RADIATION SAFETY MANUAL

Date: 15 April 2019	**Author**: Rami Meina	**Responsibility for application**: Supervising MIT and Practice Managers.
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a. Purpose

The purpose of the Radiation Management Plan is to detail the management and responsibilities of staff for the safe management, use and handling of radiation at GIG Radiology.

b. Scope

The Radiation Management Plan is intended as a guide for those staff involved in the use of ionising radiation for the medical diagnosis and treatment of disease. It also service as a source for other staff members not directly involve with the use of ionising radiation but wish to know which radiation hazards they may encounter in their day to day routine.

c. Policy

GIG Radiology is committed to ensure health, safety and security of staff, patients and others who may potentially be exposed to ionising radiation at any GIG Radiology site.

d. Processes and Practices

See each Protocol for specific processes and practices.

e. Records

Patient Records, CT and X-ray films, CT reports, Patient referrals, Incident Reports

f. Document Control

Printed versions of this document are uncontrolled and may not be current. A current protected version will be available at GIG Head Office. Document control is retained at Head Office. Changes and alterations can be suggested to the Author and Approver.

g. Document History

Version	Date	Description	Author	Approver
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Contents

Acknowledgements

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Implementation and review of the Radiation Management Plan

The Radiation Management Plan shall be distributed to all GIG Radiology Staff involved in use and handling of radiation sources. An onsite register shall be maintained of relevant staff that have received and reviewed the RMP. Practice Mangers/ Senior MIT's at each site will be locally responsible for the implementation of the RMP at the site level and will formally notify the RSO of any corrective measures that require their attention. A log of corrections shall be maintained at Head Office. Updated version of RMP shall also be placed in printed form at the workstation of each radiation modality.

The RMP shall be reviewed every 2 years or upon amendments to the related legislation / terms of the Radiation Management License.

Introduction

GIG Radiology is a group of practices located throughout South East Victoria and administrated from:

23 John Street
Pakenham, 3810

Each site has a Site Manager or Supervising Medical Imaging Technologist. They are the first point of contact for staff with questions regarding radiation safety.

GIG Radiology has Radiation Safety Officers whose role is to coordinate management of the radiation safety program and provide specialist advice and assistance in matters relating to radiation safety.

The Operations Manager in conjunction with the Medical Advisory Committee oversees and manages radiation safety matters at GIG Radiology.

Sources of Radiation at GIG Radiology

GIG Radiology uses ionising radiation in the following modalities to obtain diagnostic information:

- General X-ray
- Mammography
- OPG
- CT
- CBCT

GIG Radiology Radiation Safety Policy

1. GIG Radiology shall pay due regard and manage both the benefits and risks from the use of all types of radiation.
2. GIG Radiology shall apply the radiation protection principles outlined in the Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (2008), namely;
    - 2.1 Justification – Use of ionizing radiation in medical procedures must be justified prior.
    - 2.2 Optimisation – Radiation doses used in daily clinical practice must be kept As Low As Reasonably Achievable (ALARA)
    - 2.3 Dose Limitation - Radiation Doses for patients and staff must not exceed dose limits specified in Radiation Protection Series (RPS) No.1

3. GIG Radiology employs an extensive range of radiation procedures and the practices must meet community standards of safety for patients, staff and others.

4. GIG Radiology shall ensure that the organization:

    - 4.1. provides the clinical benefits of radiation for its patients;
    - 4.2. has the highest possible standards of radiation safety for patients and staff;
    - 4.3. provides the resources necessary to minimise radiation exposure to patients, staff and others;
    - 4.4. meets all of its relevant legal responsibilities;
    - 4.5. prepares and collects protocols for implementation of best practice in relation to radiation safety.

5. GIG Radiology will ensure that the appointed Radiation Safety Officer will comply with the list of responsibilities listed in the Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (2008) and where appropriate AS2243.4 1998 'Safety in Laboratories'.

6. GIG Radiology will comply with

    - 6.1. Radiation Act 2005
    - 6.2. Radiation Regulations 2007.
    - 6.3. Australian Health Practitioner Regulation Agency (AHPRA) / Medical Radiation Practice Board (MRPB)
    - 6.4. Conditions of the GIG Radiology Radiation Management License issued by the Victorian Department of Health, including, but not limited to, compliance with the Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (2008).
    - 6.5. ISO 9001:2000 standards related to Quality Standards
    - 6.6. RANZCR/NATA GUIDELINES
    - 6.7. The requirements of this RMP

National Standards & Legislation

Victorian Regulatory Documents

- . Victorian Radiation Act 2005.
- . Victorian Radiation Regulations 2007.

Department of Health Publications

- X-ray equipment disposal, Victorian Department of Health, 22 December 2011.
- Testing lead aprons used in diagnostic radiology departments, Victorian Department of
- Health, 22 December 2011.
- Mandatory reporting of radiation incidents, Victorian Department of Health, 13 March 2012.
- Mandatory radiation safety requirements – Management licence holder's obligations, Victorian
- Department of Health, 10 January 2012.

ARPANSA Radiation Protection Series (RPS)

- ARPANSA Radiation Protection Series (RPS) 1, Recommendations for Limiting Exposure to Ionizing Radiation (Printed 1995 – Republished 2002), and National Standard for Limiting Occupational Exposure to Ionizing Radiation (Printed 1995 – Republished 2002).
- ARPANSA Radiation Protection Series (RPS) 6, National Directory for Radiation Protection, Edition 1.0 (2004).
- ARPANSA Radiation Protection Series (RPS) 8, Code of Practice for the Exposure of Humans to Ionizing Radiation for Research Purposes (2005).
- ARPANSA Radiation Protection Series (RPS) 10, Code of Practice and Safety Guide for Radiation Protection in Dentistry (2005).
- ARPANSA Radiation Protection Series (RPS) 14, Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (2008)
- ARPANSA Radiation Protection Series (RPS) 14.1, Safety Guide for Radiation Protection in Diagnostic and Interventional Radiology (2008)

Duties of Radiation Safety Officer

- Ensure that safe radiation practices are maintained and advise Executive Management on all matters relating to radiation safety.
- Ensure that all staff are adequately trained and educated in safe radiation standards through site orientation and continued instruction.
- Ensure that all staff, patients and others are protected from unnecessary exposure to radiation through provision of safe working instructions and adequate personal and structural protective means to ensure that doses are as low as reasonably achievable (ALARA), social and economic factors being taken into account.
- Be familiar with current regulations and policies.
- Advice on safe working practices in accordance with regulations and the relevant codes of practice.
- Ensure that GIG Radiology complies with all licensing requirements.
- Consult and liaise with relevant authorities.
- Liaise with occupationally exposed persons.
- Ensure that adverse incidents are reported to the Operations Managers. Report and assist with the reporting of radiation incidents.
- In the event of an incident, ensure that arrangements are made for additional medical care and treatment.
- Ensure that documentation is completed and filed and appropriate records are kept for all radiation safety matters.
- Ensure the RMP is maintained.
- Perform any task or provide any material requested by the organisation or its workers or clients on any matter pertaining to radiation and safety.
- Oversee a Personal Radiation Monitoring Programme across all of GIG Radiology.
- Assess accumulated and committed effective doses of staff and staff groups.
- Ensure the maintenance of radiation monitoring equipment and radiation protection equipment.
- Maintain shielding plans of all sites, including amended plans where modifications have been completed.

Responsibilities

Employer Responsibilities

- Ensure that a high standard of radiation protection is provided.
- Ensure that all staff, equipment, and procedures comply with relevant radiation statutory requirements, guidelines and codes of practices.
- Ensure that all appropriate policies and procedures have been ratified and distributed to all staff and students.
- Staff are made aware of, and kept informed of changes in:
    - General radiation safety and awareness;
    - The specific hazards associated with their work procedures;
    - Reporting of radiation incidents;
    - Protective equipment requirements, including personal radiation monitoring;
    - The steps that they must take to minimise any hazard(s);
    - The names of the Radiation Safety Officer, Radiation Safety Awareness Officers, and members of the Radiation Safety Committee;
    - Emergency contacts and procedures; and
    - Adequate orientation, training, information and supervision is provided for all new staff.
- Relevant workplace and personal monitoring programs are in place and all persons are routinely informed of the results pertaining to themselves.
- All radiation apparatus are regularly checked and maintained.
- All radiation incidents are thoroughly investigated with a view to preventing a recurrence.
- All radiation incidents are reported to the relevant statutory authority if required.
- All radiation records are maintained as required by legislation.
- All construction of new facilities shall be in accordance with relevant regulatory standards designed to limit radiation exposure to both staff and public.

