radiopharmaceuticals may be made available by direct purchase of a unit dose from a commercial provider and/or through ‘in house’ production.

Bulk sources of a radionuclide, in the form of a radioactive generator, may be delivered to nuclear medicine departments to allow the department to access radionuclides for their clinical use on a daily basis. These generators are manufactured by external suppliers.

The facilities and procedures for the production, use and storage of radiopharmaceuticals requires compliance with regulations governing pharmaceutical preparations and with those governing radioactive materials. Project teams will need to confirm the scope of facilities required to support the production of radiopharmaceuticals for the Unit early in the planning process.

Nuclear Medicine Hot Lab

A hot lab is a dispensing laboratory accommodating activities that include:

- receipt and documentation of any radionuclides or radiopharmaceuticals;
- secure storage of sealed sources;
- reconstitution of cold kits with radionuclides, and the subsequent quality control testing;
- dispensing of radiopharmaceuticals for imaging or therapy; and
- temporary storage of small volumes of radioactive waste until it is safe for disposal.

All nuclear medicine services will require a hot lab.

Preparations within hot labs are largely confined to the reconstitution of ‘cold’ or non-radioactive kits with a radioactive solution to create the radiopharmaceutical. The lab may also need to accommodate a radionuclide generator.

The dispensing of therapeutic doses may be within this area but would require a separate zone. The preparation of radiolabelled blood products may also be within this area, but would also require a separate zone, and some specialised equipment such as a biological safety cabinet, or a Class A environment (depending on the types of preparations). This area should be adjacent to the nuclear medicine imaging area.

Depending on the scope of the work performed within the lab, various environmental controls may be required. For example, HEPA filtered air into the lab and fume hoods with external venting including charcoal trapping to prevent release of radioactive vapours into the external environment.

PET Hot Lab

Where PET services are collocated, a separate hot lab may be required, or a dedicated section of the main hot lab assigned as different shielding will be required. The PET hot lab will accommodate the receipt and dispensing of PET radiopharmaceuticals, as well as the transfer to automated infusion system equipment, the preparations of PET Quality Control (QC) and calibration phantoms, and the general management of patient doses for PET imaging. This area must be adjacent to the PET imaging area and uptake rooms.

Preparations for PET QC will be in a separate room to dose preparation and more likely associated with a radiopharmaceutical laboratory service.

Automated PET infusion systems are ideally accommodated within the PET hot lab or a dedicated alcove off the corridor adjacent to the PET / CT room.

Radiopharmaceutical Laboratory

Specialised units may manufacture radiopharmaceuticals ‘in house’ within a radiopharmaceutical laboratory. These can vary in size and complexity depending on the operations that are currently performed or expect to be performed.

All Nuclear Medicine Units will require a hot lab, whether for the preparation and dispensing of patient doses from multi-dose vials, or just the receipt of unit doses from a commercial supplier. However, only designated units will have a radiopharmaceutical laboratory.

The key drivers for provision of a radiopharmaceutical laboratory include services that:

- are required to generate most of their radiopharmaceuticals in-house;
- supply radiopharmaceuticals to other facilities;
- are research focussed; and/or
- provide theranostics, a treatment using PET scan imaging to determine if specific tumour receptors are present and if so, personalised radiation treatment is provided to selectively target the tumour cells. Theranostics involves large doses and bespoke radionuclides.

A radiopharmaceutical science laboratory may be adjacent to a cyclotron, where provided, and be used in the preparation of multiple radiopharmaceuticals from the output of the cyclotron, or from the use of a PET radionuclide generator.

Cyclotron

A cyclotron is a device used to produce beams of charged particles that can be directed at a specific target, resulting in the production of different types of radionuclides. For example, the cyclotron produces the radionuclide fluorine-18 (F-18) which is used to synthesise the radiopharmaceutical 18-fluorodeoxyglucose (18-FDG), which is used primarily for cancer diagnosis.

Increasingly, in-house production of PET tracers is being undertaken, even in sites without a cyclotron as PET radionuclide generators are now commercially available (e.g. Ga-68 generators). This synthesis occurs in a ‘hot cell’ located within a radiopharmaceutical laboratory. A hot cell is a heavily shielded enclosed workbench, with local QC of the synthesised products. These radionuclides undergo ongoing decay during the working day and therefore careful planning of patient scheduling and deliveries is essential.

This HPU does not address the detailed planning and design requirements for a cyclotron and associated radiopharmaceutical laboratory however some information is contained in the Non-Standard Components and Schedule of Accommodation sections of this document.

2.1.6 Patient Experience

The design of the unit should not only ease patient and carer anxiety, but also provide staff with a work environment conducive to delivering optimal patient care. As far as is practicable, a non-clinical, restful environment should be encouraged through comfortable furniture, artwork, ambient music etc.

Planning and design processes must include consideration of the local cultural context through engagement with local cultural groups. The facility should celebrate the local cultural heritage of the area and provide a culturally safe and welcoming environment that meets the needs of all people.

Arts integration can support a range of wellbeing initiatives for staff and patient to mitigate anxiety and acute stress for improved clinical outcomes.

Options may include:

- virtual skylights and windows;
- scanner skins;
- wall and floor wraps;
- ambient and mood lighting;
- VR and AR technology;
- music; and
- projections.

The AusHFG Arts in Health Framework documents pathways for the early integration of arts in health infrastructure projects.

2.2 OPERATIONAL POLICIES

2.2.1 General

The following issues should be considered in the development of the operational model for the Unit, as they will all impact the configuration of the Unit and overall space requirements.

Operational policies should be developed as part of the project planning process. Refer to Part B Section 80 General Requirements for further information.

2.2.2 Hours of Operation

The Nuclear Medicine Unit will usually operate during business hours with a possible requirement for emergency after-hours access, particularly in tertiary centres. After-hours access would only be from inpatient areas or the emergency department for cases such as emergency ventilation / perfusion (V/Q) scans, renal and transplant scans.

Delivery of radioactive supplies may occur out-of-hours and arrangements will need to be considered when planning a Unit.

2.2.3 Bookings

Appointments are made via a central booking system to coordinate supply of radiation substances. Due to the nature of some of the advice and instructions given to patients when booking the scanning procedure, access to an interview room or privacy booth will be required at reception for this purpose.

2.2.4 Sedation

General anaesthesia (GA) or deep sedation is rarely needed except in units with a large paediatric component and occasionally for special needs adults. At least one SPECT / CT and PET / CT scanning room should be GA capable. Sedation will be administered in the scanning room .

Sedated patients will usually proceed to a general recovery area after the examination is completed or may recover in the Unit (in the scanning or uptake room).

All SPECT / CT and PET / CT scanning rooms should be configured to accommodate a ventilated ICU patient.

Art, design and music can mitigate the requirement for anaesthesia and sedation for susceptible patients undergoing these procedures. Consideration should be given to integrated, evidence-based solutions. Refer to the AusHFG Arts in Health Framework for further information.

2.2.5 Paediatric Studies

Sedation, administered by a visiting anaesthetic team, may be needed for small children to undertake specific studies that take 30 to 45 minutes to complete or for which body motion may severely degrade the images. The sedation is usually oral or intravenous, depending on the child's weight.

Sometimes a full general anaesthetic is needed, particularly for PET. Unless pregnant, a parent may stay with the child during the procedure.

2.2.6 Film / Records Storage

Ideally, an electronic record system will be in place. Some units may require access to a colour printer, however the requirement for hard copy images is becoming less common.

Access to a Picture Archiving and Communication Systems (PACS) is assumed for image management and data storage.

2.2.7 Management of Medical Emergencies

A resuscitation trolley should be located in or very near the stress testing room as this is the most likely place for cardiac arrest. PET / CT services undertaking contrast CT exams may also present a higher risk as anaphylactic reactions may occur.

Access to specific equipment will be required in Units treating children. Requirements will be guided by local jurisdictional policies.

2.2.8 Management of Radioactive Contamination

Spills should be managed in accordance with Radiation Protection Series Publication No. 14.2 Radiation Protection in Nuclear Medicine, Section 10.3 Management of Radioactive Contamination, 2008 and radiation management plans.

All surfaces including floors, bench tops, walls and junctions should be impermeable and easy to clean. Floor vinyl will be coved.

An emergency eye wash should be provided in all hot labs. Where a radiopharmaceutical laboratory cleanroom is provided the eye wash will need to be located outside the cleanroom.

An additional eye wash / basin station and emergency shower will be required for staff and patients, located in close proximity to all areas of potential exposure.

A decontamination kit should be stored in the hot lab or radiopharmaceutical laboratory for quick access to contain and clean up radioactive spills.

