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TRAINING EDUCATION & ASSESSMENT PROGRAM (TEAP) CURRICULUM FRAMEWORK

DIAGNOSTIC IMAGING MEDICAL PHYSICS (DIMP)

INTRODUCTION

The purpose of the curriculum framework is to provide stakeholders with a clear understanding of what registrars should be learning throughout their training. It also provides the opportunity to align learning activities to the curriculum for the purposes of programmatic assessment. Hence, the curriculum framework is intended to be used in conjunction with the training handbook. The curriculum framework divides learning into Key Areas and Topics, which are content focused. They are specified in the Table of Contents. Key Areas are brief, high-level descriptions of content in the DIMP TEAP. The Topics are similar to Key Areas, in that they specify content but with finer granularity. Each Topic has Learning Outcomes.

Learning Outcomes are statements of what a learner is expected to know, understand and/or be able to demonstrate after completing a process of learning. This means that each Learning Outcome in the DIMP TEAP is a statement about what the registrar knows, understands, or is able to do at the completion of training. They provide a distinction between a description of the attainment of learning, and learning activities, which are described in the training handbook. Learning activities can be aligned to the Learning Outcomes in the curriculum framework.

Elements are contained within Learning Outcomes. Elements are similarly worded in such a way that they complete the sentence, “The registrar is able to…”. Elements provide a finer level of granularity, and group together to form attainment of a Learning Outcome. Competence in Learning Outcomes is demonstrated through forms of assessment evidence specified in the DIMP Programmatic Assessment Evidentiary Framework. Assessors use expert judgment, and the form of assessment evidence specified for each Learning Outcome, to determine attainment. The form of assessment evidence for each Learning Outcome is specified in the training handbook. For Learning Outcomes with non-mandatory training activities, a training site has the option to vary the activity used to attain the Learning Outcome and may include varying the form of assessment evidence to a different form of evidence. The forms of assessment evidence are routine evidence, written task, oral assessment, practical activity, and entrustment activity.

Overall, the purpose of Key Areas and their corresponding Topics is to specify the content that is important to the DIMP TEAP. Learning Outcomes and their corresponding Elements describe what the registrar needs to be able to know or be able to do for each Topic and Key Area to demonstrate competence. The curriculum provides a robust and defensible framework such that progression throughout the DIMP TEAP can be underpinned by the principles of programmatic assessment.

DIMP CURRICULUM FRAMEWORK STRUCTURE

KA 1 - A KEY AREA (KA) IS AN AREA OF STUDY ACROSS THE PROGRAM.

Topic 1.1 - A Topic within the Key Area.

LO 1.1.1 - A Learning Outcome (LO) is a statement contained within the Topic. An LO is a statement about what the registrar knows, understands, or can do by the end of the program. Assessment evidence is used to determine attainment of a LO.

E 1.1.1a - An Element (E) is a granular statement contained within a LO.

E 1.1.1b - Each Element is a distinct and specific description of a component of the LO.

LO 1.1.2 - Another LO contained within the Topic. Each LO can be thought of as the completion of the sentence, 'At the completion of training, the registrar is able to...'

E 1.1.2a - Another Element (E) contained within the LO.

E 1.1.2b - An LO usually has several Elements.

E 1.1.2c - A registrar should be able to demonstrate competence in each of the Elements to demonstrate attainment of the related LO.

Topic 1.2 - Another Topic within the Key Area

LO 1.2.1 – This LO ends with 'DR' in brackets, which means this LO is only applicable to the Diagnostic Radiology specialty (DR)

E 1.2.1a - ...

Topic 1.3 - Another Topic within the Key Area

LO 1.3.1 – This LO ends with 'NM' in brackets, which means this LO is only applicable to the Nuclear Medicine specialty (NM)

E 1.3.1a - ...

TABLE OF CONTENTS

KA 6 - Radiation Risk Assessment and Communication

6.1 - Radiation risk to the patient in diagnostic imaging

6.2 - Radiation risk to others in diagnostic imaging

6.3 - Radiation risk to the fetus

KA 7 - Technology for Diagnostic Imaging

7.1 - Radiology equipment design and operating principles

7.2 - Nuclear medicine and PET imaging equipment design and operating principles

7.3 - Radiopharmaceuticals

7.4 – Nuclear medicine and PET imaging processing

KA 8 - Equipment Performance Testing

8.1 - Assessing the performance of diagnostic imaging equipment

8.2 - Acceptance testing of diagnostic imaging equipment

KA 9 - Applications to Diagnostic Imaging Clinical Practice

9.1 - Clinical application of common diagnostic imaging procedures and techniques

9.2 - Physiological basis and protocols for diagnostic imaging procedures

9.3 - Quantitative nuclear medicine

9.4 - Assessment of image quality in diagnostic imaging

9.5 - Function and importance of the clinical audit process

9.6 - Magnetic resonance imaging applications

KA 10 - Applications to Radionuclide Therapy

10.1 - Principles and application of radionuclide therapy

10.2 - Treatment procedures for ^{131}I radionuclide therapy

10.3 - Treatment procedures for therapeutic radionuclides other than ^{131}I thyroid therapy

10.4 - Radiation safety precautions for radionuclide therapies

KA 1 – FUNDAMENTAL RADIATION PHYSICS

Topic 1.1 – Radioactive decay and the interaction of ionising radiation with matter

LO 1.1.1 – Understand radioactive decay and decay schemes

E 1.1.1a – Describe mechanisms of decay, including electron capture, beta decay, positron decay, isomeric transition and auger electron emission

E 1.1.1b – Describe decay schemes, emission types, energy, yield, range (beta), linear attenuation coefficient and HVL (gamma)

LO 1.1.2 – Understand how radiation interacts with matter, and apply to the context of diagnostic imaging

E 1.1.2a – Describe the mechanisms of photoelectric absorption and Compton scatter

E 1.1.2b – Discuss the relationship between both photon energy and atomic number of an attenuator with probability of interactions

E 1.1.2c – Discuss the interaction of radiation with matter in the context of diagnostic imaging

E 1.1.2d – Describe the applications of broad and narrow beam measurement geometries.