Employee Responsibility

- To work in a manner that is safe, keep all exposures to ionising radiation as low as reasonably achievable, and take into account the effects of their work on their fellow workers.
- Not to endanger their own health/lives, or that of others, by undertaking unsafe work practices.
- Make proper use of safety devices that are provided by the employer.
- Carry out all radiation safety procedures and requirements that apply to any procedure involving radiation sources or equipment.
- Know what to do in case of an incident or emergency. Report immediately any incidents or unsafe work conditions to their supervisor or the RSO.
- Any person performing procedures involving radiation apparatus or must be licensed to carry out such work, licences must be renewed annually and may require prior accreditation by the appropriate professional body. Students must be directly supervised by a suitably licensed person.
- Comply with all conditions of any licence they hold.
- Comply with regulatory requirements by wearing their personal radiation monitor during work practices that will potentially expose them to ionising radiation.

- Comply with all reasonable requests made of them by the Radiation Safety Officer, including attendance at relevant training programs.
- Comply with the requirements of this RMP.

- The two main Employee groups responsible for the conduct of Diagnostic Radiology Procedures, including a summary of their specific responsibilities include;

1. The Medical Radiation Practitioner;

   The Radiation Medical Practitioner is responsible for obtaining appropriate radiation licence/registration, and complying with the conditions to which the licence is subject.

   The Radiation Medical Practitioner must hold current registration with the Australian Health Practitioners Regulation Agency (AHPRA)

   The justification and optimization of procedures involving the exposure of a patient to ionizing radiation, either for each individual or by procedure specific protocols approved by the specialist.

2. The Operator (typically MIT's);

   All Operators must hold current registration with the Australian Health Practitioners Regulation Agency (AHPRA).The Operator must hold a current Radiation Use Licence relevant to their area of practice and comply with the conditions to which the licence is subject. Licences must be renewed annually and may require prior accreditation by the appropriate professional body.

   The use of supplied radiation safety equipment – lead gowns, thyroid shields, glasses, fixed shielding installations. The wearing of radiation monitors – usually worn at the hip, and under any personal protective equipment.

   The safe use of radiation apparatus under their control.

   Students under supervision have a duty of care to work in a safe and proper manner and must follow directions given to them by the licence holder supervising their work. No student shall perform any procedure unless supervised by a licence holder.

Radiation Safety Regulations

The Victorian Radiation Act 2005 and the Radiation Regulations 2007 control all use of non-ionising and ionising radiation apparatus and radioactive materials in Victoria.

The Victorian legislation requires that GIG Radiology hold a Management Licence to authorise the conduct of a radiation practice (such as possessing, selling or transporting a radioactive source) and individuals to have a Use Licence to authorise the use of a radiation source. The Department of Health (DoH) stipulates conditions of the licence, which generally include a requirement that the equipment and/or users of ionising radiation comply with appropriate Codes of Practice and Australian Standards.

Contraventions against, or failures to comply with, the Victorian Act and/or Regulations or any conditions or restrictions made under the Act or Regulations constitutes an offence and may incur a penalty.

Management Licence

The Management Licence details the maximum number of sources of each type permitted at each GIG Radiology site.

All ionising radiation apparatus and sealed sources are given a unique number (called the reference number) to be used as a means of identification. The details of all ionising radiation apparatus and sealed sources, such as manufacturer, model, serial number, reference number and current location are listed in Schedule 10 of the Management Licence.

Use Licence

All staff members who operate, use, or otherwise deal with an ionising radiation source (e.g. X-ray unit) must hold a licence to do so, unless otherwise exempt. This is known as a Use Licence. Use Licences are issued by DoH and information on licence applications and renewals are available on the DoH website.

Applications and renewals of licences are the responsibility of the individual. Certain conditions and/or exemptions may exist for certain uses of radiation. The Operations Managers maintain a list of staff licences. GIG Radiology checks the status of use licenses monthly and prior to the employment of additional users. Any staff found to have an expired use license shall be prevented from operating irradiating apparatus until such as time as their authorization is restored and may also be subject to disciplinary measures.

Conditions of Licence

Incident reporting

A principal condition of the Management Licence requires compliance with the DoH publication 'Mandatory Reporting of Radiation Incidents'. This publication instructs the licence holder on which incidents are reportable, the timeframe for reporting and how they should be reported to DoH. As part of the GIG Radiology incident reporting scheme for radiation incidents, the RSO will assess the incident and determine if it is reportable to DoH. This publication is included in the Appendix section of this document.

Acquisition and Disposal of Radiation Sources

GIG Radiology is required to notify the DoH of any acquisition or disposal of a radiation source(except unsealed radioactive material), providing all available details. For sealed sources, sealed source apparatus, ionising radiation apparatus and non-ionising apparatus the DoH must be notified within 14 days. It is the responsibility of the RSO/Operations Manager to notify DoH when a GIG Radiology site acquires disposes or relocates a radiation source.

Medical Practices Involving Ionising Radiation

Medical practices involving ionising radiation require compliance with the Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (2008) (hereafter referred to as the "Medical Code") published by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). Compliance with the Medical Code is listed as a condition of licence for all medical practices at GIG Radiology. One of the fundamental requirements of the Code is the development of this RMP which incorporates mandatory elements of the Code.

The Medical Code is accompanied by a Safety Guide: Diagnostic and Interventional Radiology, (hereafter referred to as the "Radiology Safety Guide",). This safety guide contains advisory information to assist in complying with the Medical Code.

Objectives of Radiation Protection

Ionizing radiation is a valuable tool in medicine, but its use must be tempered by the recognition that such radiation is a potential health hazard. Consequently, methods must be employed to minimize this hazard.

Ionizing radiation interacts with human tissues resulting in biological damage. The damage to tissues is primarily due to secondary charged particles which yield highly reactive free radicals that interact with molecules in the tissues, breaking chemical bonds and causing a variety of chemical changes. The resultant radiation induced biological effects are variable. Radiation effects are divided into three groups:

1. Stochastic Effects
2. Deterministic Effects
3. Hereditary Effects

In stochastic effects, the probability (but not the severity) of occurrence is related to the magnitude of the dose, without threshold. Theoretically, there is zero risk only at zero dose. In practice, the risk at very low doses is negligible. Hereditary effects are also stochastic. With deterministic effects, there is a threshold below which the effect does not occur. Beyond this threshold the severity of the effect is related to the dose**. The object of radiation Protection is to prevent detrimental deterministic effects and to limit the occurrence of stochastic events to acceptable levels. The objective is achieved by;**

1. Justification of radiation exposure
2. Optimisation of the dose to the lowest possible level (as low as reasonably achievable - the ALARA principle)
3. Setting limits to the equivalent dose which can be received in any year.

Dose limits should be treated as such and are not a permitted maximum. The lowest possible dose should always be aimed for.

Sources of Ionising Radiation

Exposure may be experienced;

1. In the workplace (occupational exposure)
2. By members of the public
3. By patients

Exposure may be intentional or accidental.

The majority of the annual radiation dose to the population is from natural sources of radiation eg.

1. Cosmic radiation
2. Building materials
3. Natural radon

The background radiation dose in Australia is of the order of 2-2.5 msV annually. Medical sources of radiation are the largest man-made component of background sources.

Risk Due to Radiation - (Ref ICRP 60)

Under normal circumstances, the risk is relatively small compared with the risk of death from other causes. However, it is not negligible, and radiation exposure to workers and patients should be kept as low as is practical.