Refer to Australian Standards AS/NZS 2243 Safety in Laboratories Set.

2.2.9 Patient Refreshments

Patients visiting the Unit should have access to drinking water.

A small beverage bay will be required as many patients undergoing scanning procedures may be fasting pre-scan or may require a cup of coffee or tea to relieve headaches and nausea.

Local policies relating to the provision of light meals or other special requirements should be considered to inform the specific beverage bay requirements.

2.2.10 Patient Waiting

For patients undergoing nuclear medicine studies, waiting areas should allow separation of dosed ('hot') and undosed ('cold') patients. It is preferable to separate dosed patients from people who accompanied them to the Unit which may include young adults, pregnant women and children.

Dosed patients should have access to drinking water and dedicated 'hot' toilet facilities without having to travel through general waiting areas. Patients will commonly leave the Unit after being dosed given the length of waiting time required and will require education regarding the radiation safety requirements for themselves and others.

Inpatients will usually be held in a holding area.

Patients undergoing PET / CT scan are typically directed to an interview room for initial education and are then injected in a shielded 'uptake' room where they will typically wait for 60 minutes prior to the scan (uptake phase). Access to dedicated 'hot' toilet/s is required.

2.2.11 Personal Protective Equipment

Personal protective equipment (PPE) will be used in areas of the Unit where there is a likelihood of contamination. The equipment should be monitored and removed before leaving designated areas. PPE may include:

- laboratory coats or protective gowns;
- waterproof gloves; and
- face masks.

Lead aprons are rarely used in these units.

Refer to Radiation Protection Series Publication No. 14.2 Radiation Protection in Nuclear Medicine, Section 9.6 Equipment and Clothing, 2008.

2.2.12 Radionuclide Supply and Administration

Half-life is the time required for the radioactivity of the radionuclide to diminish by 50% of its original activity due to radioactive decay. This is different to biological half-life which is the time required to eliminate 50% of the original activity of the radiopharmaceutical from the body. This is important with regard to timing of scans once the radionuclide has been administered to the patient, separation of patients who have been injected but are awaiting scans and also for frequency of delivery of radionuclide from external suppliers.

The most commonly used radionuclide in nuclear medicine is Technetium-99m (Tc-99m) which is delivered from a Mo-99 / Tc-99m generator and eluted as required and added to a 'cold' kit to create the appropriate radiopharmaceutical with a half-life of six hours.

Gallium 68 (Ga-68) generators are commonly used for PET. Synthesis units may also be provided for PET, as well as for research purposes.

The types and number of generators required (and synthesis units where provided) will need to be determined to inform spatial, design and shielding requirements. The generators are placed in customised lead caves on a reinforced bench. They may be returned to the supplier on expiry or may be stored on-site for longer periods.

Technetium generators may only be delivered weekly, depending on requirements. There may be no guarantee delivery will occur during business hours so arrangements will have to be made for couriers to have access to a secure area in the Nuclear Medicine Unit. This can be directly into a small storage area opening off the main corridor or into a nominated area such as the hot lab, with appropriate security controls in place.

All deliveries will be made directly to hot labs within the Unit, usually via the loading dock.

Refer to Radiation Protection Series Publication No 14.2 Safety Guide for Radiation Protection in Nuclear Medicine, Section 10.4 Storage and Safe Handling of Sealed Radiation Sources (ARPANSA 2008b).

2.2.13 Radioactive Waste Management

Radioactive waste is waste contaminated with radioactive substances and may be liquid, solid or airborne (e.g. gases and vapours).

For further information Radiation Protection Series Publication, No 14.2 Safety Guide for Radiation Protection in Nuclear Medicine, Section 10.4 Environmental Issues, 2008.

Radioactive Waste Disposal - Liquid

The trade waste plumbing and drainage system must be designed to meet the requirements of the relevant sewerage authority and health department.

A delay holding tank within the Unit for effluent from patient toilets, pan sanitisers and laboratory sinks is rarely required.

For further information regarding toilets associated with treatment of inpatients undergoing radioactive iodine treatments, refer to the Appendix.

Radioactive Waste Disposal - Solid

Solid radioactive waste includes all items / materials used in treatment and manufacture (e.g. laboratory glassware, pipette tips, plastic vials and trays, paper tissues, used syringes, tools etc). Such items are to be bagged, labelled and segregated, and retained in a dedicated secure waste holding area until they are confirmed safe for routine disposal as clinical waste, usually after 10 half-lives.

It is essential that items contaminated with iodine are stored in a shielded area for three months (approximately 10 half-lives) to allow for full decay and may then be disposed of in the usual manner (e.g. linen, sharps, and clinical waste).

The nuclear medicine radioactive waste store is ideally located on the perimeter of the Unit with carefully controlled, dual access. The room should be shielded.

Radioactive Waste Disposal - Sharps

To reduce the risk of needle stick injury and radiation exposure of staff, needles and cannulae used for dispensing and dose administration should be disposed of into shielded sharps containers at the point of use. When the containers are full, they should be held in the radiation waste storage area until designated safe for routine disposal.

2.2.14 Storage

Requirements may include:

- storage in the scanning rooms to reduce issues associated with movement of heavy or bulky articles such as collimators and scanning phantoms. This storage can be facilitated by choosing equipment with self-storage options;
- equipment bays for mobile items such as wheelchairs, beds / trolleys, lifters and workstations on wheels;
- equipment bay for Technegas unit and argon cylinder/s (or sufficient storage space within a hot lab). The Technegas unit is bulky and sits on a trolley about 600x800mm which can be wheeled to the scanning room for a patient to inhale Tc-99m. When not in use, it needs parking space alongside a large cylinder of argon gas. Alternatively, the argon gas may be piped;
- general storage for smaller equipment items with consideration of service specific requirements including AV and play therapy equipment for paediatric services; and
- storage for clinical consumables.

Medications are typically stored on Nuclear Medicine / PET units within the scanning rooms and / or hot lab, so a separate medication store is not typically required.

2.2.15 Staffing

A staff establishment should be developed early in the planning process in order to assess the office space and amenities that will be required.

The staff establishment may include:

- medical specialists qualified in nuclear medicine including radiologists, physicians, endocrinologists, cardiologists and paediatricians;
- junior medical staff;
- nuclear medicine physicists;
- nuclear medicine technologists / scientists;
- radiopharmaceutical scientists;
- cardiac technologists (for units providing cardiac scans);
- nursing staff;
- administration staff; and
- orderlies.

2.2.16 Teaching and Research

The extent of teaching and research conducted in the Unit will need to be ascertained to ensure that necessary workspace, meeting rooms, laboratories, and staff and student amenities are provided.

All major teaching hospitals will undertake staff and student teaching, research and possibly prepare novel radiopharmaceuticals for clinical use.

Units undertaking clinical trials will need to carefully assess needs in excess of routine requirements both in terms of treatment rooms and staff facilities.

2.3 PLANNING MODELS

2.3.1 Location

The Unit must not be a thoroughfare to other units of the healthcare facility. Both the Nuclear Medicine service and the PET service are prescribed as controlled radiation areas.

The floor loading weight of both equipment and shielding should be taken into consideration when locating the Unit. A ground floor site may be the most suitable location but if this cannot be achieved, consider units above, below and adjoining the proposed location with regard to radiation shielding requirements, the weight of equipment and associated shielding and access for equipment and radionuclides. For Units located on the ground floor, consideration still needs to be given to adjacent areas to inform shielding requirements.

Where a cyclotron is planned, close proximity to the PET hot lab (either horizontal or vertical) is required to support the transport of radiopharmaceuticals. A system for rapid transport of very short lived radiopharmaceuticals should be installed.

Future expansion and replacement of major medical equipment needs to be considered when planning the location of the Unit. Considerations may include:

- expansion of the scanning rooms to allow for upgrades to the equipment which will require additional shielding, increased load bearing capabilities and services requirements (power supply and heat dispersion in particular);
- access for supply and installation of new equipment; and
- identification of expansion zones for increased staffing requirements to meet service demand and technological changes.

2.3.2 Configuration

Configuration of the Unit is critical for optimal patient and staff flows. The layout must not allow unnecessary traffic movement in front of, through or adjacent to areas occupied by dosed patients and scanning rooms This should ensure that radiation doses to patients, carers, the public and occupationally exposed persons are kept as low as reasonably achievable. Maximising the distance to a radiation source and minimising the exposure time are key principles for radiation protection and should also guide the planning process for Nuclear Medicine Units to minimise radiation shielding requirements.

The PET area will be in a discrete zone within the Nuclear Medicine Unit.