LO 1.1.3 – Understand the dependence of exposure on source geometry

E 1.1.3a – Describe and calculate variation in exposure with distance from point, line, or plane radiation sources

Topic 1.2 – Ultrasound physics

LO 1.2.1 – Understand the characteristics of ultrasound and how it interacts with tissues

E 1.2.1a – Describe the characteristics of sound including wavelength, frequency, pressure and intensity (including use of dB notation)

E 1.2.1b – Describe interactions of ultrasound with tissue including interference, diffraction, resonance, reflection, refraction, attenuation, absorption and scattering

E 1.2.1c - Describe the relationship between acoustic impedance, frequency, and attenuation

E 1.2.1d - Discuss factors affecting the speed of sound through tissue

E 1.2.1e - Describe the Doppler effect

E 1.2.1f - Perform basic calculations associated with transmission of ultrasound through tissue

Topic 1.3 - Nuclear magnetic resonance physics

LO 1.3.1 - Understand the basic physics of nuclear magnetic resonance

E 1.3.1a - Define magnetic susceptibility, nuclear magnetic moments, nuclear precession, RF pulse, resonance and Larmor frequency, free induction decay, and longitudinal (T1) and transverse (T2) relaxation time

KA 2 – FUNDAMENTAL CLINICAL

Topic 2.1 – Anatomy and physiology for medical physics

LO 2.1.1 – Identify and describe anatomical, physiological and pathophysiological features in diagnostic imaging and radionuclide therapy

E 2.1.1a – Identify typical anatomy and physiology displayed on radiological, nuclear medicine and PET imaging

E 2.1.1b – Describe the function of key anatomical and physiological features

E 2.1.1c – Discuss basic radiopharmaceutical biokinetics in normal and abnormal states

E 2.1.1d – Discuss the use of interventional drugs in diagnostic and therapeutic procedures

E 2.1.1e – Demonstrate the use of appropriate medical terminology

Topic 2.2 – Basic biostatistics

LO 2.2.1 – Understand and use basic statistical terminology and perform basic statistical analysis for medical applications

E 2.2.1a – Interpret results from and perform basic descriptive statistical analysis, analysis of variance, and paired and unpaired t-tests

E 2.2.1b – Interpret basic non-parametric analyses

E 2.2.1c – Discuss basic concepts in epidemiological studies

E 2.2.1d – Discuss the concepts of relative versus absolute risk

E 2.2.1e – Interpret results from, and calculate test characteristics commonly used in clinical studies including sensitivity, specificity, positive predictive value, and negative predictive value

Topic 2.3 Basic radiation biology

LO 2.3.1 Understand the basic principles of radiation biology

E 2.3.1a - Define and discuss biological effects and responses to ionising radiation exposure

E 2.3.1b - Discuss risk models and quantitative radiation risks, including consideration of uncertainties at low doses

Topic 2.4 - Clinical activities and factors that affect patient care

LO 2.4.1 - Be familiar with clinical activities commonly used in radiology, nuclear medicine and PET imaging, and radiation oncology

E 2.4.1a - Discuss diagnostic imaging and therapeutic procedures in radiology, nuclear medicine and PET imaging, and radiation oncology including the broad merits of each technique

E 2.4.1b - Describe patient workflow for radiology, nuclear medicine and PET imaging, and radiation oncology procedures

KA 3 – FUNDAMENTAL TECHNOLOGICAL

Topic 3.1 – Basic image quality metrics

LO 3.1.1 - Describe key image quality metrics used in diagnostic imaging

E 3.1.1a - Describe the following and their effect on clinical image quality: noise, quantum mottle, SNR, count statistics, Poisson distribution, spatial resolution, point and line spread function, MTF, DQE, noise power spectrum, subject contrast, image contrast, and contrast detectability

Topic 3.2 - Imaging informatics

LO 3.2.1 - Explain how to use common medical imaging information systems

E 3.2.1a - Describe the function of PACS

E 3.2.1b - Conduct simple tasks on a PACS workstation

E 3.2.1c - Explain the basic principles, components and elements of DICOM standards

E 3.2.1d - Discuss the use and application of radiation dose structured reports and DICOM headers

LO 3.2.2 - Understand the limits of appropriate use and access to information/data

E 3.2.2a - Discuss and apply the key principles of privacy, confidentiality, sensitivity, and permission to use data

Topic 3.3 - Basics of image reconstruction and processing

LO 3.3.1 – Understand tomographic image reconstruction techniques

E 3.3.1a - Describe filtered back projection, iterative and Artificial Intelligence based reconstruction methods

LO 3.3.2 - Perform basic image processing and discuss artefacts specific to digital images

E 3.3.2a - Perform basic image processing and describe the consequences of manipulation using image processing software

E 3.3.2b - Describe artefacts specific to digital images including aliasing, partial volume and Moire pattern

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KA 4 – RADIATION SAFETY AND PROTECTION

Topic 4.1 – Radiation protection principles and legislation

LO 4.1.1 – Understand radiation protection principles and legislation

E 4.1.1a – Recognise international, national and local radiation protection bodies and detail relevant legislation

E 4.1.1b – Discuss principles and control methods of radiation protection

LO 4.1.2 – Communicate radiation protection principles

E 4.1.2a – Discuss operational radiation protection frameworks

E 4.1.2b – Communicate principles and control methods of radiation protection to staff groups

Topic 4.2 – Sources of exposure and incidents

LO 4.2.1 – Identify, quantify, and discuss sources of radiation exposure

E 4.2.1a – Identify sources of background radiation including natural and artificial sources, and typical magnitudes

E 4.2.1b – Identify internal and external radiation hazards including identification of occupational areas where higher exposure is likely to occur