Public perception of the risk due to radiation can be exaggerated, so it is important to put this risk into comparison with other activities. The baseline cancer mortality rate (all other causes) is 0.15-0.25 per million (0.00000015 –0.00000025)

The following table illustrates the relative risk involved for a number of common activities and the risks associated with the irradiation of particular organs.

Organ irradiated	**Risk per mGy**	
Lung	8.5 X 10-6	(0.0000085)
Breast	4.0 X 10-6	(0.0000040)
Thyroid	0.8 X 10-6	(0.0000008)
Skin	2.0 X 10-6	(0.0000020)
Ovary	2.0 X 10-6	(0.0000020)
Bone marrow	5.0 X 10-6	(0.0000050)

Scenario	**Cause of death**	**Risk**
100km travel by car	Accident	1.0 X 10-6
1000km travel by car	Accident	1.0 X 10-6
Smoking 1-3 cigarettes	Cancer / Lung disease	1.0 X 10-6
2 hours passive smoking	Cancer / Lung disease	1.0 X 10-6
Drinking ½ bottle of wine	Liver / other disease	1.0 X 10-6
5 hour flight by jet aircraft	Cancer (cosmic rays)	1.0 X 10-6

For patients irradiated during diagnostic or therapeutic procedures using ionising radiation, there are risk/benefit considerations. Often the benefit of the diagnostic information obtained far outweighs the radiation hazard. Also, the risk associated with a patient's illness may be such that any additional hazard from radiation will be insignificant.

NO EXAMINATION INVOLVING IONISING RADIATION SHOULD BE PERFORMED IF LITTLE OR NO INFORMATION IS LIKELY TO BE OBTAINED.

MULTIPLE TESTS INVOLVING IONISING RADIATION SHOULD BE DISCOURAGED UNLESS CLINICALLY RELEVANT.

The tissues and organs of paediatric patients are more radiosensitive than those of adults. Consequently, the irradiation of paediatric patient needs special consideration.

ALL RADIATION DOSES MUST BE KEPT AT THE MINIMUM.

Ionising radiation is also potentially damaging to the foetus, especially during the 8-16 week period. These risks, even at relatively large levels of exposure, are small compared to the normal risks of pregnancy.

However, accidental or unintentional exposure of the embryo or foetus of a patient who is consequently found to be pregnant must be referred to the Practice Radiation Safety Officer immediately for investigation and assessment.

For female staff working with radiation, upon confirmation of pregnancy, arrangements should be made to ensure that the woman works only under such conditions that the foetus receives the same protection as for a member of the public. (<1msV per year)

Further, more specific information, including recommended annual dose rates, is available in ICRP 60.

Principles of Radiation Protection

1. TIME — The total radiation exposure to an individual is directly proportional to the time of exposure to the radiation source i.e. the longer the exposure, the higher the dose
2. DISTANCE — The intensity of a radiation source and hence the radiation exposure, varies inversely as the square of the distance from the source to the point of exposure. (Even if the source is not a point, the inverse square law will be a good estimate.)
3. SHIELDING — Various high atomic number materials that can absorb radiations can be used to provide radiation protection. For economic reasons, lead is most commonly used for this purpose.

- **gamma or X-radiation - any dense material eg. lead, concrete, steel.**
- **beta particles - light materials eg. perspex.**
- **neutrons - materials containing a high proportion of hydrogen eg. paraffin wax.**

IN MANY INSTANCES, TIME AND DISTANCE ARE THE BEST PRACTICAL PROTECTION MEASURES.

Shielding is best used in fixed installations, but is useful in other forms e.g. lead aprons, etc. Each individual worker has a responsibility to himself and his co-workers to ensure that safe practices are followed at all times. Those staff dealing with patients must ensure that not only their own, but also the patient's exposure to radiation is minimal, consistent with the procedure involved.

Radiation Incident Process

GIG Radiology must comply with the DoH publication *Manadatory reporting of radiation incidents*. One of the requirements of this document is that all radiation incidents as defined in the publication are reported to the DoH within 14 days. This publication is included in the Appendix section of this document. Reportable incidents include,but are not limited to the following;

- Any unplanned exposure to a child (under 18 years old).
- Any unplanned exposure to a pregnant female.
- A human diagnostic procedure that results in a skin dose that exceeds 6 Gy.
- Where a radiation source is or has been out of control. This includes situations where, for example, the source is not safely secured or shielded, or contamination is not confined.
- Where an ionising radiation apparatus, sealed source, or sealed source apparatus is or has been damaged or has malfunctioned, in a manner that could result in a person receiving a higher radiation dose than would be received under normal circumstances.
- A worker or a member of the public has or may have received an unplanned or abnormal exposure to ionising radiation, other than a justified medical exposure, exceeding 1 mSv total effective dose.
- Any human diagnostic procedure other than as prescribed that could lead to an effective dose exceeding 1 mSv (including wrong patient, or wrong body part examined).
- The management licence holder becomes aware that a radiation source that was in their possession is lost or has been stolen.
  Note that Section 20 of the Act requires that the management licence holder on becoming aware that a radiation source that was in their possession is lost or stolen must immediately notify the Department of the loss or theft.

The reporting time frame does not apply when there has been a loss or theft of a source of radiation. In these instances, the DoH must be notified immediately on 1300 790 733. This number is available 24 hours a day, 7 days a week.

Radiation Incident reporting process

1. In the event of a Radiation Incident as listed the RSO must be notified by phone as soon as practicable following the event.
2. A GIG Radiology Incident from must be completed as soon as possible and forwarded to the operations manager the same day. This report must contain
    i. Patient and staff details
    ii. Copy of the radiology request
    iii. Details of the exposure (kV, mAs, distance, apparatus, or estimated dose)
    iv. In the event of an unplanned exposure to a pregnant female, the patient must also be questioned about any other radiological or nuclear medicine procedures that may have taken place during gestation.
3. The RSO will contact the responsible Operations Manager by phone.
4. Based on the information provided, the RSO's will determine if the incident needs to be reported to the DoH and will assist with submitting the incident report.
5. If the Radiation Incident is reportable expert advice from a Medical Imaging Physicist (SGS Australian Radiation Services) shall be sought and a risk assessment report produced.
6. The RSO's may use the information from the incident and report to review current working practices and may make recommendations with the intention of reducing the probability of such incidents occurring in the future.
7. If the incident involves exposure to staff or a member of the public, management of the exposure is to be co-ordinated by the RSO following an assessment of risk provided by a Medical Imaging Physicist (SGS Australian Radiation Services). Where appropriate the RSO shall coordinate the management of the exposure with an appropriately qualified GIG Radiology Medical Radiation Practitioner and where staff are involved, the Occupational Health and Safety Officer. Any staff member or member of the public subject to an unplanned or abnormal exposure, including where a foetus has been inadvertently exposed, it to be informed of the risk and counselled by a suitably qualified Medical Practitioner upon completion of the Medical Imaging Physicists report. It is the responsibility of the RSO to arrange appropriate counselling resources, including but not limited to the patients referring Medical Practitioner, a GIG Radiology Medical Radiations Practitioner and a Specialist Medical Consultant.

Dose Measurements & Limits

Regulatory Dose Limits

Dose limits are determined by the regulatory authority, taking into account recommendations, and apply to occupationally exposed persons and members of the public. The dose limits, as recommended by the ICRP, and subsequently adopted into Victorian Legislation are listed in Table 1 below.

Table 1: Annual dose limits

Tissue	Radiation / Occupationally exposed worker	Member of the public
Whole of body	20 mSv[1]	1 mSv
Lens of the eye	150 mSv	15 mSv
Skin	500mSv	50 mSv
Hands and feet	500 mSv	50 mSv
Foetus, once pregnancy declared	1 mSv (uterus)	

1. The occupational exposure dose limit is based on an average of 20 mSv per year over five years with the further provision that the effective dose shall not exceed 50 mSv in any single year for occupational exposure.

An occupationally exposed person is a worker who receives a radiation dose because of their employment. It does not include the radiation doses received from natural background radiation, medical procedures or participation in voluntary research projects.