Scanning and uptake rooms should be located on an external wall of the Unit where possible to minimise shielding requirements, acknowledging this will depend on adjacent areas.

During the design process, it is recommended that ‘hot’ and ‘cold’ patient flows are mapped to guide optimal planning and minimise shielding requirements.

Separate entries should be provided for the general public / outpatients and for patients on beds / trolleys. All patient corridors should accommodate the passing and turning of wheelchairs and beds. For larger units, separate entry and exit flows should be supported for outpatients.

If provided, the bone densitometry room should be located near the entry to the Nuclear Medicine Unit to ensure patients do not unnecessarily come in contact with dosed patients. Consider separating the room by distance or shielding to avoid interference from high ambient radiation levels.

2.4 FUNCTIONAL AREAS

2.4.1 Functional Zones

Functional zones will include:

- Entry / exit, reception and undosed (cold) waiting area;
- Nuclear Medicine areas
    - dosed (hot) waiting area with access to 'hot' toilets
    - nuclear medicine scanning and support areas
    - patient holding
    - therapeutic procedures (where provided)
- PET areas including uptake rooms and support;
- Shared support areas;
- Staff areas including staff work areas, teaching and research, and amenities.

2.4.2 Entry / Exit, Reception and Undosed (Cold) Waiting Area

Facilities, depending on the size of the service, will usually comprise:

- entry lobby and general waiting area for patients who may be ambulant or in wheelchairs;
- child play area if the service provides a significant volume of paediatric activity;
- reception / enquiry desk; and
- work space for bookings and other administration activities.

Public toilets should be readily available but need not be inside the Unit.

The design of the entry and exit must support optimal patient flows including controlled exit for hot patients.

Reference should be made to contemporary guidelines regarding COVID-19 / other pandemics including consideration of physical distancing requirements in waiting areas. Strategies to enable expansion of waiting areas when required should be explored, e.g. through collocation of meeting rooms that can be expanded into.

If the Nuclear Medicine Unit is part of a Medical Imaging Unit, these facilities may be shared. This area should be arranged so patients cannot readily gain access to other areas of the Unit.

2.4.3 Nuclear Medicine Areas

Outpatient Dosed Waiting Area

There will be controlled access to the 'dosed' waiting area for nuclear medicine outpatients who may be ambulant or in a wheelchair.

Access to dedicated toilets and waster dispenser is required to ensure separation of 'dosed' and 'undosed' patient flows is essential.

Inpatients, both dosed and undosed, will be managed in the patient holding area.

Nuclear Medicine Scanning and Support Areas

Access to these areas must be restricted.

All the following rooms are accessed by patients and require radiation shielding as advised by consultants:

- injection room/s - ideally adjacent to the dispensing hot lab;

- scanning room/s;
- cardiac stress testing room;
- a bone densitometry room, if provided would be located with other rooms but should not interrupt other flows.

Support areas will include a hot lab and radioactive waste store. The hot lab may be combined with the PET hot lab, however this will depend on the size of the Unit as the PET hot lab must be closely located to the uptake rooms.

Patient Holding Area

This area will comprise:

- patient bays for holding patients prior to or following their scan. The size of each bay and configuration of the overall space should permit both dosed and undosed patients to be held safely;
- a staff station so that staff can observe all bed spaces and preferably have overview of the non-inpatient waiting area as well;
- access to hand hygiene, including hand basins; and
- ready access to dirty utility, linen bay, storage for clinical supplies and a patient toilet/s.

A dedicated entry for inpatient beds will ensure beds do not travel through public waiting areas.

Therapeutic Procedures

For services providing therapeutic day procedures (e.g. lutetium therapy), a dedicated space will be required and may be collocated with the patient holding area for staffing efficiencies. These bays are often provided as a shielded pod with access to a 'hot' toilet. Where open bays are provided, mobile shields will be necessary to ensure the safety of other patients and staff.

Ceiling mounted radiation dose monitors may be provided in this area to monitor radiation exposure.

2.4.4 PET / CT Suite

The PET / CT Suite will consist of the following rooms / areas:

- individual pre-scan uptake rooms with a proportion designed to accommodate patients on beds and one designed for anaesthesia and recovery (paediatric services will require a higher proportion of uptake rooms that can accommodate beds and supporting anaesthesia);
- PET / CT Scanning Room/s;
- control room (these may be shared between two PET / CT rooms);
- specialised PET patient toilet;
- patient discharge lounge; and
- support areas including hot lab and radioactive waste store.

An equipment / plant room will be required to accommodate UPS batteries, water cooling units, servers and communications racks.

The number of uptake rooms, scanning rooms and hot toilets is determined by the anticipated patient throughput of the facility.

Future expansion space should be considered during planning given the growth in PET / CT and the significant challenges associated with establishing additional scanning rooms at a later date.

2.4.5 Shared Support Areas

Shared support areas across the Unit include the following areas:

- viewing / reporting area;
- radiopharmaceutical laboratories;
- hot labs / dispensary / QC zone and radioactive waste store;
- dirty utility room;
- disposal room;
- equipment bays;
- equipment, and general stores; and
- clean store.

Storage space must be available for one or more patient beds in case of transfer of an inpatient from another facility via ambulance etc. or in case of deterioration of a non-inpatient such that they need to be urgently transferred to an acute care area such as the emergency department (ED).

If collocated with a medical imaging unit, some support areas listed above may be shared.

2.4.6 Staff Areas Including Work Areas and Amenities

Depending on the size and location of the Unit, and collocation with adjoining units, staff will need access to:

- meeting rooms to support staff activities, education and research;
- staff work areas in accordance with staff establishment, jurisdictional policies and teaching / research roles;
- staff amenities including staff room, toilets, showers and lockers. Lockers should be in a secure staff area; and
- optional staff monitoring room to check for contamination.

2.5 FUNCTIONAL RELATIONSHIPS

The Unit should be located so ready access is provided from inpatient units (predominately cardiology, oncology and respiratory), the emergency unit and medical imaging unit.

Where a PET is included, the location in relation to the radiation oncology unit should be considered.

Easy access including drop-off is needed for patients arriving as outpatients.

Direct access for delivery of radionuclides to the Unit is also essential.

The location of medical physics staff and nuclear medicine physicians, technologists and nurses should also be considered during the design process to optimise communication and collaboration between these disciplines.

03 DESIGN

3.1 ACCESS

3.1.1 External

Provide:

- direct access to a weather protected drop off zone for patients;
- direct access for delivery of radionuclides / cold kits both during and after business hours;
- easy access to / from all clinical units; and
- easy access for vehicles providing maintenance or delivery of large, heavy equipment items.

3.1.2 Internal

There will be a single public entry point to the Unit. Separate access will be provided for staff, patient transfers and the movement of supplies and waste.

Circulation routes through the Unit will allow access and ease of movement of beds / trolleys. Corridor width should be sufficient to allow beds / trolleys with associated pumps to pass in a corridor.

The Unit should be designed to restrict access to treatment areas and staff only areas. Waiting areas should be arranged to achieve separation between dosed and undosed patient groups.

Consideration regarding equipment replacement needs to be considered during the design phase, including external access and movement through the Unit. Selected equipment items are extremely heavy, such as a PET/MR which weigh approximately 10 tonnes.

3.2 PARKING

The nature of nuclear medicine treatments means that time lost can impact on service provision. For example, PET tracers decay quickly. Access to adequate parking nearby can reduce these delays.

Longer treatments may also influence the need for extended hours parking.

Dedicated parking for delivery of radionuclides is recommended to support ease of access.

For information regarding staff parking, refer to AusHFG Part C: Design for Access, Mobility, Safety and Security.

3.3 DISASTER PLANNING

Each Unit will have operational plans and policies detailing the response to a range of emergency situations both internal and external. Consider issues such as the placement of emergency alarms, the need for uninterrupted power supply (UPS) to essential clinical equipment, and the emergency evacuation of patients, many of whom will require assistance.

For further information refer to:

- local jurisdiction disaster management plans; and
- AusHFG Part B.

3.4 INFECTION PREVENTION AND CONTROL

Refer to:

- AusHFG Part D: Infection Prevention and Control; and
- jurisdiction policies and guidelines related to infection prevention and control.

Reference should be made to contemporary guidelines regarding COVID-19 / other pandemics, particularly in relation to the provision of ventilation / perfusion (V/Q) scans, given the infection control risks associated with the ventilation portion of the scan. Rather than establish negative pressure scanning rooms, most services have implemented modified scans or alternative diagnostic tests for pulmonary embolism during the COVID-19 pandemic such as CT angiography.