E 4.2.1c – Measure and quantify external dose rates

LO 4.2.2 – Identify, investigate and report on radiation incidents

E 4.2.2a – Identify and describe what constitutes a radiation incident

E 4.2.2b – Detail reporting requirements

E 4.2.2c – Investigate and document a radiation incident in a format suitable for submission to the appropriate regulator

Topic 4.3 – Monitoring radiation levels

LO 4.3.1 – Understand local legislative requirements for personal dosimetry

E 4.3.1a – Outline local legislative requirements for personal dosimetry including persons who are or may be pregnant

E 4.3.1b - Discuss the requirements for record keeping of staff radiation doses including issues of privacy and digital storage of data

LO 4.3.2 - Understand the theory, principles of operation and limitations of personal dosimeters

E 4.3.2a - Explain the theory, principles of operation and limitations of electronic personal dosimeters, thermoluminescent dosimeters and optically stimulated luminescent dosimeters

E 4.3.2b - Discuss the theory, principles and limitations of personal monitoring

E 4.3.2c - Define the following basic operational quantities and their relationship to effective and/or organ dose for a) Personal dose equivalent Hp(10), Hp(3) and Hp(0.07), b) Ambient dose equivalent

E 4.3.2d - Contrast methods of monitoring personal radiation doses and discuss appropriate monitors for a) Routine monitoring of occupational exposure, b) Assessing exposure from an individual procedure, c) Providing feedback during a procedure including the concept of instantaneous and integrated dose

LO 4.3.3 - Practice personal dosimetry in a clinical setting

E 4.3.3a - Participate in the management of a personal radiation dose monitoring service

E 4.3.3b - Investigate and report on high doses

LO 4.3.4 - Understand and apply the theory, principles of operation and know the limitations of contamination monitors and survey meters

E 4.3.4a - Explain the theory, principles of operation and limitations of a) Gas filled detectors, b) Scintillation detectors

E 4.3.4b - Demonstrate appropriate selection and use of survey meters and contamination monitors

Topic 4.4 - Handling and management of unsealed sources

LO 4.4.1 - Discuss and perform safe handling of unsealed sources

E 4.4.1a - Discuss methods to reduce/minimise exposure from unsealed radioactive sources and decontamination techniques

E 4.4.1b - Perform safe handling practices for unsealed sources and decontamination of an unsealed source spill

E 4.4.1c - Report on environmental and personnel decontamination following a radioactive spill

E 4.4.1d - Identify how workflow and procedures can reduce non-essential contact with radioactive patients and other sources

E 4.4.1e - Perform wipe testing to quantify and assess surface radioactive contamination

LO 4.4.2 - Understand and apply design principles and legislative requirements for areas used for unsealed sources

E 4.4.2a - Identify the grade of a laboratory used for handling unsealed radioactive sources depending on the radionuclides and activity

E 4.4.2b - Discuss local legislation and guidelines to be applied to the design of areas to use and store unsealed radioactive substances

E 4.4.2c - Identify key design principles of areas suitable for the preparation, dispensing and administration of radiopharmaceuticals

LO 4.4.3 - Understand and participate in radioactive waste management

E 4.4.3a - Interpret local legislation for disposal of radioactive waste (air, water, sewage)

E 4.4.3b - Discuss radioactive waste management system principles

E 4.4.3c - Participate in the operation of a local management system

E 4.4.3d - Identify key design principles for areas suitable for a radioactive waste store

Topic 4.5 - Radiation shielding

LO 4.5.1 - Understand the principles and requirements of shielding design for diagnostic imaging facilities

E 4.5.1a - Discuss metrics applicable to shielding design including occupancy factors, workload, room layout, equipment output, and technique factors

E 4.5.1b - Identify primary, secondary, and tertiary radiation and compare the transmission through barriers

E 4.5.1c - Interpret regulatory requirements and guidelines

E 4.5.1d - Identify materials commonly used for shielding in diagnostic imaging facilities and compare their attenuation properties

LO 4.5.2 - Perform verification of radiation shielding

E 4.5.2a - Determine the attenuation properties of shielding materials

E 4.5.2b - Confirm compliance of shielding with regulatory safety limits

LO 4.5.3 - Perform radiation shielding design for nuclear medicine and PET facilities

E 4.5.3a - Perform radiation shielding design for nuclear medicine and PET facilities

LO 4.5.4 - Perform radiation shielding design for radiology facilities (DR)

E 4.5.4a - Perform radiation shielding design for radiology facilities

LO 4.5.5 - Perform radiation shielding design for radionuclide therapy facilities (NM)

E4.5.5a – Perform radiation shielding design for radionuclide therapy facilities

Topic 4.6 - Non-ionising radiation safety

LO 4.6.1 - Understand basic MRI safety

E 4.6.1a - Describe exposure sources in the MRI suite

E 4.6.1b - Describe adverse health effects of each exposure source and their cause

E 4.6.1c - Discuss the risk assessment performed for objects prior to entry to the MR suite

E 4.6.1d - Discuss the hazards and implications of a magnet quench

E 4.6.1e - Describe the procedures used to maintain safe control of the MRI environment

E 4.6.1f - Identify the risks of MRI during pregnancy

LO 4.6.2 - Describe in detail factors impacting MRI safety (DR)

E 4.6.2a - Assess the risks of common types of medical devices and non-medical items which may interact with the MRI environment

E 4.6.2b - Using manufacturer information, discuss the field interaction from a medical device identified above being brought into the suite

E 4.6.2c - Describe patient and staff exposure limits

E 4.6.2d - Describe the physical principles and risks of Gadolinium contrast and Helium

LO 4.6.3 - Understand the basic physics of MRI safety (DR)

E 4.6.3a - Define Specific Absorption Rate (SAR), Specific Energy Dose (SED) and B1+rms

E 4.6.3b - Describe induced electric fields and method for calculation of peripheral nerve stimulation thresholds