Dose limits do not apply to patients who are exposed to radiation for the purposes of diagnosis or treatment. The principles of justification and optimization are applied such that the benefits from the patient exposure must be weighed again the known (or estimated) risks. Medical exposure of ionising radiation must be managed in such a way that radiation doses to occupationally exposed persons and members of the public do not exceed the dose limits.

Examinations

Referrals

All patient referrals for a diagnostic medical imaging procedure or test require a request letter or form signed by a registered Medical Practitioner, licensed in Australia, or from referrers permitted to request specific examinations as described by the Health Insurance Commission (HIC) or the Australian Department of Immigration. These include Dentists, Physiotherapists, Speech therapists, Chiropractors and Podiatrists. All referrals must be signed and dated.

A request older than 12 months may be refused as being ineligible under the HIC Act and will only be considered valid if the request is still clinically relevant.

The referral must contain sufficient detail such that the patient's details are unique and comply with normal standards or comparison with details contained on patient identification documentation. The referral may be returned to the referrer if details are insufficient.

The referral must contain sufficient details for the test to be performed safely and must contain sufficient clinical information to justify the risk inherent in the procedure, including asking clinical questions that the diagnostic procedure should aim to answer. Any referral may be queried with the referrer with regards to clarification and risk benefit and should therefore provide the referrers contact details for consultative purposes.

Patient Identification

Care must be taken to ensure that the correct patient is examined. The identification of all patients must be checked against the primary documentation (i.e. the referral) and not internally generated documents (i.e. work lists or patient labels). All patients' identification checks should involve a minimum of three-points including;

- Full Name
- Date of Birth
- Home address
- Examination requested

Where a patient is unable to provide information regarding identification due to language, health issues or inability to communicate or understand, identification must be provided by a relative, attached wrist band or legal carer.

Care must be taken to ensure that the correct procedure is performed including the correct site, side and modality. These details should be checked with the patient, the request and where necessary or where a disagreement exists, the radiologist and or the referrer. Any discrepancy must be carefully documented. No change is to be made to the request without agreement from the radiologist and/ or the referrer.

Authorization, Justification and Approval of Medical Radiation Procedures

A medical radiation procedure may only be conducted once the following prerequisites have been completed;

1. Any procedure involving ionizing radiation may only be authorized and approved by a medical radiation practitioner (radiologist, nuclear physician or cardiologist) who is registered with the relevant regulatory authority.
2. A procedure involving ionizing radiation cannot be considered for further approval if the referral does not contain sufficient detail as outlined previously in this RMP.
3. The medical radiation practitioner and operator must satisfy themselves as to the correct identity and pregnancy status of the patient and the details of the requested procedure as outlined previously in the RMP.
4. Each medical radiation procedure must be individually or generically approved prior by a medical radiation practitioner (radiologist, nuclear physician or cardiologist). In approving a medical radiation procedure the practitioner must ensure that it is the most effective diagnostic procedure for the patient and their specific clinical question after consideration of the patient's medical history and following an assessment of the efficacy of available relevant procedures not involving ionizing radiation. Where the medical radiation procedure is not approved the Medical Radiation Practitioner must consult with the referring clinician with respect to the decision not to proceed and to assist in determining the most appropriate diagnostic pathway.
5. The Operator (Medical Imaging Technologist) must not commence the medical radiation procedure until the medical radiation practitioner has completed steps 1 to 4 above. This Radiation Management Plan includes a Clinical Indications Chart (Appendix 6) which may be used to list those specific clinical indications where the individual Practitioner has determined that the requested Medical Radiations Procedure is the most appropriate examination. Any clinical referral which does not have a generically approved medical radiation procedure must not be commenced until the practitioner individually reviews and justifies the referral in accordance with steps 1-4.
6. The nature of approval for the Procedure (generically or individually authorized**) must be documented and signed off prior** to commencement using relevant modality specific pre imaging checklists which also provide confirmation of patient identification and pregnancy status. These checklists must be scanned into the patient specific archive file at the completion of the examination. Copies of the CT Pre-scan checklist are included with this Plan (Appendix 6). General Imaging examinations must also be pre-approved by the operator, documented on the relevant paperwork produced with the patient labels and scanned in at the completion of the procedure.

CT Contrast Procedure

- Arrive at 8:45 to enable you to switch on the Xray and CT machines, do the daily check up and be ready at 9:00 for the first patients.
- Ensure all clinical information are available for the radiologist, if there is no referral the clinical notes on the booking form is deemed sufficient.
- Inform the medical centre / doctor on call of the number of contrast studies and an approximate start and ending time for the day.
- Phone the reporting radiologist to protocol all the CT contrast studies.

o The reporting Radiologist must be consulted, by the Radiographer / MIT responsible for CT imaging, prior to examination to confirm use of IVCM and examination protocol. It would be advisable to phone the reporting Radiologist prior to commencing CT's for the day, with all of the CT cases of the day. Instructions should be clearly documented as well as the Radiologist spoken to.

- Adjust any examinations on the reception list and also indicate the oral contrast /water to be used for every patient.
- Warm up IV contrast and ensure oral contrast is available at reception.
- As soon as a patient arrives, ensure that oral contrast requirements are followed. Note the time on the referral as well as on the receptionists list. (Some receptionists are more than capable/ willing to give the oral contrast to the patient if there is no allergies or thyroid or renal problems)
- Ensure all documentation is correct and get patient ready for exam.
- Exam procedure

o Get patient changed, and ensure no allergies

o Follow set protocol

o Once acquisition is completed, the recons can be run, before patient is taken off the bed.

o Ensure patient is okay and dismiss patient

o Do the reformats and send to PACS.

o Ensure room is ready for the next patient

o After examinations please inform the patients about the risk of contrast and the necessity of hydration

o NOTE: All abdo/pelvis examinations need to have last cup of contrast on CT table immediately prior to the scan.

o NOTE: MIPs reconstruction is now recommended for all IVPs examinations.

- In the event of an allergic reaction, follow the correct protocol.
- Once all CT Contrast examinations are completed, inform the medical centre / doctor on call that all examinations are completed for the day.
- Sign all relevant documentation.

- Please dispose of the contrast waste in the appropriate medical waste bins.

REMEMBER: Communication is key – if there is any delay communicate this to the patient and keep them informed at all times

CT Contrast Bookings

When booking CT Contrast the following should be remembered:

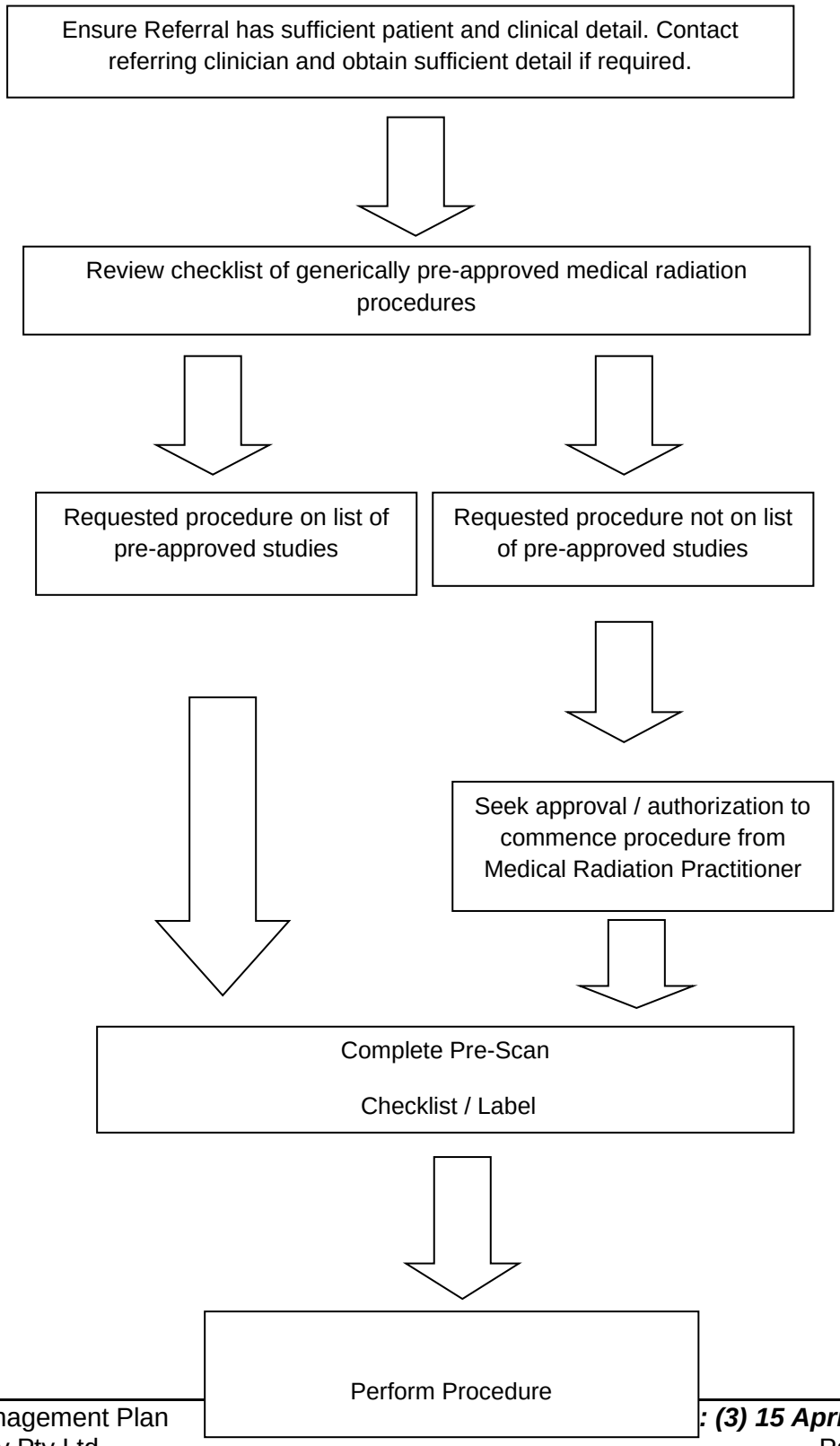
- For CT Abdomen/Pelvis with contrast examinations (as well as CT CAP):
  - Appointment times will be given to the patients from 10:00, but the receptionist needs to inform the patient that they need to be there an hour before their appointment time.
  - The hour before the patient's appointment time will be used to administer oral contrast.
  - The patient needs to be told that they will be in the department for a minimum of 90 minutes.
  - CT Booking forms need to be filled in and ensure that the referral as well as the biochemistry are available.
  - If the patient are diabetic no diabetic medication should be taken on the morning of the contrast examination

- For CT Chest with contrast
  - Appointment times will be given to the patient and they do not need to be there prior to their allocate time slot as no oral contrast needs to be administered.
  - The patient needs to be informed that they will be in the department for a minimum of 30 minutes
  - CT Booking forms need to be filled in and ensure that the referral as well as the biochemistry are available.
  - If the patient are diabetic no diabetic medication should be taken on the morning of the contrast examination

  - **CT Morning Procedure**
- Ensure that all patient referrals /clinical details and biochemistry are available.
- Print a schedule for the day, for radiographer and reception.
- Please ensure that the CT IV Consent form is completed correctly and full prior to exam.
- Please ensure that the CT Information sheet is completed correctly and in full after the examination.
- After examinations please inform the patients about the necessity of hydration

ALWAYS BE PROFESSIONAL AND FRIENDLY.

The following flowchart summarizes the justification and approval process for Medical Radiation Procedures



Once approved all examinations must be performed in accordance with a written protocol or as prescribed by the radiologist. All X-ray rooms at GIG Radiology sites must have exposure charts for each piece of X-ray equipment, outlining factors for common exposures and film speeds. These protocols should be reviewed annually. Written protocols for General Diagnostic Radiographic Procedures must be derived from Accredited Professional Organisations only. These include, but are not limited to;

1. RANZCR Imaging Guidelines 4.0 (http://www.gmp.usyd.edu.au/ig/home.htm)
2. NHS Standard Radiographic Operating Protocols Rev.5 ,January 2013 http://www.heft-radiology.co.uk/Images2/radiographic%20referral%20and%20justification%20protocols%20jan%202011.pdf

All CT rooms must have a copy of the GIG Radiology CT Protocol Guide. The CT Protocol Guide lists the most commonly requested indications for CT examinations and provides specific instructions on how these indications are to be imaged using CT. Once justified each individual CT examination must be performed in accordance with the specific protocol for the clinical indication as outlined in the protocol guide, or, in accordance with a modified protocol as specified by a Radiologist.

The principle of optimisation should be followed such that the radiation doses delivered are kept as low as reasonably achievable (ALARA). Diagnostic equipment and methods must be selected to ensure that the radiation administered to the patient is sufficient to enable the procedure to provide the required diagnostic information and is not greater than is necessary to provide that information. Strategies to reduce radiation exposure should be considered with each procedure. These strategies include but are not limited to;

1. Use of Automatic Exposure Control Mechanisms (AEC)
2. Attention to Patient Positioning, Exposure Factors, Collimation and use of Gonadal Shielding.

For example a PA skull X-ray reduces the dose to the lens of the eye by up to 50% and a PA chest X-ray can reduce the radiation dose to the breast tissue by 30%.

X-Ray & Radiation Procedure Rooms

Protection during an exposure - patient

Radiation shielding must be provided to the patient as long as the shielding does not exclude or degrade important diagnostic information. Available shielding includes:

- Lead aprons
- Thyroid shields
- Lead shields
- Gonad Shields

The gonads of children or persons of reproductive age are to be protected from primary radiation during any X-Ray examination or treatment, unless their shielding excludes or degrades important diagnostic information. Ovary shields are generally recommended for paediatric patients however their effectiveness depends on the positioning of the shields in relation to the ovaries in the pelvis.

Protection during an exposure - others

It is the responsibility of the operator to ensure that only persons whose presence is necessary shall be in the procedure room during the exposure. All persons in the room during an exposure must wear appropriate protective equipment including a lead apron (minimum 0.35 mm Pb equivalent) or they must stand behind a lead barrier.

Where possible clinical areas (control rooms, work areas) should be restricted to staff only, as visitors or relatives may provide distractions. Any visitor to an area must be supervised.

In general, staff should follow the radiation protection methods listed in Table 2 below to reduce radiation exposure during the course of their employment.

Table 2: Protection from external radiation hazards

Protective Measure	Description and application
Time	The radiation dose is directly proportional to the time spent in a radiation field. Radiation exposure can be reduced by limiting the time spent around radiation hazards for example a nuclear medicine patient.
Distance	The intensity of the radiation field dramatically reduces with increasing distance such that if the distance from the source is doubled, the radiation dose is reduced by a quarter.
Shielding	Shielding limits the amount of radiation by attenuating the incident intensity. The effectiveness of shielding depends on the radiation type, energy and density of the shielding material. Lead personal protective shielding such as aprons, thyroid shields and lead shields can be used to minimize radiation dose.
Positioning	Keep other areas of the body out of the beam (extend arms, seat patients alongside table.

Patients requiring restraint

Where possible mechanical devices should be used to restrain patients rather than staff members. If a staff member or carer is required to restrain the patient, they must be appropriately attired with lead aprons and if necessary a thyroid shields. Pregnant women and individuals under 18 years should not hold patients during a radiation examination

Care must be taken when restraining patients as non-compliant patients frequently result in repeat studies.

Lead Aprons & Other Shields

The Australian/New Zealand Standard (AS/NZS 4543.3:2000) IEC 61331-3:1998 "Protective devices against diagnostic medical X radiation. Part3: Protective clothing and protective devices for gonads", states the required attenuation equivalent of light protective aprons shall be not less than 0.25 mm lead (Pb) over entire area. For heavy protective aprons, not less than 0.35 mm Pb for the front section and 0.25 mm Pb for remaining parts.

Lead aprons do not stop all radiation but they are effective in limiting the amount of radiation that can pass through them by attenuating the incident intensity. Their effectiveness depends on the thickness of the lead and the energy of the incident radiation as demonstrated in Table 3 below.