Operational strategies to support physical distancing requirements should also be considered, as noted under Section 2.4.2, as well as appropriate access to PPE and facilities to support optimal hand hygiene, noting that access to a hand basins is essential for radioactive contamination.

3.5 ENVIRONMENTAL CONSIDERATIONS

3.5.1 Acoustics

Sound attenuation should be provided, but not limited to, the following areas:

- scanning rooms especially where MRI or air-cooled CT is used;
- viewing / reporting room;
- consult rooms;
- plant and communication rooms; and
- toilets, particularly if adjacent to offices.

Also refer to acoustic requirements noted on Room Data Sheets, where provided.

3.5.2 Natural Light

As much natural light as possible should be provided, especially into public spaces, waiting areas and those treatment areas that patients and staff occupy for long periods of time. External windows provided in scanning and uptake rooms should be assessed by a Radiation Consultant for shielding requirements. In practice, it may be difficult to shield windows equal to wall shielding levels. Alternatives may be lighting systems that aim to replicate light or provide alternate means of distraction.

Control of external light is essential in uptake rooms and reporting rooms (e.g. for 18-FDG brain scans).

3.5.3 Privacy

Visual and acoustic privacy is required in all consultation, examination rooms, and treatment spaces / scanning rooms.

3.5.4 Interior Decor

As far as possible without compromising clinical practice or safety, the environment should be calming, non-threatening and welcoming.

Ideally, the decor should be relaxing and provide positive distractions for patient undergoing scans that may take some time.

Simple measures such as furniture selection and ambient light can improve patient experience. Additional elements such as framed art displays or music can complement interior design strategies.

3.6 SPACE STANDARDS AND COMPONENTS

3.6.1 Human Engineering

Human engineering covers those aspects of design that permit effective, appropriate, safe and dignified use by all people, including those with disabilities. Refer to AusHFG Part C.

3.6.2 Ergonomics

It is essential that the unit is designed to ensure patients, staff, visitors and maintenance staff are not exposed to avoidable risks of injury and radiation exposure.

For example, a hoist or crane may be needed to position the generator in the hot lab.

Consider work practices in relation to manual handling of equipment with significant weight. Manual handling requirements may be reduced by appropriate local storage such as equipment bays. These bays may also accommodate mobile patient lifting hoists. Alternatively, a scanning room may be equipped with a ceiling mounted hoist to manage patients up to 250kgs.

Refer to AusHFG Part C for further details.

3.6.3 Access and Mobility

Where relevant, the design needs to comply with AS 1428 Design for Access and Mobility.

For further information refer to AusHFG Part C.

3.6.4 Building Elements

Building elements include walls, floors, ceilings, doors, windows and corridors and are addressed in detail in AusHFG Part C. Refer also to Room Data and Room Layout Sheets.

Ensure that floors are designed to support the weight of equipment, and shielding, and that equipment is not located in vibration prone areas.

Provide the same level of shielding to vision panels in doors to treatment rooms and hot labs as to the adjoining walls.

Consider the need for shielding to floors or ceilings directly above, below or adjacent to the Unit.

Ensure that the allowances in some equipment specification manuals provide adequate space for complex transfers requirements such as transferring a patient from an ICU bed to the scanner. Refer to the Schedule of Accommodation and relevant standard components for guidance on appropriate room sizes for the scanning rooms.

3.6.5 Doors and Doorways

All entry points, doors or openings, should be sized to permit the manoeuvring of beds and other equipment. Larger openings may be required for special equipment (e.g. bariatric beds) as determined by local requirements.

The size of a basic bed or trolley is often enlarged by the addition of monitors, other equipment and several staff, making movements more difficult than in other areas of the hospital.

It is important that adequate circulation space is provided for the safe and efficient movement of these beds. Corridors throughout the Unit will be consistent with AusHFG Part C. High volume services may benefit from a racetrack design to reduce turning of beds / trolleys.

Doorways to scanning rooms should be flush to the floor for ease of camera installation and movement of equipment such as collimator carts. Consideration should also be given to transfer of major equipment through entry doorways when designing.

Refer to:

- AusHFG Part C: Design for Access, Mobility, Safety and Security; and

- relevant AusHFG Standard Components.

3.7 SAFETY AND SECURITY

3.7.1 General

A safety audit via a risk analysis of potential hazards should be undertaken during the design process. For details refer to:

- AusHFG Part C; and
- individual jurisdiction policies and guidelines where applicable

3.7.2 Safety

Consider the impact of finishes, surfaces and fittings on safety. In particular, consider:

- adequate protection for workers against infection and any other hazards - particularly radiation exposure. This can be improved by placing areas housing radiation in areas that avoid staff and visitors walking by;
- location of hot labs / radiopharmaceutical science laboratories as these rooms and associated facilities should be located so they are not accessible by the public;
- locating spill kits in each scanning and injecting room so they are easily accessible; and
- manual handling of technetium generators. The generators weigh up to 20kg and a hoist may be required to transfer from transport package to bench top and vice versa. The hoist should be capable of slow, accurate manipulation to avoid damage to the Molybdenum-99 (Mo99) column within the generator shield.

3.7.3 Radiation Shielding and Signs

The principles of radiation safety and protection should be developed and integrated into the design and documentation of the Unit from the earliest stages and it is important the design team is comprehensively briefed. Advice must be sought for each project from the Radiation Safety Officer of the facility, a qualified medical physicist and a suitably qualified radiation safety expert.

Radiation shielding will be required in a number of areas within the Unit including, but not limited to:

- gamma camera rooms;
- SPECT scanning room;
- SPECT / CT scanning room;
- PET / CT or PET / MR room;
- dosed patient waiting area;
- uptake rooms;
- post scan waiting areas;
- therapeutic procedures area;
- hot toilets;
- hot labs and radiopharmaceutical laboratories;
- corridors within the ‘hot’ zones; and
- reception and other rooms adjacent to dosed patient areas.

Requirements for shielding to floors or ceilings directly above or below nuclear medicine / PET treatment rooms should be considered.

As the aim is to reduce the exposure of staff to dosed patients, signage in selected areas will need to be instructional so that patients can self-manage where possible (e.g. movement between uptake rooms and hot toilets). The amount of shielding required is influenced by available space. It may be possible to reduce shielding where additional space is provided.

Visible warning signs are to be provided at every entry to a room where unsealed radioactive material is stored or used.

Visible warning signs are also required to rooms with irradiating apparatus - bone densitometry, SPECT / CT and PET / CT systems.

For further information refer to:

- Radiation Protection Series Publication No 14.2 Safety Guide for Radiation Protection in Nuclear Medicine, Section 10.2 Radiation Shielding and Signs and;
- Australian Standard AS 1319-1994 Safety Signs for the Occupational Environment.

3.7.4 Security

General security considerations will include use of duress in selected areas (e.g. staff station, reception). Swipe card access to staff only and other restricted areas.

The security of radionuclides and radioactive waste is of particular importance. Refer to:

- Radiation Protection Series Publication No. 14.2 Safety Guide for Radiation Protection in Nuclear Medicine, Section 10 (ARPANSA 2008b); and
- Radiation Protection Series Publication No. 11 - Security of Radioactive Sources, (ARPANSA 2019).

3.8 FINISHES

3.8.1 Walls

Walls should be washable and easily decontaminated in the event of a radioactive spill. Adequate wall protection should be provided to areas that will regularly be subjected to damage. Particular attention should be given to areas where beds or trolley movement occurs such as corridors, bed space walls, treatment areas, equipment storage bay / rooms and linen trolley bays.

Refer to AusHFG Part C and relevant AusHFG Standard Components for further information.

Clinically appropriate antimicrobial wall skins and/or projections may be considered to support patient wellbeing.

3.8.2 Floor Finishes

Floor finishes and junctions should be impermeable, non-absorbent and coved in case of radiation spills.

Where joints exist in vinyl flooring in hot labs / radiopharmacies, they should be welded. Expansion joints should be avoided within these spaces.

Refer to:

- AusHFG Part C: Design for Access, Mobility, Safety and Security;
- AusHFG Standard Components and
- Department of Health, NSW, 2009, Technical Series TS7 - Floor Coverings in Healthcare Buildings.

3.8.3 Ceiling Finishes

Refer to AusHFG Part C and relevant standard components.

3.9 FIXTURES, FITTINGS & EQUIPMENT

3.9.1 Definitions - Fixtures and Fittings

Room Data and Room Layout Sheets in the AusHFG define fixtures, fittings and equipment (FFE). Refer to the Room Data Sheets (RDS) and Room Layout Sheets (RLS), as well as AusHFG Part C.