E 4.6.3c - Discuss the influence of MR sequence parameters on patient exposure

LO 4.6.4 - Understand the basic principles of lasers and associated safety issues

E 4.6.4a - Discuss the basic operating principles of lasers

E 4.6.4b - Compare the main characteristics of Class I, II, III and IV lasers

E 4.6.4c - Describe the hazards lasers present to the eyes and the skin

E 4.6.4d - Discuss basic operational safety procedures for lasers in a clinical setting

LO 4.6.5 - Understand the basic principles of ultrasound safety

E 4.6.5a - Describe risks of ultrasound to the patient

E 4.6.5b - Explain the metrics used to quantify the risk of bioeffects

E 4.6.5c - Discuss safe limits for fetal and non-fetal ultrasound exposures


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5cm
SP R17.8
Sag>Cor(2.1)>Tra(-0.8)
W 872
C 417
HFS 12 IMA 12 / 19
5cm
SP L8.2
Sag>Cor(2.1)>Tra(-0.8)
W 872
C 417
HFS 12 IMA 16 / 19

KA 5 – DOSIMETRY AND DETRIMENT

Topic 5.1 - Patient dosimetry and detriment

LO 5.1.1 - Understand the main dosimetric quantities relevant to diagnostic imaging

E 5.1.1a - Define fundamental dosimetric quantities including absorbed dose, kerma, mass energy absorption coefficient, photon and energy fluence and mass energy transfer coefficient

E 5.1.1b - Define applied dosimetric quantities including $CTDI_{air}$, $CTDI_{100}$, $CTDI_{w}$, $CTDI_{vol}$ and dose-length product (DLP)

LO 5.1.2 - Understand measurement devices used in diagnostic imaging

E 5.1.2a - Know the theory and principles of operation of ionisation chambers and solid-state detectors

E 5.1.2b - Recognise the limitations of radiation dosimeters including sensitivity, energy dependence and angular dependence

LO 5.1.3 - Describe and perform measurement of dosimetric quantities in diagnostic radiology (DR)

E 5.1.3a - Define applied dosimetric quantities including incident air kerma, entrance surface air kerma, kerma-area product (KAP), patient entrance reference point , cumulative air kerma (CAK), air kerma rate and mean glandular dose (MGD)

E 5.1.3b - Identify factors to be considered when selecting the appropriate dosimeter for measurement of dosimetric quantities related to radiology

E 5.1.3c - Apply methodologies of measuring/deriving appropriate dosimetric quantities for all radiological modalities

E 5.1.3d - Demonstrate how to account for backscatter factors and explain their dependence on beam quality, field size and thickness and composition of patient or phantom

LO 5.1.4 - Understand the concepts associated with patient and fetal dose and detriment

E 5.1.4a - Describe the concept of detriment including how age and gender should be considered

E 5.1.4b - Define equivalent dose and effective dose and discuss their applications and limitations

E 5.1.4c - Discuss uncertainties associated with dose calculations

E 5.1.4d - Discuss the size and varying position of the fetus through stages of pregnancy

LO 5.1.5 - State typical dose values for common diagnostic imaging applications

E 5.1.5a - State estimates of effective dose for common general radiography, fluoroscopy, CT, nuclear medicine, PET imaging, and mammography examinations

E 5.1.5b - State order of magnitude estimates of fetal dose for common general radiography, fluoroscopy, CT, and nuclear medicine and PET examinations

LO 5.1.6 - Calculate organ, effective and fetal dose in CT and be aware of associated limitations and uncertainties

E 5.1.6a - Apply k-factors to DLP to estimate effective dose

E 5.6.1b - Use an application for CT dosimetry (e.g. CT-Expo) to calculate absorbed, fetal, and effective dose

E 5.1.6c - Apply adult and paediatric models within the dosimetry application

E 5.1.6d - Apply SSDE to $CTDI_{vol}$ to account for variations in patient size

E 5.1.6e – Apply alternative methods or corrections to improve estimates of fetal dose at various stages of pregnancy

E 5.1.6f - Describe the limitations and uncertainties of dose estimates

LO 5.1.7 - Calculate organ, effective and fetal dose in radiography and fluoroscopy and be aware of associated limitations and uncertainties (DR)

E 5.1.7a - Describe the effect of the following variables on dose estimation: Beam quality, projection and other geometric considerations, and patient size

E 5.1.7b - Use an application for general radiography (e.g. PCXMC) to calculate absorbed, fetal, and effective dose, applying both adult and paediatric models

E 5.1.7c - Apply alternative methods or corrections to improve estimates of fetal dose at various stages of pregnancy

E 5.1.7d - Describe the limitations and uncertainties of dose estimates

LO 5.1.8 - Calculate peak skin dose in interventional fluoroscopy applications (DR)

E 5.1.8a - Discuss and apply methodologies and corrections required to estimate peak skin dose in interventional radiology

KA 5 – DOSIMETRY AND DETRIMENT

LO 5.1.9 - Calculate organ, effective and fetal dose in nuclear medicine and PET and be aware of associated limitations and uncertainties

E 5.1.9a - Know the physical and biological parameters required for absorbed dose calculation

E 5.1.9b - Describe physical and biological factors that affect the absorbed dose to particular organs

E 5.1.9c - Use published activity to dose conversion factors to calculate absorbed dose to organs, effective dose and to estimate fetal dose

E 5.1.9d - Discuss the uncertainties involved in effective dose estimates

LO 5.1.10 - Understand and apply the principles of calculation of organ and effective dose using the MIRD methodology (NM)

E 5.1.10a - Describe the MIRD methodology for internal dosimetry, including its advantages, assumptions and usefulness

E 5.1.10b - Calculate organ and effective dose using the MIRD methodology and basic biokinetic data

Topic 5.2 - Standards for radioactivity measurement

LO 5.2.1 - Understand the traceability chain for radionuclide activity measurements