Table 3: Measured Transmission of Lead apron

kVp	LEAD EQUIVALENCE	
	0.25 mm	**0.5 mm**
60	2.2%	0.5%
90	9.0%	2.7%
120	14.7%	5.7%

Lead aprons are manufactured in different Pb equivalents (0.5 and 0.35mm Pb equiv.) and various styles and sizes (e.g. skirts, tops, coats, half back). The garment will have the lead equivalence marked on it.

The GIG Radiology policy for lead aprons is stated below.

- The 0.5 mm Pb are heavier but will give more protection in high dose areas such as CT.
- The 0.35 mm Pb is adequate for low risk areas such as general rooms. And where low kV exposures are used
- In areas such as CT full wrap around gowns (either 1 or 2 piece) are preferred for best protection.
- Half back gowns are no longer considered adequate and should not be used.
- Care should be given to ensure that lead aprons fit well. Consideration should be given to ensure that breast tissue is covered (arm pits should not be too large) and that skirts overlap in the front. It may be necessary to have special fitting gowns.
- Skirts and tops provide the best protection for staff who wear aprons for long periods as the weight is not carried on shoulders, and the double flap/panel of the skirt and the top provide increased shielding.
- Thyroid shields should be worn by everybody working within two metres of the primary beam.

The location and type of lead aprons available in your clinic is listed in Appendix 2.

Infants & Children “Image Lightly”

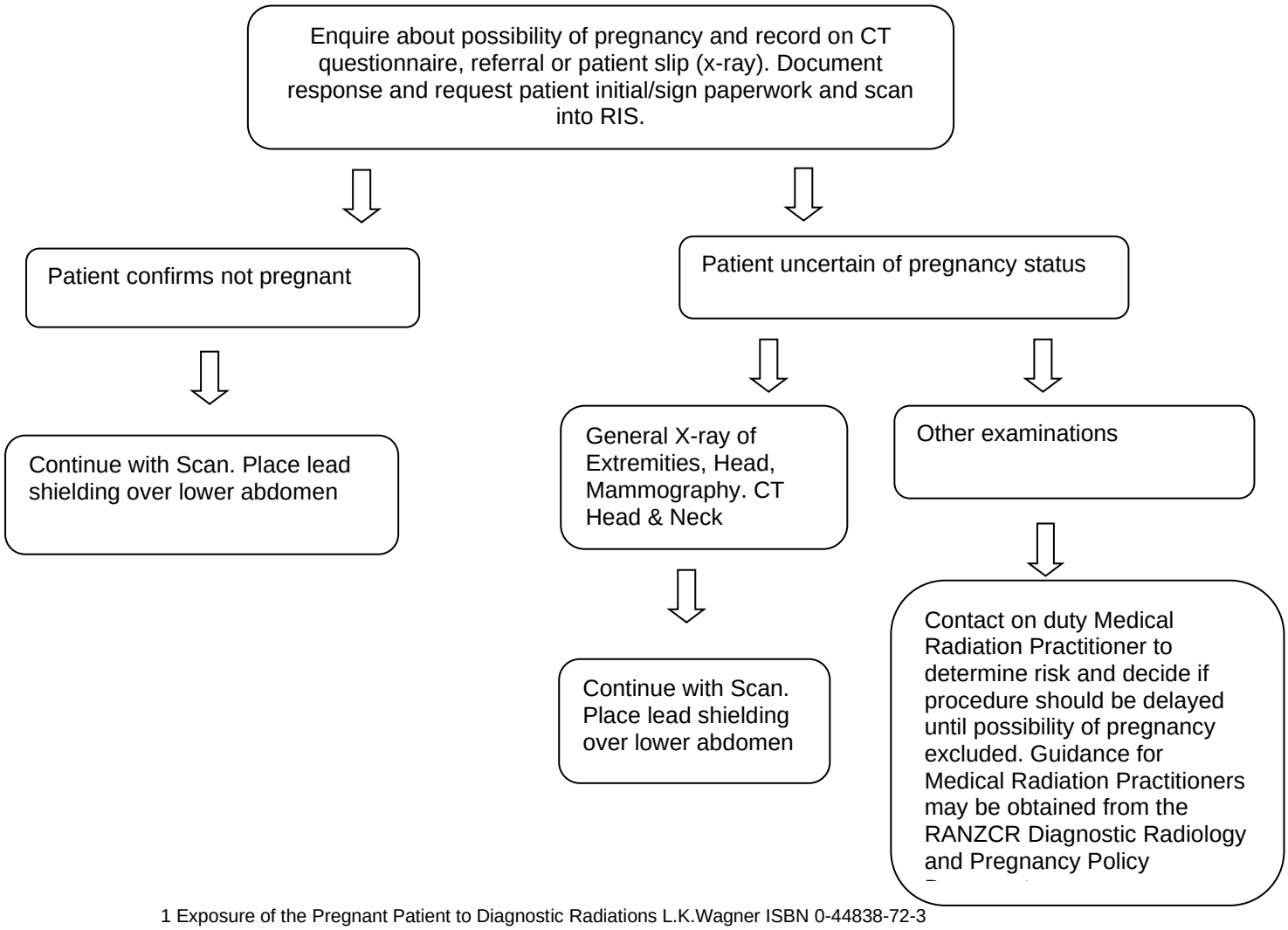
Infants and children are 2-3 times more radiosensitive than adults. As such, imaging of paediatric patients requires additional consideration. The following should be considered when imaging paediatric patients.

- Any repeat series should include Radiologist consultation.
- Where practicable relatives and not staff should be used to hold or provide support for young patients.
- Where relatives are used to hold young patients, the pregnancy status must be checked for each person.
- Gonad shields must be used where possible for pelvic examinations.
- CT radiographers must be aware that breast tissue is more radiosensitive than gonads and where possible reduce dose by using PA planning scan, dose modulation and range reduction.
- For CT scans of children under 16 years, the site radiologist must be consulted and a strategic plan formulated.
- Lead aprons must be provided for children under 16 years in CT, where possible.
- All CT exposures must be adjusted for the size of the person being scanned. Reduction of kV and mAs is mandatory-“Image Lightly”. It is useful to calculate the dose received (mSv) using a DLP conversion factor.
- Where possible the manufacturer generated summary dose page should be saved on the PACS. If this is not possible then the dose summary should be recorded manually.
- All children (under 16yrs) requiring a high dose procedure, or X-rays of sensitive areas, should be considered at risk. A dose reduction strategy should be discussed with the patient's legal guardian and the radiologist and a process agreed upon.

Pregnancy-Patients

Before performing an examination on a female of reproductive age (15-49 years of age[3]), where it is likely to result in a radiation dose to an embryo or foetus of more than 1mSv, the **Medical Imaging Technologist must take reasonable steps to determine the pregnancy status of the patient.** General radiographic examinations of the extremities, head and skull, mammography and CT examination of the head and neck can be undertaken on pregnant or possibly pregnant women without concern as effective does to the foetus in these procedures are significantly less than 1mSv. In all other examinations the pregnancy status of the patient should be determined prior to undertaking a procedure. Radiation exposure during pregnancy can cause significant concern for the patient. However when investigated, it is often found that the radiation dose and the resultant risk to the foetus are very small[1,2].

The following steps must be followed prior to commencing any procedure on a female of reproductive age;



1 Exposure of the Pregnant Patient to Diagnostic Radiations L.K.Wagner ISBN 0-44838-72-3

2 Erin Angel et al, Radiation Dose to the Fetus for Pregnant Patients Undergoing Multidetector CT Imaging: Monte Carlo Simulations Estimating Fetal Dose for a Range of Gestational Age and Patient Size Radiology October 2008 249:220-227.

3 World Health Organization.

The radiographer should take reasonable steps to establish the pregnancy status of all females of childbearing age. The radiographer should note the pregnancy status on the referral and ask the patient to initial their response. Where some doubt exists or for some higher dose procedures such as lumbar spine, pelvis and abdomen X-ray procedures, it may be appropriate to order a pregnancy test. The procedure may be postponed until after a pregnancy test has been done or after the patient's next period.