3.10 BUILDING SERVICE REQUIREMENTS

3.10.1 General

High cost engineering areas which should receive careful consideration by design teams include:

- lighting and the impact of deep planning on lighting requirements;
- the number of sanitary fittings and the potential for reducing these by strategic location;
- extent of the required emergency and uninterrupted power supply;
- extent of provision of essential back-up systems (e.g. dual generators, chillers, boilers and dual electrical circuits);
- dimmable lights in reporting areas, scanning rooms and uptake rooms; and
- low light capable CCTV monitoring may be required.

Refer to jurisdictional guidelines relating to engineering services.

3.10.2 Construction

In constructing the Unit, it will be necessary to ensure:

- new and existing floor structures and finishes are adequate to meet load requirements for equipment, shielding, patients, and staff. Some examples include:
    - a PET / CT, Total Body PET system and PET / MRI can weigh approximately three tonne, six tonne and 10 tonne respectively;
    - shielding weight, for example up to 150kg per m2 of shielding on some walls is required for PET / CT which has significant structural engineering implications;
    - ‘hot cells’ used within radiopharmaceutical science laboratories can weigh between three and 10 tonnes;
- RF shielding is required for MRI with current PET-MRI operating at up to 3 tesla;
- provision is made for cable trays, ducts or conduits in floors, walls, and ceilings as required for specialised equipment;
- the integrity of the shielding should not be compromised by ducts and penetrations (a post shielding integrity test will be required to confirm this);
- extraction systems in hot labs and radiopharmaceutical laboratories;
- penetrations for sewer / water / electrical may need to be angled and shielded, as well as located strategically in terms of radiation hygiene considerations;
- ceiling heights in the scanning rooms should be a minimum of three metres;
- ceiling mounted equipment should be designed with rigid support structures located above the finished ceiling; and

- laser marker systems may be required in the PET camera room to assist with radiation therapy planning and co-registration systems.

3.10.3 Electrical Services

A sufficient number of power outlets, both general and essential supply, including three phase outlets, will be required to support current and anticipated future needs.

An emergency back-up system for the power supply should be available for high priority equipment and illumination of patient areas including scanning rooms.

Provide uninterrupted power supply (UPS) to cameras, acquisition workstations and servers to prevent data loss and/or damage during power surges or brown outs and to reduce the risk of reimaging that patient. The intent is to provide limited supply to support patient care until the back-up power supply is available.

All patient areas should be body protected.

A Technegas Generator will require access to a 20-ampere electrical power outlet.

All scanning rooms require dimmable down lighting with lighting not located directly above scanning beds.

Refer to:

- relevant Australian Standards; and
- jurisdiction specific engineering services guidelines.

3.10.4 Hydraulic Services

When routing hydraulic services and air conditioning ducts in ceiling spaces, avoid the space above major medical equipment as water leaks can cause significant damage.

Provisions for water cooling plant equipment, where used, will be required within easy access to scanning equipment modules.

The requirement for delayed holding tanks to patient toilets in the immediate post-uptake area will be dependent on the local water authority requirements and advice from the Radiation Safety Officer.

3.10.5 Information Technology and Communication Systems

Unit design should address information technology and communications issues including:

- wireless technology;
- CCTV monitoring systems of entry points, and in the scanning and uptake rooms if direct observation is not possible;
- intercom systems to support communication with patients from scanning and uptake rooms;
- duress call - fixed and personal (optional);
- patient / nurse and emergency call systems compatible with existing hospital systems
- infrastructure for PACS, electronic records and imaging information management system;
- robotics systems housed within hot cells and operated remotely via computer; and
- video conferencing capacity.

3.10.6 Mechanical Services

Additional cooling and ventilation will be required for scanning rooms and associated computer equipment rooms as the equipment is sensitive to excessive ambient heat. The system should have the ability to increase cooling capacity for future growth and technology development.

Designers should obtain actual scanner equipment information to determine any chilled water requirements.

Avoid large temperature changes in scanning rooms (>4˚C/hour) because of the possibility of crystal fracture in gamma cameras.

General air conditioning needs to cool equipment but not blow over partially undressed patients. Patients waiting in uptake rooms should be provided with a warm environment as this helps with the uptake of radiopharmaceuticals.

Smoke detectors in treatment rooms should be carefully selected and located.

Additional air extraction may be required in the camera room/s where ventilation agents such as Technegas are administered in accordance with state regulatory requirements.

Hot lab and Technegas room air should not be recirculated but exhausted. Both rooms should be at a negative pressure to the rest of the Unit.

The Hot Lab may require a fume cabinet, which should be ducted directly to external exhaust and fan discharge, in a manner compliant with all codes.

3.10.7 Medical Gases

Oxygen, suction and medical air will be required in all scanning rooms, stress testing rooms and to patient bed bays.

Nitrous oxide and scavenge will be required in rooms where general anaesthesia may be administered, particularly in units where children are treated.

Argon gas is required for Technegas machines where this agent is used for lung scanning. Argon may be provided by a mobile cylinder or pipe.

Medical gases installation and testing is to be in accordance with Australian Standard AS 2896: 2021.

04 COMPONENTS OF THE UNIT

4.1 STANDARD COMPONENTS

Rooms / spaces are defined as:

- standard components (SC) which refer to rooms / spaces for which room data sheets, room layout sheets (drawings) and textual description have been developed;
- standard components – derived rooms are rooms, based on a SC but they vary in size. In these instances, the standard component will form the broad room 'brief' and room size and contents will be scaled to meet the service requirement; and
- non-standard components which are unique rooms that are usually service-specific and not common.

The standard component types are listed in the attached Schedule of Accommodation.

The current Standard Components can be found at: www.healthfacilityguidelines.com.au/standard components

4.2 NON-STANDARD COMPONENTS

Non-standard components are unit-specific and provided in accordance with specific operational policies and service demand. These non-standard components for Nuclear Medicine Units are detailed below.

4.2.1 Injection Room

Description and Function

This room is used for patient consulting, examination and administration of isotopes.

In most respects, this room is similar to the Standard Component - Consult Room except that radiation shielding will be required and a recliner chair is preferable given most patients can be injected in a seated position. The chair should be fully reclinable to appropriately manage adverse patient incidents.

Location and Relationships

Ready access to nuclear medicine scanning rooms and general patient waiting is required. Ideally, it should be located adjacent to the Hot Lab.

4.2.2 Bone Densitometry (DXA) Room

Description and Function

A room for bone densitometry imaging studies (also called dual-energy x-ray absorptiometry – DXA) is primarily for osteoporosis assessment and management.

Patients are not always required to change for their DXA scan, although this is preferable. All attenuating material such as metal fasteners – zips, bra underwire, hooks, piercings and attenuating fabrics must be removed if they are in the scanning field of view. If necessary, the patient may change within the room itself in a curtained off area, although throughput may be improved by providing separate change rooms that open into the scanning room.

The room should allow the operator to maintain a safe distance from the active equipment and to be able to see the patient during the scan and not positioned with back to the patient (minimum 2 metre distance between scanner and operator).

In facilities with spinal cord injury units or where the Unit may be expected to see highly dependent patients, the room should be sufficiently sized to allow the use of a hoist and safe transfer from a trolley. In these cases, the scanner will need to be positioned to allow staff to access all sides of the scanner for the safe transfer of the patient.

Location and Relationships

The room(s) should be located at or near the Unit entry to prevent patients coming into contact with dosed patients waiting scanning or having to pass in front of the scanning rooms. The scanner should be separated by distance or shielding from adjoining areas used by dosed patients. Check whether high radiation levels from nearby patients, e.g. Iodine -131 or PET could interfere with data / image quality of BMD scans.

Provide ready access to undosed patient waiting areas or alternatively, these patients may use the general public waiting area.

Considerations

Other considerations include:

- bone densitometer machine - dual-energy x-ray absorptiometry - DXA or DEXA & console desk (large enough to hold acquisition system and hospital PC);
- computer workstation and height adjustable chair;
- storage cupboards for gowns, positioning pillows, braces, scanning phantoms etc;
- wall mounted height measure;
- scales;
- hand basin Type B; and
- shielding as required noting modern machines have a very low radiation dose for the scans.

4.2.3 Entry Lobby - Radionuclide Delivery

Description and Function

A space where external couriers deliver radionuclides.

Location and Relationships

Ensure the room is readily accessible to / from the hot lab. An external entrance may be provided so that deliveries do not have to penetrate the main Unit.

Considerations

Other considerations include:

- radiation shielding as advised by Consultants;
- appropriate radioactive signage on access doors; and
- crane system to assist with movement of heavy goods (e.g. shielded generator, weight above safe lifting limits).