E 5.2.1a - Define the traceability chain and provide a common example

Topic 5.3 - Patient specific dosimetry in therapeutic nuclear medicine

LO 5.3.1 - Perform patient specific dosimetry in therapeutic nuclear medicine (NM)

E 5.3.1a - Identify when patient specific dosimetry is required to ensure a therapeutic effect to the tumour, to spare critical organs, or both

E 5.3.1b - Calculate the activity required for patient specific radionuclide therapies

E 5.3.1c - Calculate dose to target lesion(s) and appropriate organs at risk from patient imaging and uptake measurements for common radionuclide therapies


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KA 6 – RADIATION RISK ASSESSMENT AND COMMUNICATION

Topic 6.1 - Radiation risk to the patient in diagnostic imaging

LO 6.1.1 - Use patient dose estimates to assess stochastic and tissue reaction risks

E 6.1.1a - Define stochastic effects and tissue reactions and describe the limitations and uncertainties in estimating risks

E 6.1.1b - Define the relationship between dose quantities and associated stochastic or tissue reaction risks, as described in the ICRP and BEIR models

E 6.1.1c - Calculate the risk to adults and paediatric patients from common diagnostic imaging procedures

LO 6.1.2 - Perform risk assessments for research studies/clinical trials involving exposure of humans to ionising radiation

E 6.1.2a - Determine radiation exposure to participants in addition to normal clinical management

E 6.1.2b - Assess radiation risks for research studies

E 6.1.2c - Prepare medical physicist reports for research studies involving radiation exposure

LO 6.1.3 - Effectively communicate patient radiation risks to a range of stakeholders

E 6.1.3a - Appropriately communicate patient radiation risks to: the patient, hospital/facility staff, health professionals and the general public

Topic 6.2 - Radiation risk to others in diagnostic imaging

LO 6.2.1 - Assess and effectively communicate radiation exposure risks from patients administered with radiopharmaceuticals to others

E 6.2.1a - Assess the radiation risk to close contacts of patients who have recently been administered with a radiopharmaceutical

E 6.2.1b - Assess the radiation risk to breastfeeding infants from a mother administered with a radiopharmaceutical

E 6.2.1c - Effectively communicate the risk to other close contacts, including other health professionals and carers

LO 6.2.2 - Assess and effectively communicate occupational radiation exposure risks in diagnostic radiology

E 6.2.2a - Assess and communicate the radiation risk to staff in interventional radiology, CT fluoroscopy, cardiology and other high dose procedures

Topic 6.3 - Radiation risk to the fetus

LO 6.3.1 - Assess radiation exposure risks to the fetus and effectively communicate these risks

E 6.3.1a - Recognise the threshold doses associated with detrimental radiation effects on the fetus and the risk dependence on gestational age

E 6.3.1b - Assess the radiation detriment to the fetus from diagnostic imaging procedures

E 6.3.1c - Communicate this risk appropriately to referrers, health professionals, and families

KA 7 – TECHNOLOGY FOR DIAGNOSTIC IMAGING

Topic 7.1 - Radiology equipment design and operating principles

LO 7.1.1 - Understand the fundamental design and operating principles of X-ray equipment

E 7.1.1a - Explain the operating principles of X-ray tubes and flat panel detectors including design features and components

E 7.1.1b - Discuss radiographic acquisition parameters and sources of scatter

E 7.1.1c - Explain the operating principles of CT scanners

E 7.1.1d - Discuss the use of AEC in CT

E 7.1.1e - Recognise common image artefacts in CT and their causes

E 7.1.1f - Discuss the principles and use of contrast agents

LO 7.1.2 - Operate and detail the application and design principles of x-ray equipment (DR)

E 7.1.2a - Competently operate general X-ray, mammography, fluoroscopy and CT systems for performance testing

E 7.1.2b - Describe the theory of operation and clinical application of AEC devices in general radiography

E 7.1.2c - Describe the theory of operation and clinical application of AEC devices in CT

E 7.1.2d - Describe methods for measurement of KAP and explain KAP meter applications

E 7.1.2e - Identify generator waveform characteristics associated with input power source and rectification methods

E 7.1.2f - Interpret X-ray tube ratings charts

E 7.1.2g - Describe common causes of X-ray tube failure

E 7.1.2h - Define Exposure Index (EI) and its use in radiographic imaging

E 7.1.2i - Describe radiographic image processing and identify the key characteristics of raw and processed images

E 7.1.2j - Describe the design and operating principles of image intensifier and flat panel image receptors and digital radiographic detectors

E 7.1.2k - Identify unique X-ray tube filter characteristics and describe their applications in each of general X-ray, mammography, fluoroscopy and CT systems

E 7.1.2l - Describe the effect of filtration on X-ray beam quality

E 7.1.2m - Describe scatter reduction techniques

E 7.1.2n - Describe the design and clinical application of anti-scatter grids

E 7.1.2o - Explain principles unique to OPG and CBCT (dental and fluoroscopic) imaging and the design features of these units

E 7.1.2p - Explain principles unique to mammographic imaging and the design features of mammography units

E 7.1.2q - Explain the principles and applications of digital breast tomosynthesis and mammographic biopsy systems

E 7.1.2r - Discuss the effect of fluoroscopic acquisition modes, ABC/ADRC, pulse rates and magnification modes on radiation dose and image quality

E 7.1.2s - Describe image processing in fluoroscopy and DSA imaging

E 7.1.2t - Explain the principles, methods and applications of ECG-gated, perfusion, and dual energy/spectral CT image acquisition

E 7.1.2u - Recognise common image artefacts and their causes

E 7.1.2v - Assess the impact on dose and image quality of technique factors, mode selection, image reconstruction and processing, and system configuration in general radiography, fluoroscopy, mammography and CT

LO 7.1.3 - Understand the design and operating principles of diagnostic ultrasound equipment

E 7.1.3a - Explain the basic construction and principles of operation of ultrasound transducers

E 7.1.3b - Explain the principles of and equipment design for real time ultrasound imaging