Justifying exposure to a pregnant patient

In the case where a patient is pregnant, the radiation medical practitioner must assess the risk to the embryo or foetus as a result of the radiation exposure and the risk to the patient if the procedure is not performed. If possible, a lower dose modality or a modality that does not use ionizing radiation should be considered. It may be necessary to accurately calculate foetal age. Ultrasound may be useful for this in the case of disputed conception dates. The referring physician should be contacted and if necessary the RSO. If the procedure is likely to result in a dose of greater than 1 mSv to the embryo or foetus then an estimate of the expected radiation dose must be made and recorded. Guidance for Medical Radiation Practitioners may be obtained from the RANZCR Diagnostic Radiology and Pregnancy Policy Document.

Where the examination is justified then a strategy must be discussed with the patient and an indication of risk discussed. The exposure to the foetus should be minimized as much as possible provided that sufficient diagnostic information can be retrieved. This includes the lowest possible exposure factors, for example adjusting the beam collimation.

Lead aprons are appropriate protection to the foetus for examinations above waist height. If lead aprons are to be offered during CT scans, the apron should wrap completely around the patient's abdomen.

The risk to the foetus must be fully explained to the patient and referring doctor by the medical radiation practitioner, prior to the procedure.

Unplanned exposure of a pregnant patient

In accordance with the DoH publication ´Mandatory report of radiation incidents', an unplanned foetal exposure is regarded as a radiation incident. Where a patient is found to be pregnant after the event then the RSO should be contacted to estimate the radiation dose and conduct any incident reporting.

Pregnancy-Staff

When a female worker declares a pregnancy, the foetus is given the same level of protection as a member of the public, that is, 1mSv over the course of the pregnancy. The employer is responsible for ensuring that the dose limit is adhered to once the pregnancy has been declared.

It is recommended that pregnancies are declared to the employee's supervisor so that potential radiation exposure to the foetus can be assessed. Based on the employee's dose history and dose histories of other staff in the workgroup, an assessment of the dose to the foetus over the course of the pregnancy can be made. The RSO will determine whether a change in work practice is required to limit radiation dose. This may include avoidance of high radiation dose work areas such as CT.

Personal radiation monitors can be issued on a monthly rather than three monthly basis to provide a more frequent assessment of ionizing radiation. It is recommended that the personal radiation monitor is worn on or near the abdomen. The dose to the foetus is actually less than that measured by the personal radiation monitor as the abdomen provides a level of shielding to the foetus. For diagnostic and interventional X-rays the shielding effect is about 50%.

Routine Safety Testing

GIG Radiology has an ongoing safety testing program. The routines tests and details of record management are listed below in Table 4.

Table 4: Routine Safety Tests

ITEM	TEST	PERIOD	RECORDS
Personal Radiation Monitors	Passive measure of radiation exposure	3 monthly (or as directed by issuing authority)	Kept at Head Office
Lead Aprons, thyroid shields, lead gloves, gonad shields and other shields	Integrity	Annually	Kept at each site
X-ray Machines	Quality Assurance / compliance testing	Annual	Kept at site and Head Office
Radiation Testing and Shielding of rooms	Adequacy	Following installation and modifications to room or use	Kept at site and Head Office

All radiation producing equipment owned by GIG Radiology undergoes regular preventative maintenance service in accordance with manufacturer's specification. Copies of all servicing and maintenance records are maintained by the Operations Manager.

In the event of an equipment malfunction that could compromise patient safety, diagnosis or treatment, the RSO/Operations Manager should be contacted immediately.

Shielding

In accordance with Clause 3.1.5 of the Medical Code rooms must be designed, constructed, shielded, used, and maintained so that the dose constraints stipulated by DoH are applied, and dose limits to occupational exposed persons and members of the public are not exceeded. In addition shielding should not be designed to prevent the direct observation of patients during procedures where patient motion may result in the compromise of diagnostic information necessitating further irradiation.

The shielding required in a particular room must be assessed using an accepted calculation method such as that described in NCRP 147 Structural shielding design for Medical X-ray Imaging Facilities prior to construction. Details of such assessments must be provided when notifying DoH of installation of the machine. The shielding should be reassessed whenever the original design parameters change, such as a large increase in workload, a new X-ray machine, etc. GIG Radiology maintains adequate records of all shielding calculations and architectural/building details of shielding installed.

Practical assessments of shielding should also be carried out to confirm that the shielding installed meets the design requirements. This can be carried out by directly measuring the attenuation of ionising radiation through the barriers, or by undertaking an area monitoring program of the facility.

When shielding advice is required to be assessed as per the criteria stipulated above, Complyrad Australia shall be engaged to provide these services. Complyrad Australia shall also assess, where practicable, the integrity of on-site shielding during mandatory equipment compliance testing.

Local Shielding Plans and Reports details are located in Appendix 3 of the RMP.

Compliance Testing

The Act requires that a Certificate of Compliance is current for all prescribed radiation sources. The prescribed radiation sources possessed by GIG Radiology are X-ray machines used for human diagnostic imaging purposes, excepting dental. It is an offence to use a prescribed source for clinical purposes without a current Certificate of Compliance. Compliance testing is to be performed following the installation of new equipment and relocation of existing equipment to a new site.

A Certificate of Compliance can only be issued by a person approved to do so by the DoH, known as an "Approved tester". The prescribed radiation sources and the currency period of a Certificate of Compliance issued are listed below in Table 5.

Table 5: Summary of Certificate of Compliance details

Prescribed radiation source type	**Currency Period**
General radiography X-ray Equipment	2 years after issue
Mammography X-ray Equipment	12 months after issue
Computed Tomography Scanners	12 months after issue

GIG Radiology Approved Tester:
ComplyRad Pty Ltd

Personal Monitoring

All Staff who are exposed to radiation in the course of their employment will be supplied with a personal radiation monitor (PRM). The type will depend on the nature of their exposure. PRMs are generally worn for a three month period with the exception of pregnant employees who have requested monthly monitoring.

It is the staff member's responsibility to wear the monitor and ensure that it is not damaged or lost. PRMs should remain at work and should not be taken home or left in an employee's car.

The badge should be worn at waist level on the side closet to the radiation source, free from any other devices such as pagers and belt buckles that could shield the PRM from radiation. They should be worn inside a lead gown (except for special monitoring).

It is the Radiographer site manager's responsibility to ensure that PRMs are collected, exchanged and returned to the service provider. The results are sent to the Operations Manager and to each site. Each staff member is entitled to know what their individual exposure level is.

Where a high reading is detected by the monitor or when annual dose constraints have been exceeded, the Operations Manager will be notified by SGS Australian Radiation Services (SGS ARS), the Personal Radiation Monitoring Service provider. The RSO, site manager, Occupation Health and Safety Officer and the individual must be notified. A GIG Radiology Incident Form must be completed and forwarded to the RSO. A formal risk report is to be provided by SGS Australian Radiation Services (SGS ARS) and appropriate action must be taken. This may involve counselling, work place investigation and medical testing. The employee has the right under legislation to seek help and advice. The following authorities may be useful (www.arpansa.gov.au).

Maintenance of Lead Aprons & Shields

The following GIG Radiology policy relates to the maintenance of lead aprons and lead shields.

- The company will provide adequate lead aprons to all staff that need them while working in the department.
- Lead Aprons shall be uniquely identified and listing on a register maintained by the RSO.
- The company is responsible for the repair or normal wear and tear of the aprons
- The department will carry out regular (yearly) checks on the aprons, shields and other devices for cracks and defects. The yearly check will be in accordance with ARPANSA guidelines. All lead aprons will be tested for shielding integrity on receipt, allocated a unique identification number and routinely screened to ensure they are defect-free.
- Any aprons with defects will be replaced if the defect is greater than 15 mm^2.If the defect is clearly not over a critical organ then use of the apron may continue, provided the defect is clearly marked on the apron, and the size, location and date the defect was identified is logged in the apron audit. If the defect is greater than 670mm^2 the gown should be replaced.
- Thyroid shields with defects greater than 11mm^2 should be replaced.
- Staff must notify the RSO of any gowns with suspect integrity immediately.
- The department will provide proper hangers and storage locations for the aprons. It is the individual staff member's responsibility to care for the apron/shield and store appropriately.