Services may instead receive deliveries directly into the hot lab.

4.2.4 Hot Laboratory

Description and Function

A hot lab is a dispensing laboratory in which the activities can vary quite widely between institutions. Where PET services are collocated, a separate hot lab may be required, or a special section of the main hot lab assigned to these activities due to either the different shielding requirements or required proximity to the scanning rooms.

The hot lab will accommodate the following activities:

- receipt and documentation of any radionuclides or radiopharmaceuticals;
- preparation and dispensing of radiopharmaceuticals for imaging, possibly into an automatic dose dispensing unit; and
- a special section of the hot lab will receive and store radioactive waste until it is safe for disposal.

Location and Relationships

Ensure the room is readily accessible to/from dosing rooms and scanning rooms.

The room must be staff only access.

Considerations

Other considerations include:

- radiation shielding as advised by shielding consultants;
- appropriate radioactive signage on access doors;
- crane system to assist with movement of heavy goods (e.g. shielded generator, weight above safe lifting limits).
- a sharps bins and a bin for general radioactive waste which may be located under a bench in lead-shielded cupboards;
- the design of a preparation bench incorporating a lead shielded cover behind where preparation occurs.
- fridges, freezers and storage cupboards for cold kits;
- a computer and label printer; and
- dose calibrator.

Sinks / handwash basins are typically located immediately outside the lab as they may be a source of microbiological contamination.

A dedicated PET hot lab will need to be located alongside uptake rooms. Where automated infusion systems are provided, they will commonly be stored within the hot lab or a dedicated alcove off the corridor adjacent to the uptake room.

An L-Block with lead glass shielding will be provided on the bench.

Radioactive waste holding may also be incorporated into this space.

4.2.5 Cold Laboratory

Description and Function

A cold lab is used in some services as a laboratory to undertake activities that involve low level radioactivity. This may include:

- performing QC testing on departmentally prepared radiopharmaceuticals;
- preparation of equipment for radioactive administrations in other areas of the hospital;

- preparation of radiolabelled blood products;
- preparation of cold kit labels;
- denaturation of blood cells;
- counting of GFR samples;
- accommodation of Technegas; and
- storage of equipment and data.

Location and Relationships

A cold lab is usually located close to the hot lab as several procedures feed from one room to the next.

Considerations

Key fit out requirements may include:

- stainless steel sink and drying rack;
- computer and label printer;
- blood label printer;
- laminar flow cabinet;
- drug safe;
- gamma counter;
- centrifuge, blood rotator and PCV spinner;
- heat bath and heat block;
- auto pipettes;
- hospital emergency spill kits;
- personal dosimeters; and
- fridges, freezers and storage.

4.2.6 Radiopharmaceutical Laboratory

Description and Function

A radiopharmaceutical laboratory may be provided for the aseptic manufacturing of pharmaceuticals.

Manufacturing of sterile pharmaceuticals as cold kits for supply to private practices or interstate to other nuclear medicine units requires full compliance with TGA for the premises and persons working there. This scope is not detailed in this HPU.

Location and Relationships

If there is future expectation of a cyclotron, such a facility should be expandable via provision of a ground level or sub-ground space, suitable for extensive shielding, sited with direct access to the PET hot lab.

Where nuclear medicine and PET services are collocated, a single location for manufacture may be considered. Shielding requirements may vary.

Considerations

Apart from routine laboratory requirements, there will be specific requirements in terms of environment and equipment, depending on the functions it will serve. These could include:

- laminar flow units in a Class A environment;
- BSC Class II cabinets for biological protection;
- fume hoods (for extraction); and
- hot cells (one to two units), for radioprotection.

Each of these units of equipment have their own specific building requirements such as specialist extraction capabilities, positive air pressure, and extra floor loading capacity. There may also be a requirement for additional shielding of the area, access to specific equipment via a 'hole in the wall', or a specific work flow design.

A hot cell can weigh up to 10 tonne and requires external ventilation as well as a power source.

4.2.7 Radioactive Waste Holding

Description and Function

A room for the temporary storage of radioactive material until it is fully decayed when it can be disposed of as normal waste. Radiation shielding is to be provided in accordance with advice from the Radiation Consultants.

Location and Relationships

Dual access to/from the Unit is desirable including external access that is well controlled.

4.2.8 PET MRI Scanning Room

Appropriate provisioning of non-ferromagnetic infrastructure fixture, fittings and furniture is required for PET- MRI as well as lockers for valuables (staff and patients).

4.2.9 Uptake Room - Large

In this room, patients may be anaesthetised or sedated. In most respects, this room is similar to the general uptake room (refer to AusHFG Standard Component UPRM). Additional room requirements include:

- minimum room size of 15m2 to accommodate a patient bed;
- patient monitor;
- nitrous oxide, scavenging and medical air;
- anaesthetic trolley; and
- benches and storage shelves / cupboards for supplies.

05 APPENDICES

5.1 SCHEDULE OF ACCOMMODATION

The schedule of accommodation follows providing two scenarios:

- Scenario 1: 1 SPECT/CT and 1 PET/CT
- Scenario 2: 3 SPECT/CT and 2 PET/CT

A stress testing room and a bone densitometry room are assumed under both scenarios.

These schedules of accommodation are indicative only and the number of scanners provided should be based on a clinical services plan which examines future service trends and projected activity.

The ‘Room / Space’ column describes each room or space within the Unit. Some rooms are identified as ‘Standard Components’ (SC) or as having a corresponding room which can be derived from a SC. These rooms are described as ‘Standard Components – Derived’ (SC-D).

The ‘SD/SD-C’ column identifies these rooms and relevant room codes and names are provided. All other rooms are non-standard and will need to be briefed using relevant functional and operational information provided in this HPU.

In some cases, Room / Spaces are described as ‘Optional' or ‘o’. Inclusion of this Room / Space will be dependent on a range of factors such as operational policies or clinical services planning.

5.1.1 Entry / Exit / Reception / Undosed Waiting

Note 1: It is assumed that this entry / reception provides a single public access to nuclear medicine and PET services.

AusHFG Room Code	Room / Space	SC / SC-D	1SPECT / CT + 1 PET/CT		3 SPECT / CT + 2 PET/CT		Remarks
			Qty	m2	Qty	m2	
WAIT-20	Waiting	Yes	1	15	1	24	Cold' Waiting Area. Indicative area allocation based on 3 people waiting per modality including bone densitometry. Area to be confirmed based on service profile.
PLAP-10	Play Area - Paediatric	Yes	1	8 (o)	1	10 (o)	Optional. Only required for services with a significant paediatric casemix.
RECL-10	Reception / Clerical	Yes	1	10	1	15	May be shared with adjacent services in smaller units eg medical imaging.
	Office - Workstation			4.4	1	4.4	Administration workstations collocated with reception. Number of workstations dependent on staff profile.
INTV	Interview Room	Yes	1	12 (o)	3	12 (o)	Optional, depending on operational practices and local jurisdictional policies.
STPS-8	Store - Photocopy / Stationery	Yes	1	3	1	5	Bay including multifunction device.
WCPU	Toilet - Public	Yes			2	3	'Cold' toilets.
WCAC	Toilet - Accessible	Yes	1	6	1	6	'Cold' toilets.
	Discounted Circulation			25%		25%	

5.1.2 Nuclear Medicine Zone

Dosed / 'Hot' Waiting

AusHFG Room Code	Room / Space	SC / SC-D	1SPECT / CT + 1 PET/CT		3 SPECT / CT + 2 PET/CT		Remarks
			Qty	m2	Qty	m2	
WAIT-10	Waiting	Yes	1	6	1	18	Number of patients waiting will depend on the service profile, eg patients having cardiac scans will wait longer. 2m2 per person recommended for radiation protection purposes. A separate 'hot' play space will be required where a significant paediatric service is provided.
WCPT	Toilet – Patient	Yes	1	4	2	4	'Hot' toilets.
BWD-1	Bay - Water Dispenser	Yes	1	1	1	1	
	Discounted Circulation			25%		25%	