E 7.1.3c - Explain the principles of and equipment design for Doppler ultrasound imaging

E 7.1.3d - Recognise common image artefacts and their causes

E 7.1.3e - Explain the principles and use of contrast agents

LO 7.1.4 - Understand the design and operating principles of MRI equipment

E 7.1.4a - Explain the principles of image formation in MRI

E 7.1.4b - Describe commonly used clinical pulse sequences including spin-echo, inversion recovery and gradient echo

E 7.1.4c - Recognise common image artefacts and their causes

E 7.1.4d - Explain the principles and use of contrast agents

LO 7.1.5 - Understand the design and principles of specialised MRI protocols (DR)

E 7.1.5a - Describe the physics principles behind common specialist examinations: MR angiography, ADC measurement, diffusion tractography, MR perfusion, spectroscopy

Topic 7.2 - Nuclear medicine and PET imaging equipment design and operating principles

LO 7.2.1 - Explain the fundamental design and operating principles of nuclear medicine and PET imaging equipment

E 7.2.1a - Explain the operating principles, design features and components of gamma cameras (for planar and SPECT imaging), PET scanners, CT for attenuation correction, dose calibrators

LO 7.2.2 - Operate and detail the application and design principles of key nuclear medicine and PET equipment (NM)

E 7.2.2a - Competently operate the following equipment: Dose calibrators, SPECT/CT and PET/CT scanners

E 7.2.2b - Describe the effect of geometry, source position, activity, energy and emission type on measurement of radioactivity in a dose calibrator

E 7.2.2c - Identify and describe the corrections required for routine clinical use of a gamma camera including uniformity, energy and linearity

E 7.2.2d - Identify and describe the corrections required for routine clinical use of PET scanners including attenuation, scatter, randoms, deadtime, decay, normalisation and scanner calibration

E 7.2.2e – Recognise common image artefacts and discuss their causes

E 7.2.2f - Describe the advantages and limitations of CT for attenuation correction and anatomical localisation

E 7.2.2g - Explain the operating principles, design features and components of gamma counters

Topic 7.3 - Radiopharmaceuticals

LO 7.3.1 - Describe methods of production of medical radioisotopes

E 7.3.1a - Discuss production of radioactive materials using nuclear reactors, cyclotrons, and radionuclide generators

LO 7.3.2 - Describe desirable characteristics for radionuclides used in nuclear medicine and PET imaging

E 7.3.2a - Compare commonly used radionuclides and detail the physical and chemical properties of each that makes them suitable for use in nuclear medicine and PET imaging

Topic 7.4 - Nuclear medicine and PET imaging processing

LO 7.4.1 – Understand the structure of image file formats commonly utilised in nuclear medicine and PET (NM)

E 7.4.1a - Discuss the differences between PET and SPECT DICOM file structures and elements

LO 7.4.2 – Perform basic image manipulation and analysis on a clinical workstation (NM)

E 7.4.2a – Perform basic image manipulation and analysis using a clinical workstation

KA 8 – EQUIPMENT PERFORMANCE TESTING

Topic 8.1 - Assessing the performance of diagnostic imaging equipment

LO 8.1.1 - Understand and assess image quality on diagnostic graded medical displays

E 8.1.1a - Describe and use relevant test patterns to assess image quality

E 8.1.1b - Describe luminance and illuminance and Just Noticeable Difference (JND) and how these impact image quality

E 8.1.1c - Describe and apply the GSDF as described in DICOM part 14

LO 8.1.2 - Conduct performance testing of radiological equipment and interpret results (DR)

E 8.1.2a - Perform relevant tests, analyse and interpret results of the following equipment types: general radiographic equipment, digital radiography equipment, CT equipment, mammography equipment, extra-oral dental radiography equipment, fluoroscopy and interventional equipment

E 8.1.2b - Provide recommendations for addressing non-compliances with relevant radiation safety standards/regulations or performance guidelines

LO 8.1.3 - Conduct performance testing of nuclear medicine and PET equipment and interpret results (NM)

E 8.1.3a - Perform relevant tests, analyse and interpret results of the following equipment types: dose calibrators, gamma cameras, PET scanners, CT for hybrid imaging

E 8.1.3b - Identify results that are out of local tolerance and recommend appropriate actions

LO 8.1.4 - Apply a suitable quality control program for diagnostic imaging systems

E 8.1.4a - Apply a quality control program for diagnostic imaging systems including staff training, auditing of compliance and ongoing results review

Topic 8.2 - Acceptance testing of diagnostic imaging equipment

LO 8.2.1 - Understand the requirements for acceptance testing

E 8.2.1a - Identify the key elements and purpose of acceptance testing of diagnostic imaging equipment in addition to routine performance testing requirements

LO 8.2.2 - Conduct acceptance testing of diagnostic imaging equipment and interpret results

E 8.2.2a - (for your specialty) Identify commonly performed acceptance tests for a specific modality in diagnostic imaging and outline how these results are used to establish a baseline

E 8.2.2b - Design plans to conduct acceptance testing for a PET camera (NM) or an interventional fluoroscopy unit (DR)

E 8.2.2c - Conduct acceptance testing for a specific piece of diagnostic imaging equipment and compare measurements with the manufacturer's specifications and any required minimum performance standards

E 8.2.2d - Identify results that are out of required tolerance and recommend appropriate actions

KA 9 – APPLICATIONS TO DIAGNOSTIC IMAGING CLINICAL PRACTICE

Topic 9.1 - Clinical application of common diagnostic imaging procedures and techniques

LO 9.1.1 - Understand the clinical purpose and techniques used in common diagnostic radiology procedures

E 9.1.1a - Interpret the clinical information elicited from common diagnostic radiology procedures

LO 9.1.2 - Understand the clinical purpose and techniques used in common nuclear medicine and PET imaging procedures

E 9.1.2a - Interpret the clinical information elicited from common nuclear medicine and PET studies