Warning Lights, Signs & Labels

All CT must have an illuminated warning light mounted over each access point into the room. The illuminated sign must be connected to the anode of the X-ray tube and illuminate from the commencement of prep mode until the completion of the exposure. The warning sign must display the word IONIZING RADIATION-DO NOT ENTER or equivalent.

All areas where irradiation apparatus are kept or used must display large radiation warning signs. The signs must have the words 'Caution Radiation' (or equivalent) and include the radiation trefoil sign in black on a yellow backing.

A multi lingual pregnancy hazard warning poster should be displayed in each change cubicle and public area. These are available from Australian Institute of Radiography.

Radiation Safety Training

GIG Radiology shall provide an annual refresher course in Radiation Safety to all staff involved in the use and handling of radiation and radiation sources. Radiation Safety Lectures shall to be conducted by SGS Australian Radiation Services Pty.Ltd. Topics covered in the refresher courses include:

Ionising radiation units

- The units commonly used to describe and quantify ionising radiation;
- Typical magnitudes of each unit; and
- Units used to describe the potential level of risk from an exposure to ionising radiation.

Natural and man-made radiation

- The sources of natural background radiation and typical annual doses; and
- Difference between natural and man-made radiation.

Radiation and radioactivity

- The concept of radioactivity and how it is characterised (e.g., half-life, mode of decay);
- Difference between radioactivity and radiation;
- Difference between ionising and non-ionising radiation; and
- Different types of ionising radiations.

Biological effects of ionising radiation

- The tissue reactions and stochastic effects of exposure to radiation; and
- Difference between acute and chronic exposure to ionising radiation.

Philosophy of radiation protection and radiation dose limits

- The risk/benefit considerations of the use of ionising radiation
- As Low As Reasonably Achievable (ALARA) principle;
- Radiation dose limits for occupationally exposed persons and members of the public; and
- Exposures not included in legislated dose limits (e.g. medical exposures, background).

External radiation hazards and its control

- The external radiation hazards;
- Principal methods for the control of external hazards through time, distance and shielding;and
- The inverse square law.

Staff Pregnancy

- Employer and employee responsibilities;
- Modification of duties; and
- Typical

Radiation protection in practice – diagnostic radiology

- Sources and control of personal exposure; and
- Dose reduction techniques.

Radiation Regulations and Codes of Practice

Diagnostic Reference Levels

Radiation Incident Reporting

Radiation Management Plan

Other matters pertaining to radiation safety

Compliance Audits

Compliance audits are carried out annually as part of a regular quality activity and any change in compliance should be discussed with the RSO. Compliance audits shall be undertaken by responsible GIG Radiology staff and ComplyRad Pty Ltd.

Sites should be assessed for compliance with the relevant sections of the Act, Regulations and Conditions of Licence as well as the RMP. The assessment should include reviewing procedures and protocols, shielding, and other matters relating to radiation safety.

Obtaining Expert Advice

GIG Radiology has appointed SGS ARS and ComplyRad Pty Ltd to provide expert advice on any and all matters pertaining to Radiation Safety. Requests for expert advice are to be directed initially to the RSO who shall then coordinate the most appropriate resource for the resolution of the particular query.

GIG Radiology Diagnostic Reference Levels Program

In 1996, the International Commission of Radiological Protection (ICRP) recommended the inclusion of Diagnostic Reference Levels (DRLs) as a tool for optimising the radiation dose delivered to patients in the course of diagnostic and/or therapeutic procedures. In 2008 the Australian Radiation and Nuclear Safety Agency (ARPANSA) introduced a requirement in the Code of Practice - Radiation protection in the Medical applications of ionizing Radiation (hereafter referred to as the 'Code') for the collection and assessment of DRLs by the 'responsible person'.

To comply with the conditions of licence stipulated by the Victorian Department of Health, GIG Radiology, the holder of a Management Licence, must comply with the Code. As a requirement of the code, GIG Radiology (the 'responsible person') must develop and continually compare individual Practice Diagnostic Radiation Levels (PRLs) and organisational DRLs with published National Diagnostic Reference Levels (NDRLs).

In Australia, ARPANSA has been conducting an online based nationwide survey to obtain its first National Diagnostic Reference Level (NDRL) based on Multi Detector Computed Tomography (MDCT). The GIG Radiology PRLs and DRLs will be compared with the current NDRLs provided on the ARPANSA website (http://www.arpansa.gov.au/services/ndrl/current.cfm).

The main objective of the GIG Radiology DRL program is to help avoid excessive radiation dose to the patient that does not contribute additional clinical information value to the medical imaging task. The DRLs are to be periodically compared with published DRLs for diagnostic procedures for which DRLs have been established in Australia. If the DRLs are consistently exceeded, radiation doses administered to a patient for diagnostic purposes are to be reviewed to determine whether radiation protection has been optimised.

The purpose of this project is to collect and collate the necessary data to establish the PRLs and DRLs across all of the GIG Radiology departments and practices.

Subsequent DRL reviews will be conducted at regular intervals to maintain consistency and monitor quality assurance. Exception to this timing may be when a machine is replaced although in that case immediate review against DRLs.

Radiation Units

Excerpt from www.arpansa.gov.au/radiaitionprotection/basics/units

Radiation Activity

Radiation activity is measured in an international (SI) unit called a Becquerel (Bq). The Becquerel counts how many particles or photons (in the case of wave radiation) are emitted per second by a source.

Radiation Exposure

Radiation exposure is expressed in several ways to account for the different levels of harm caused by different forms of radiation and the different sensitivity of body tissues.

Absorbed Dose

Radiation exposure is measured in an international (SI) unit called the gray (Gy). The radiation exposure is equivalent to the energy "deposited" in a kilogram of a substance by the radiation. Exposure is also referred to as absorbed dose. The important concept is that exposure is measured by what radiation does to substances, not anything particular about the radiation itself. This allows us to unify the measurement of different types of radiation (i.e., particles and wave) by measuring what they do to materials.

Equivalent Dose

Often we are interested in the effect of radiation exposure on human tissue. Enter a quantity called equivalent dose. This relates the absorbed dose in human tissue to the effective biological damage of the radiation. Not all radiation has the same biological effect, even for the same amount of absorbed dose. Equivalent dose is measured in an international (SI) unit called the Sievert (Sv). Like the gray, the Sievert is a large unit and for normal radiation protection levels a series of prefixes are used:

To determine equivalent dose (Sv), you multiply absorbed dose (Gy) by a radiation weighting factor that is unique to the type of radiation. The radiation weighting factor WR takes into account that some kinds of radiation are inherently more dangerous to biological tissue, even if their "energy deposition" levels are the same.

In Australia the dosage rate from background radiation, the sum of all natural radiation, is about 2 milliSieverts per year.

Effective Dose

The probability of a harmful effect from radiation exposure depends on what part or parts of the body are exposed. Some organs are more sensitive to radiation than others. A tissue weighting factor is used to take this into account. When an equivalent dose to an organ is multiplied by the tissue weighting factor for that organ the result is the effective dose to that organ. The unit of effective dose is the Sievert (Sv).

Comparative Doses

Dose limit for radiation workers	20 mSv per year
Dose limit for public	1 mSv per year
Natural background radiation (Australia)	2.5 mSv per year
Natural background radiation (India)	8 mSv per year
Dose from return flight Melbourne to London(40 hrs @ 12000m)	0.2 mSv
Dose to patient from PA Chest x-ray	0.015mSv
Dose to patient AP Lumbar spine x-ray	0.26 mSv
Dose to patient from Wrist series x-ray	0.01 mSv
Dose to patient from Mammogram	0.5 mSv
Dose to patient from OPG	3-7 µSv
Dose to patient from CT Head	2.3 mSv
Dose to patient from CT Abdomen	3-10 mSv
Dose to patient from CT Chest	3-5 mSv
Dose to patient from CT Pulmonary Angiogram	3-5 mSv
Dose to patient from CT Renal Colic	3-5mSv

www.arpansa.gov.au