Nuclear Medicine Scanning & Support Areas

AusHFG Room Code	Room / Space	SC / SC-D	1SPECT / CT + 1 PET/CT		3 SPECT / CT + 2 PET/CT		Remarks
			Qty	m2	Qty	m2	
	Injection Room		1	12	2	12	For dose administration and examination. Assume 1 room shared between 2 scanners. Shielded consult room with recliner chair.
CHPT	Change Cubicle - Patient	Yes			2	2	Pre and post-scan; radiation shielded. 1 change cubicle per scanning room.
CHPT-D	Change Cubicle – Accessible	Yes	1	4	1	4	Pre and post-scan; radiation shielded.
SPECT-CT	SPECT-CT Imaging Room	Yes	1	50	3	50	
SPECT-CTCR	SPECT-CT Control Room	Yes	1	14	2	14	
	SPECT / CT Equipment / Computer Room		1	10 (o)	2	10 (o)	Optional. Includes computer mainframe / server modules for the SPECT/CT. Room temperature to be maintained for heat generating equipment. Notional space allocation only and will depend on vendor requirements.
STRT	Stress Testing Room	Yes	1	20 (o)	1	20 (o)	Optional depending on service profile. Trolley / bed access assumed. Similar arrangement to STRT however this needs to be a shielded room, does not require the Echo machine. The defibrillator may be located within or very near to the room.
	Bone Densitometry		1	20 (o)	1	20 (o)	Optional depending on service profile. Assumes trolley / bed access required and overhead ceiling mounted hoist.
	Nuclear Medicine Hot Lab		1	14	1	18	Refer to separate line item for PET hot lab. A combined hot lab, serving both Nuclear Med & PET, may be possible, however the PET hot lab must be located close to PET uptake rooms. Assumed to include Technegas and emergency eye wash. Area requirements will depend on scope of services eg dispensing of therapeutic doses, preparation of radiolabelled blood products etc.
	Nuclear Medicine Cold Lab		1	10 (o)	1	18 (o)	Optional depending on service requirements and local jurisdictional approaches. Used as a low level radioactive laboratory. Where provided the hot lab area allocation may be reduced.
	Entry Lobby - Isotope Delivery		1	4	1	4	Dual access from external corridor and within unit.
	Store - Phantoms			1		2	
	Radioactive Waste Holding Store		1	5	1	8	
	Discounted Circulation			37%		37%	

Nuclear Medicine Patient Holding and Therapeutic Procedures

Where therapeutic procedures are provided, the projected activity will require confirmation to determine the number of bays to be provided. These may be shared with the patient holding area for Nuclear Medicine, however consideration needs to be given to the types of procedures undertaken and radionuclides used to guide whether patient amenities i.e. toilets, can be shared.

Shared clinical support space noted below, such as utilities, linen bays and mobile equipment bays should be within ready access of the patient holding areas.

AusHFG Room Code	Room / Space	SC / SC-D	1SPECT / CT + 1 PET/CT		3 SPECT / CT + 2 PET/CT		Remarks
			Qty	m2	Qty	m2	
PBTR-H-9	Patient Bay – Holding, 9m2	Yes	2	9	6	9	Inpatient holding for Nuclear Medicine. Indicative number of bays noted, actual number will depend on projected volume of inpatients. Shielding requirements will depend on location.
PBTR-H-9	Patient Bay – Holding, 9m2	Yes			4	9 (o)	Optional. For services providing therapeutic procedures. Number of bays will depend on projected activity, may include clinical trials. Shielded area. Separate treatment room/s for day procedures may be required depending on the number of spaces provided and proposed arrangement.
TRMT	Treatment Room	Yes			1	14 (o)	Optional, to support therapeutic procedures depending on types of procedures provided. Shielded room.
BHWS-B	Bay - Handwashing - Type B	Yes	1	1	2	1	Additional required for therapeutic procedures.
SSTN-10	Staff Station	Yes	1	8	1	12	For oversight of patient holding.
WCPT	Toilet – Patient	Yes	1	4	2	4	Additional required for services providing therapeutic procedures.
	Discounted Circulation			37%		37%	

5.1.3 PET Suite

AusHFG Room Code	Room / Space	SC / SC-D	1SPECT / CT + 1 PET/CT		3 SPECT / CT + 2 PET/CT		Remarks
			Qty	m2	Qty	m2	
	Uptake Room		3	10	6	10	Radiation shielded. Assumes ambulant patients who will be injected in a recliner. Assume 4 uptake rooms per PET/CT.
	Uptake Room - Large		1	15	2	15	Radiation shielded. This room will be used as an uptake room for those on beds. Number will depend on service profile, increased number required for paediatric services. Children will often be induced in the Uptake room so access to anaesthetic gases is required.
CHPT-D	Change Cubicle – Accessible	Yes	1	4	2	4	Pre and post-scan; radiation shielded
WCPT	Toilet – Patient	Yes	1	4	1	4	Hot' toilets - Radiation shielded.
WCAC	Toilet - Accessible	Yes	1	6	1	6	Consider automated door given heavy weight due to shielding is difficult for disabled patients to manage.
PET-CT	PET-CT Imaging Room	Yes	1	50	2	50	This will also accommodate Total Body PET systems, however consideration needs to be given to shielding requirements and the number of uptake rooms given the faster throughput.
	PET-CT Control Room	Yes	1	14	2	14	Includes communication (intercom) connection to PET/CT and Uptake rooms.
	PET/ CT Computer / Equipment Room		1	10 (o)	2	10 (o)	Optional. Includes computer mainframe / server modules for the PET/CT. Room temperature to be maintained for heat generating equipment. Notional space allocation only and will depend on vendor requirements.
	PET/CT - Alcove for Automated Infusion System		2	2 (o)	3	2 (o)	Optional. Shared between 2 uptake rooms for location of automated infusion system where provided via a port.
BHWS-B	Bay - Handwashing – Type B	Yes	1	1	2	1	In corridor, 1 per 4 uptake rooms.
	PET Hot Laboratory		1	14	1	18	Will be adjacent to uptake rooms. Includes emergency eye wash.
	Radiopharmaceutical Laboratory		1	40 (o)	1	40 (o)	Optional, specialised services only where manufacturing is undertaken. Indicative minimum area allocation for a radiopharmaceutical lab noted. Actual area to be determined based on the scale and scope of manufacturing and associated activities across nuclear medicine and PET services.
BES	Bay – Emergency Shower	Yes	1	2	1	2	Radiation shielded. Locate outside radiopharmaceutical lab where provided.
	Discharge Lounge		1	8	1	12	Radiation shielded. Collocate with Beverage Bay. Operational policy relating to patients on trollies requiring transfer to be confirmed.
	Discounted Circulation			37%		37%	

5.1.4 Shared Support Areas

It is assumed that much of the support space is shared between nuclear medicine and PET services but this will be dependent on Unit size and layout. In some cases, space may need to be duplicated.

AusHFG Room Code	Room / Space	SC / SC-D	1SPECT / CT + 1 PET/CT		3 SPECT / CT + 2 PET/CT		Remarks
			Qty	m2	Qty	m2	
CLN-10	Clean Store	Yes	1	10	1	14	Clean consumables.
STEQ-14	Store - Equipment	Yes	1	12	1	20	
BLIN	Bay – Linen	Yes	1	2	2	2	For inpatient holding & uptake rooms
BMEQ	Bay - Mobile Equipment	Yes	1	2	1	3	Mobile equipment requirements to be confirmed.
BRES	Bay - Resuscitation Trolley	Yes	1	1.5	1	1.5	Requires careful consideration of location. Rapid access from the Stress Test Room, if defib not located within the room, and other patient care areas is required.
BWP	Bay - Wheelchair Park	Yes	1	2	1	4	
BBEV-OP	Bay - Beverage, Open Plan	Yes	1	4	1	4	
CLRM-5	Cleaner's Room	Yes	1	5	1	5	Dedicated to unit to avoid radioactive contamination.
DTUR-8	Dirty Utility	Yes	1	8	1	10	Refer to Section 2.2.14 re radioactive waste disposal.
DISP-8	Disposal Room	Yes			1	8	Note separate radioactive waste store included above. Assume shared with adjacent department for smaller service.
	Discounted Circulation			37%		37%	

5.1.5 Staff Areas

AusHFG Room Code	Room / Space	SC / SC-D	1SPECT / CT + 1 PET/CT		3 SPECT / CT + 2 PET/CT		Remarks
			Qty	m2	Qty	m2	
REPR	Reporting Room		1	18	1	36	Assume 1-2 workstations per scanner with 6m2 per reporting workstation.
OFF-S9	Office- Single Person	Yes		9		9	Number and area allocation will depend on staff profile and local jurisdictional policies.
	Office - Workstation			4.5		4.5	Number and area allocation will depend on staff profile and local jurisdictional policies.
INTV	Interview Room	Yes		9		9	Number dependent on service requirements.
MEET-L-20	Meeting Room	Yes	1	15	1	25	Size will depend on number of people to be accomodated and local jurisdictional policies.
SRM-15	Staff Room	Yes	1	16	1	24	Area will depend on staffing profile and operational policies.
BPROP	Bay - Property, Staff	Yes	1	2	1	3	
WCST	Toilet – Staff	Yes	2	3	4	3	Number dependent on service profile.
SHST	Shower – Staff	Yes	1	3 (o)	1	3 (o)	Optional depending on approach to end of trip facilities.
	Discounted Circulation			25%		25%	