Topic 9.2 - Physiological basis and protocols for diagnostic imaging procedures

LO 9.2.1 - Explain the commonly performed diagnostic nuclear medicine studies across the following key areas: bone, brain, lung, myocardial, endocrine and renal function (NM)

E 9.2.1a - For each diagnostic nuclear medicine study type a) discuss the clinical purpose of the study and the relevant physiological processes and imaging factors, b) outline the appearance of normal and abnormal studies, c) describe factors that may affect the quality of the study, including patient factors that may cause artefacts

LO 9.2.2 - Explain commonly performed diagnostic radiology procedures across the following key examinations: coronary angiography, head CT, CTPA and chest X-ray (DR)

E 9.2.2a - For each key examination type a) discuss the clinical purpose of the examination and the relevant physiological processes and imaging factors, b) outline the appearance of normal and abnormal examinations, c) describe factors that may affect the quality of the examination, including patient factors that may cause artefacts

LO 9.2.3 - Understand the physiological basis and protocols for FDG PET studies (NM)

E 9.2.3a - Discuss the underlying condition being assessed/diagnosed

E 9.2.3b - Discuss the relevant physiological uptake process(es)

E 9.2.3c - Describe the imaging acquisition and reconstruction protocols

E 9.2.3d - Compare normal and abnormal uptake

E 9.2.3e - Describe factors that may affect the quality of the examination, including patient factors that may cause artefacts

LO 9.2.4 - Understand the physiological basis and protocols for common diagnostic PET studies using non-FDG tracers (NM)

E 9.2.4a - Discuss the underlying condition being assessed/diagnosed

E 9.2.4b - Discuss the relevant physiological uptake process(es)

E 9.2.4c - Describe the imaging acquisition and reconstruction protocols

E 9.2.4d - Compare normal and abnormal uptake

E 9 .2.4e - Describe factors that may affect the quality of the examination, including patient factors that may cause artefacts

Topic 9.3 - Quantitative nuclear medicine

LO 9.3.1 - Explain the main factors affecting quantitative measurements in nuclear medicine (NM)

E 9.3.1a - Explain factors that affect quantitative accuracy of the following study types: gated cardiac SPECT for LVEF, renal function, quantitative SPECT

E 9.3.1b - Describe the corrections required

LO 9.3.2 - Perform calibrations for quantitative planar and SPECT nuclear medicine studies (NM)

E 9.3.2a - Perform planar and SPECT activity concentration calibration and validation

E 9.3.2b - Discuss sources of error and their potential impact on the accuracy of quantitation

Topic 9.4 - Assessment of image quality in diagnostic imaging

LO 9.4.1 - Understand and apply metrics to assess image quality for various diagnostic radiology modalities (DR)

E 9.4.1a - Discuss objective image quality metrics for evaluation of radiological imaging systems

E 9.4.1b - Discuss clinical image quality metrics for evaluation of radiological imaging systems

E 9.4.1c - Perform image quality evaluation through assessment of objective measures with phantoms

E 9.4.1d - Perform image quality evaluation through assessment of clinical images

LO 9.4.2 - Design and participate in optimisation processes for radiology examinations (DR)

E 9.4.2a - Formulate recommendations for adjustment of technical settings and/or operator controllable factors for management of clinical image quality with consideration of patient radiation dose

LO 9.4.3 - Understand and apply optimisation processes for nuclear medicine examinations (NM)

E 9.4.3a - Describe the trade-off between absorbed dose to the patient and diagnostic image quality in diagnostic nuclear medicine procedures

E 9.4.3b - Evaluate the impact on image quality of administered activity, acquisition and processing methods for nuclear medicine examinations

Topic 9.5 – Function and importance of the clinical audit process

LO 9.5.1 - Describe national diagnostic imaging accreditation requirements and the role of clinical audit in medical imaging facility accreditation

E 9.5.1a - Review the DIAS (Australia) or IANZ (NZ) standards and RANZCR Standards of Practice

E 9.5.1b - Describe the role of the medical physicist in accreditation and clinical audit within a diagnostic imaging department

LO 9.5.2 - Perform a dose audit/survey and interpret the results

E 9.5.2a - Define the purpose and appropriate metrics for Diagnostic Reference Levels (DRL) for all diagnostic imaging modalities

E 9.5.2b - Collate, analyse, interpret and present data as part of a dose survey for a specific examination within a diagnostic imaging department

E 9.5.2c - Compare results from a dose survey to National Diagnostic Reference Levels (NDRL) or other relevant standards

Topic 9.6 - Magnetic resonance imaging applications

LO 9.6.1 - Discuss the effect on MRI image quality of altering key acquisition parameters (DR)

E 9.6.1a - Describe the effect on signal to noise ratio and spatial resolution of field of view, matrix, TR, TE, signal averaging, parallel imaging, bandwidth, k-space manipulations and influence of field strength

E 9.6.1b - Recognise the appearance of standard sequences/weightings: T1, T2, T2*, PD

KA 10 – APPLICATIONS TO RADIONUCLIDE THERAPY

Topic 10.1 - Principles and application of radionuclide therapy

LO 10.1.1 - Understand the basic principles and legislation pertaining to radionuclide therapy

E 10.1.1a - Compare the types of radiation emissions from therapeutic radionuclides and the advantages and limitations

E 10.1.1b - List radiopharmaceuticals commonly used for therapy

E 10.1.1c - Identify relevant legislative limits for outpatient radionuclide therapies and for release of patients following in patient radionuclide therapies

E 10.1.1d - Outline the principles and provide examples of contemporary theranostic treatments

Topic 10.2 - Treatment procedures for ^{131}I radionuclide therapy

LO 10.2.1 - Understand the principles and aims of ^{131}I thyroid therapies (NM)

E 10.2.1a - Identify clinical applications of ^{131}I thyroid therapies

E 10.2.1b - Discuss the mechanism of action of ^{131}I for the therapeutic treatment of thyroid diseases

E 10.2.1c - Identify contraindications and common side effects

E 10.2.1d - Describe measures taken to optimise therapy and reduce side effects

Topic 10.3 - Treatment procedures for therapeutic radionuclides other than ^{131}I thyroid therapy

LO 10.3.1 - Discuss common conditions in which non-^{131}I thyroid therapies are used (NM)

E 10.3.1a - List conditions commonly treated with radionuclide therapy including which radiopharmaceuticals are appropriate for treatment

E 10.3.1b - Discuss treatment protocols for routine standard dose therapies

E 10.3.1c - Describe treatment contraindications, critical organ dose and common side effects

Topic 10.4 - Radiation safety precautions for radionuclide therapies

LO 10.4.1 - Effectively communicate appropriate radiation safety precautions for both ^{131}I thyroid and non-^{131}I thyroid therapies (NM)

E 10.4.1a - Advise patients, and their families, of preparations to follow prior to, and precautions to follow during and after, routine therapies

E 10.4.1b - Advise hospital staff involved in therapies on safe work practices to ensure safety of themselves, the patient, other healthcare employees and visitors

LO 10.4.2 - Manage radiation safety and regulatory requirements for both ^{131}I thyroid and non-^{131}I thyroid therapies (NM)

E 10.4.2a - Monitor safe administration of radionuclides for therapy

E 10.4.2b - Determine patient discharge with respect to legislative limits for radiation safety

E 10.4.2c - Perform post-discharge room decontamination and radioactive waste disposal

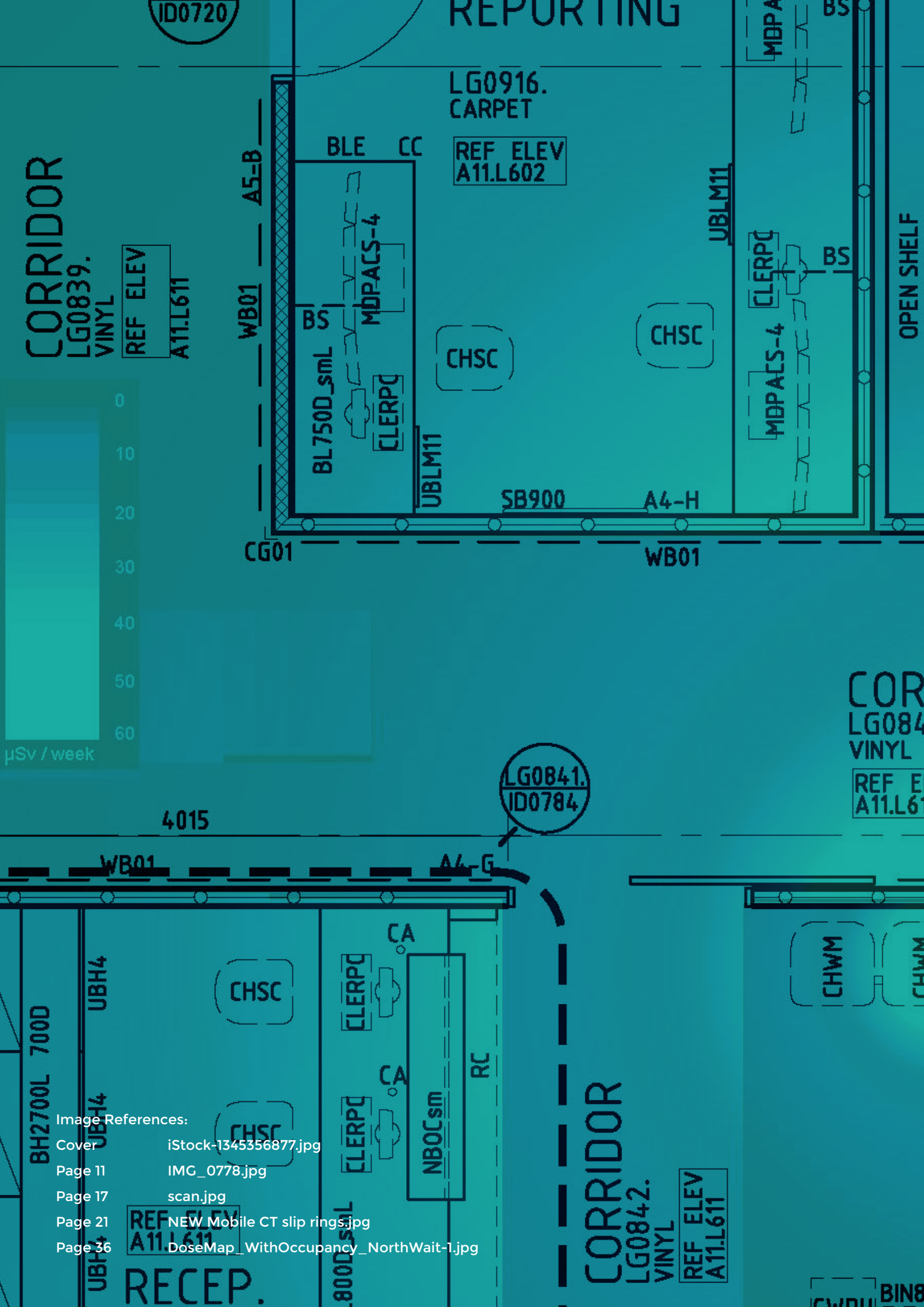

Image References:

Cover	iStock-1345356877.jpg
Page 11	IMG_0778.jpg
Page 17	scan.jpg
Page 21	NEW Mobile CT slip rings.jpg
Page 36	DoseMap_WithOccupancy_NorthWait-1.jpg

Name of document and version: Diagnostic Imaging Medical Physics (DIMP) Training, Education and Assessment Program (TEAP) Curriculum Framework, Version 1.0

Approved by: Diagnostic Imaging Certification Panel

Date of approval: 16 January 2023

Effective date: 31 March 2023

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