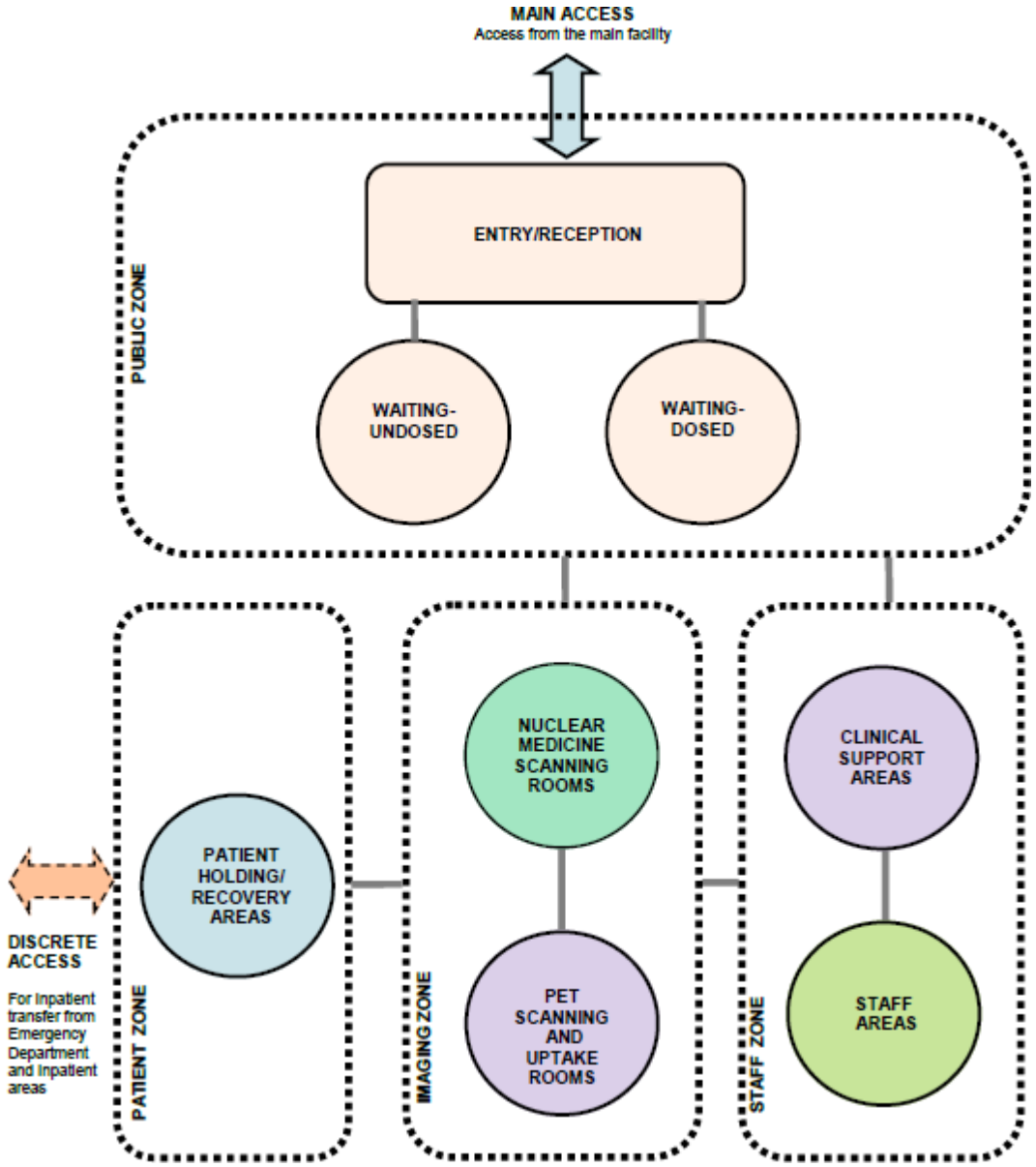
5.1.6 Cyclotron and Radiopharmaceutical Science Laboratory

Very few services across Australian and New Zealand will plan collocated cyclotron facilities.

An indicative area allocation of 400m2 including shielding, will be required for a cyclotron facility including the cyclotron vault, control area, laboratory space, storage and staff / technical support areas. It is recommended that planners refer to the most recently completed projects to better understand the latest technology and approaches to planning.

5.2 FUNCTIONAL RELATIONSHIPS / DIAGRAMS

A diagram of key functional relationships is shown below.



5.3 IODINE-131 BEDROOM

5.3.1 Iodine-131

Iodine-131 (^{131}I) is used for the treatment of thyroid conditions including cancer. The radionuclide has a half-life of approximately eight days. Patients undergoing treatment are nursed in a radiation-shielded room for a period of three to four days. During this period, the patient is an external radiation hazard to others nearby and an internal radioactivity hazard to those who may come in contact with the patient's body fluids including urine, saliva, sweat, vomit, and contaminated items and surfaces.

5.3.2 Location of Radioactive Iodine Sealed Bedroom

Some patients who receive radioactive iodine-131 treatment will require inpatient management within a specially shielded inpatient single bedroom. This service is generally provided at tertiary facilities with up to two rooms provided within an inpatient unit.

5.3.3 Radiation Shielding

Radiation shielding should be provided in accordance with regulations.

5.3.4 Bedroom

The bedroom will be part of an inpatient unit but located so as to minimise passing traffic and consequent radiation exposure and therefore minimise shielding needs. This may be achieved by locating the room at the end of a corridor or by locating the dedicated ensuite and storage between bedroom and public corridor and/or adjacent to unoccupied areas.

With the exception of the radiation shielding, the bedroom will be identical to other inpatient unit bedrooms with regard to furniture, fixtures and fittings. Refer to Standard Component - 1 Bed Room.

5.3.5 Ensuite Shower / Toilet

A dedicated ensuite accessible from inside the bedroom is required. Connection to a delay / holding tank may be required by the local water or regulatory authorities, however they are not commonly required.

Where delay / holding tanks are not required, it may be appropriate to consider radiation shielding of plumbing stacks particularly if the iodine-131 bedroom is located on an upper level with drainage lines passing through habitable accommodation areas of the floors below. Advice should be obtained from the Radiation Protection Officer.

Toilets should NOT be dual flush system as low volume flush may lead to blockage.

Installation of a water outlet suitable for use with a portable haemodialysis machine might be considered however it is generally preferred to coordinate this therapy around dialysis treatments.

Refer to Standard Component Ensuite for details.

5.3.6 General Disposal

A small cleaner's room should be provided to be accessed from the anteroom for dedicated cleaning equipment and supplies and slop hopper / sluice. Alternatively, the mops can be disposed of after use.

5.3.7 Delay / Holding Tanks

Refer to Radiation Protection Series 16 - Safety Guide for the Predisposal Management of Radioactive Waste for details regarding holding tanks.

Waste that exceeds the regulatory exemption limits should be assessed to determine if it can be disposed of to the sewer or to a municipal tip

If the effluent from toilets used by these patients may cause the exemption limit for discharge of iodine-131 from the premises to the sewer to be exceeded, the relevant regulatory authority may require that the toilets be connected to a holding tank system. The radioactivity and volume of the tank contents should be monitored continuously. Sufficient time should be allowed for decay of stored iodine-131 to below the exemption level for discharge to the sewerage system before a tank is emptied.

To avoid leakage problems, the tanks should be located such that the drainage line from the toilet to the tanks does not cross a building expansion joint.

Advice on the size of holding tanks will be provided by the Radiation Safety Consultant and local water authority requirements.

5.4 REFERENCES

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- Radiation Protection Series 16 - Safety Guide for the Predisposal Management of Radioactive Waste. Australian Radiation Protection and Nuclear Safety Agency (ARPANSA 2008).
- Australian and New Zealand Society of Nuclear Medicine, Requirements for PET Accreditation, 3rd Edition, 2017.
- Australian / New Zealand Standards 2243, Safety in Laboratories, Part 4 Ionizing Radiations, 2018.
- Australian Standard AS 1319-1994 Safety Signs for the Occupational Environment.
- Australian Standard AS 2896: 2021 Medical gas systems - Installation and testing of non-flammable medical gas pipeline systems.

5.5 FURTHER READING

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